OUTDOOR SYSTEMS

TRAFFIC & ROAD SAFETY ASSESSMENT

Existing Digital Advertising Sign

Wentworth Avenue

Pagewood NSW 2035

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Revision	Details	Date	Author
A	Report	04/04/2023	NP

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1 INTRODUCTION

1.1 BACKGROUND & REPORT PURPOSE

Traffic and Safety Solutions Pty Ltd has been commissioned by Outdoor Systems to undertake a Traffic & Road Safety Assessment to accompany a planning proposal to amend the Bayside Local Environmental Plan 2021 (BLEP 2021) to permit the continued use of the existing digital advertising signs installed on the bridge over Wentworth Avenue that links both sides of the Lakes Golf Course. The existing signs are visible to eastbound and westbound traffic in Wentworth Avenue, Pagewood.

The existing digital advertising signs were approved in 2017 (DA05-123/02) by Bayside Council with concurrence provided by Roads and Maritime Services (RMS)[1]. The signs were installed in July 2017.

RMS's concurrence is for the sign to operate until 31st December 2025, however the Council DA approval for the sign is for the sign to operate until 29th November 2021.

Since the approval in 2017, Bayside Council have adopted the Bayside Local Environment Plan 2021 (BLEP 2021) and of particular note, prohibits advertising signage land use within land zoned SP2 Infrastructure.

Council have advised Outdoor Systems that a planning proposal will be required to amend BLEP 2021 to add a Clause under Schedule 1 Additional Permitted Uses of the BLEP 2021, that will permit advertising signage.

The purpose of this report is to provide the details of the Traffic and Road Safety assessment that has been undertaken for the existing digital signs, with reference to the criteria specified in the '*NSW PLANNING AND ENVIRONMENT DEPARTMENT OF PLANNING TRANSPORT CORRIDOR OUTDOOR ADVERTISING AND SIGNAGE GUIDELINES – ASSESSING DEVELOPMENT APPLICATIONS UNDER SEPP 64 (NOVEMBER 2017)*' hereon referred to as the guidelines.

[1] It should be noted that RMS is now part of Transport for NSW (TfNSW).

1.2 STUDY METHODOLOGY

This report has been based upon the following sources:

- site observations and inspections,
- a review of the visibility of the location of the existing digital sign from a driver's perspective (dash camera images) from both the eastbound and westbound road approaches to the sign,
- analysis of the crash data obtained from TfNSW for the 5 year period (01 January 2016 to 31 December 2020) in the vicinity of the site (Appendix A),
- Austroads Guide to Road Design (Part 3 – Geometric Road Design-Edition 3.4 February 2021) hereon referred to as AGRRD,
- The following Road Safety Audits (RSA) prepared by McLaren Traffic Engineering:
    - Stage 2 Concept Design RSA dated 15th July 2016,
    - Stage 4 6 Week Post Opening RSA dated 24th August 2017, and
    - Stage 6 18 month Post Opening Audit dated 28th September 2018. (Appendix B)
- OMA Evidence and Research Summary Paper Impacts of Digital Billboards on Driver Behaviour (Appendix C).

2 PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The site is located in Wentworth Avenue, Pagewood approximately midway Southern Cross Drive and Bay Street.

The existing digital signs are installed on the bridge over Wentworth Avenue that links both sides of the Lakes Golf Course.

The signs are visible to eastbound and westbound traffic in Wentworth Avenue, Pagewood.

The aerial photo provided in figure 2.1 and the locality map provided in figure 2.2 show the location of site in the context of the surrounding road network.

FIGURE 2.1: SITE LOCATION – WENTWORTH AVENUE, PAGEWOOD
SOURCE: SIX MAPS

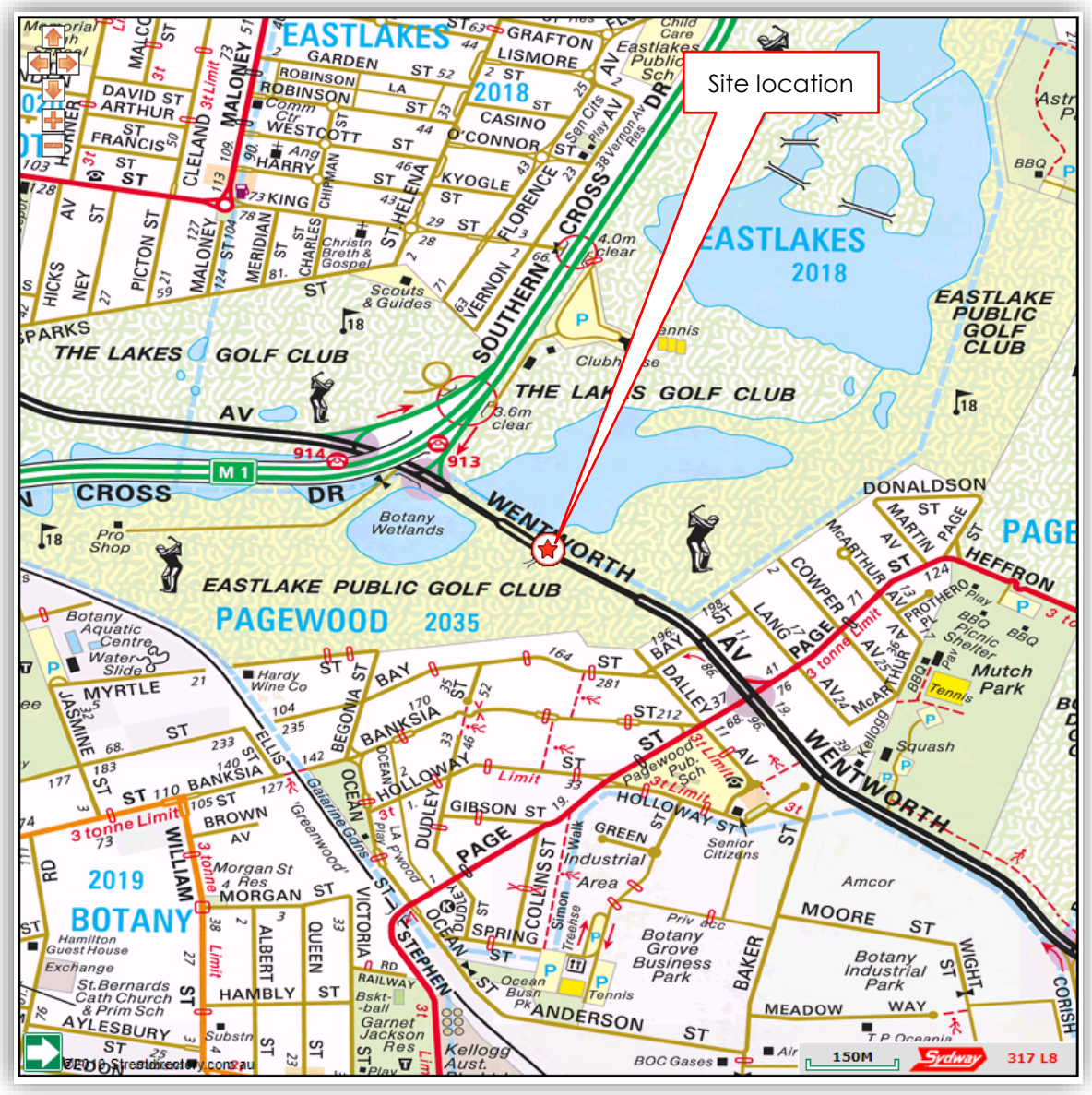


FIGURE 2.2: LOCALITY MAP – ROAD NETWORK SURROUNDING THE SITE LOCATION
SOURCE: STREET-DIRECTORY.COM.AU

2.2 ROAD NETWORK

A description of the roads that the sign is visible from is provided in Table 2.1 below.

Road Name	No of lanes	Road Type	Road Authority	Speed Limit
Wentworth Avenue (visible from both approaches)	2 lanes in each direction	State	TfNSW	70km/h

TABLE 2.1: ROAD NETWORK DETAILS

2.3 PROPOSED DEVELOPMENT DESCRIPTION

The planning proposal seeks to amend the BLEP 2021 to add a Clause under Schedule 1 Additional Permitted Uses of the BLEP 2021, that will permit advertising signage.

The existing digital signs are proposed to operate in the same manner and dwell time that was previously approved in 2017 and does not involve any changes to the existing digital signs in any form.

The size of the existing sign is 12.48m x 3.25m = 40.46m^2.

The existing digital sign will operate with the previously approved dwell time of 10 seconds which is consistent with the 'guidelines' for a speed zone under 80km/h and similar to other approved digital signs on other state roads. There are no changes proposed to the dwell time.

Figure 2.3 shows the photograph of the existing digital sign that is proposed to continue to operate.

FIGURE 2.3: WESTERN ELEVATION - VISIBLE TO EASTBOUND TRAFFIC IN WENTWORTH AVENUE
SOURCE: GOOGLE STREET VIEW

FIGURE 2.4: EASTERN ELEVATION - VISIBLE TO WESTBOUND TRAFFIC IN WENTWORTH AVENUE
SOURCE: GOOGLE STREET VIEW

Section 3.5.1 of the guidelines refers to the road safety review of signs over 20m^2:

'A road safety check which focuses on the effects of the placement and operation of 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. A road safety check must be carried out by an independent 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 accordance with section 3.5.1 the following Road Safety Audits (RSA) prepared by McLaren Traffic Engineering:

- Stage 2 Concept Design RSA dated 15th July 2016,
- Stage 4 6 Week Post Opening RSA dated 24th August 2017, and
- Stage 6 18 month Post Opening Audit dated 28th September 2018.

The installation of the signs has not impacted on road safety as indicated in the RSA's concluding statement:

'The brief provided has been examined and the site inspected both during clear daylight and night periods to determine the safety impacts of the subject digital signage.

This road safety audit has found no adverse impact on road safety associated with the subject and operational digital advertising sign.'

3 ROAD SAFETY ASSESSMENT

3.1 STOPPING SIGHT DISTANCE - AUSTROADS

Section 3.2.3 of the guidelines relates to the proximity to decision making points and conflict points. The guidelines state that the sign should not be located:

- less than the safe sight distance from an intersection, merge point, exit ramp, exit ramp, traffic control signal or sharp curves,
- less than the safe stopping distance from a marked foot crossing, pedestrian crossing, pedestrian refuge, cycleway crossing, cycleway facility or hazard within the road environment,
- so that it is visible from the stem of a T-intersection.

The provision of stopping sight distance is a mandatory design condition for all roads and intersections. The definition of stopping sight distance as described in Austroads Guide to Road Design Part 3 is illustrated in figure 3.1.

Stopping sight distance (SSD) is the distance to enable a normally alert driver, travelling at design speed on wet pavement, to perceive, react and brake to stop before reaching a hazard on the road ahead.

Stopping sight distance is calculated using the following:

- driver reaction time (figure 3.2),
- design speed (figure 3.3), and
- grade corrections (figure 3.3).

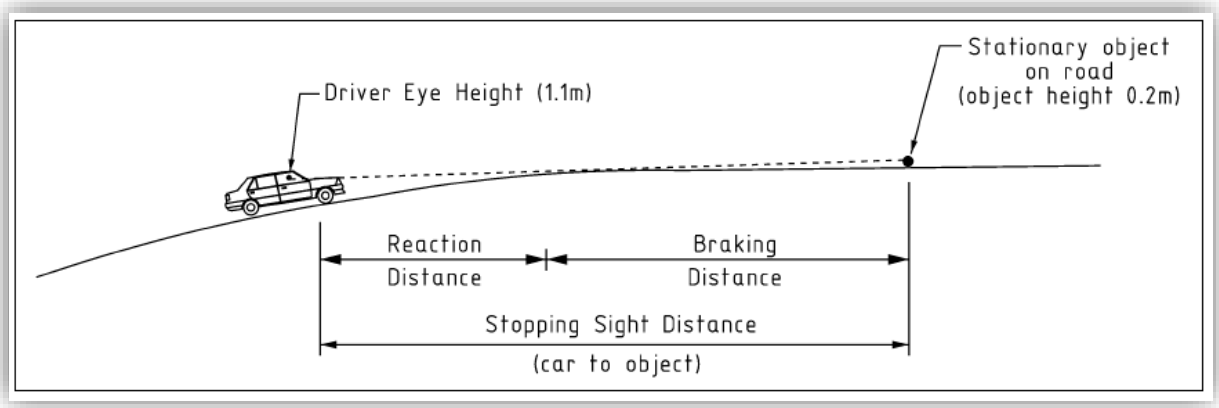


FIGURE 3.1: STOPPING SIGHT DISTANCE DEFINITION
SOURCE: AUSTROADS GUIDE TO ROAD DESIGN – PART 3 (FIGURE 5.2)

Reaction time R_T (s)	Typical road conditions	Typical use
2.5	• Unalerted driving conditions due to the road only having isolated geometric features to maintain driver interest • Areas with high driver workload/complex decisions • High speed roads with long distances between towns.	Absolute minimum value for high speed roads with unalerted driving conditions. General minimum value for: • high speed rural freeways • high speed rural intersections • isolated alignment features.
2.0	• Higher speed urban areas • Few intersections • Alerted driving situations in rural areas • High speed roads in urban areas comprising numerous intersections or interchanges where the majority of driver trips are of relatively short length.	Absolute minimum value for the road conditions listed in this row. General minimum value for most road types, including those with alert driving conditions.
1.5(1)	Alert driving conditions e.g.: • high expectancy of stopping due to traffic signals • consistently tight alignments for example, mountainous roads • restricted low speed urban areas • built-up areas – high traffic volumes • interchange ramps when sighting over or around barriers.	Absolute minimum value. Only used in very constrained situations where drivers will be alert. Can be considered only where the maximum operating speed is ≤ 90 km/h. Should not be used where other design minima have been used.

FIGURE 3.2: DRIVER REACTION TIME CRITERIA
SOURCE: AUSTROADS GUIDE TO ROAD DESIGN – PART 3 (TABLE 5.2)

Design speed (km/h)	Absolute minimum values Only for specific road types and situations(1) based on $d = 0.46$(2),(3)			Desirable minimum values for all road types based on $d = 0.36$			Values for major highways and freeways in flat terrain(7) based on $d = 0.26$	
	R_T = 1.5 s(4)	R_T = 2.0 s(4)	R_T = 2.5 s	R_T = 1.5 s(4)	R_T = 2.0 s(4)	R_T = 2.5 s	R_T = 2.0 s	R_T = 2.5 s
40	30	36	–	34	40	45	–	–
50	42	49	–	48	55	62	–	–
60	56	64	–	64	73	81	–	–
70	71	81	–	83	92	102	113	123
80	88	99	–	103	114	126	141	152
90	107	119	132	126	139	151	173	185
100	–	141	155	–	165	179	207	221
110	–	165	180	–	193	209	244	260
120	–	190	207	–	224	241	285	301
130	–	217	235	–	257	275	328	346
Corrections due to grade (5) (6)	**–8**	**–6**	**–4**	**–2**	**2**	**4**	**6**	**8**
40	5	3	2	1	–1	–2	–2	–3
50	8	5	3	2	–1	–3	–4	–5
60	11	8	5	2	–2	–4	–6	–7
70	15	11	7	3	–3	–5	–8	–10
80	20	14	9	4	–4	–7	–10	–13
90	25	18	11	5	–5	–9	–13	–16
100	31	22	14	6	–6	–11	–16	–20
110	38	26	17	8	–7	–13	–19	–24
120	45	31	20	9	–8	–16	–22	–29
130	53	37	23	11	–10	–18	–26	–34

FIGURE 3.3: STOPPING SIGHT DISTANCE CRITERIA
SOURCE: AUSTROADS GUIDE TO ROAD DESIGN – PART 3 (TABLE 5.4)

The above parameters have been used to determine the stopping sight distance for the signs in Wentworth Avenue and is summarised in Table 3.1.

Road Name	Driver Reaction Time (R_T)	Design Speed	Grade %	Grade Correction	Stopping Sight Distance
Wentworth Avenue (both EB & WB)	1.5s	70km/h	-0%	+0m	83m

TABLE 3.1: STOPPING SIGHT DISTANCE SUMMARY
SOURCE: AUSTROADS

3.2 VISIBILITY OF THE PROPOSED DIGITAL LED SIGN

Section 1.6.4 of the guideline's states that:

'Accurate perspective photo-montages of the proposed digital LED sign, at human eye level from the driver's perspective, taken from critical viewing points in advance of the sign in each approach direction are required.'

A site inspection was conducted on 03/11/2021 and dashcam images were taken to present a driver's perspective of the existing digital sign from different approach distances as shown in the following photographs.

FIGURE 3.4: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE WB 150M EAST OF SIGN
PHOTOGRAPH TAKEN 03/11/2021

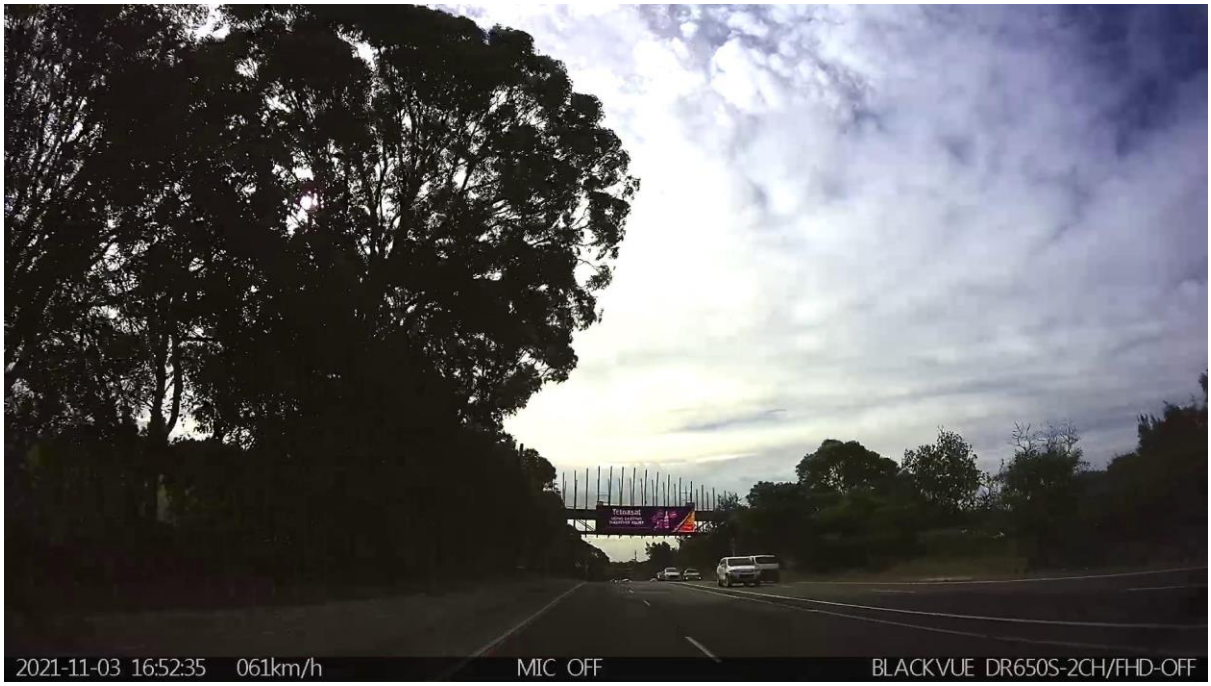


FIGURE 3.5: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE WB 85M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

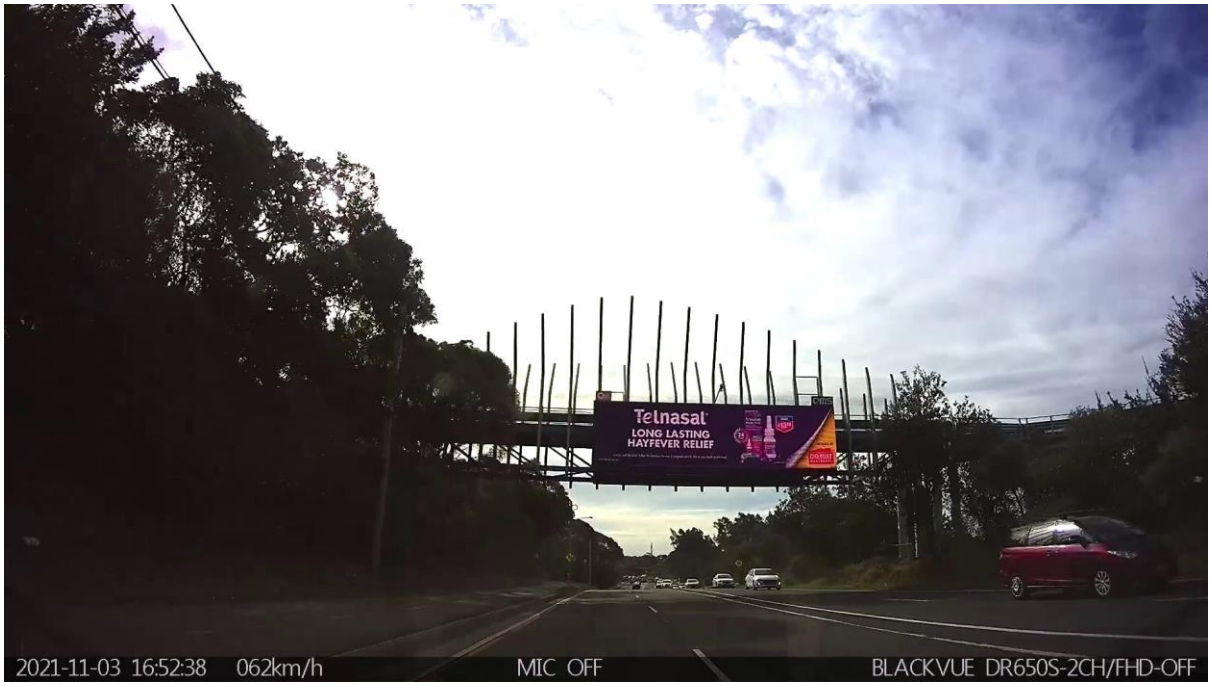


FIGURE 3.6: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE WB 30M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.7: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE WB 150M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.8: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE WB 85M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.9: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE WB 30M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

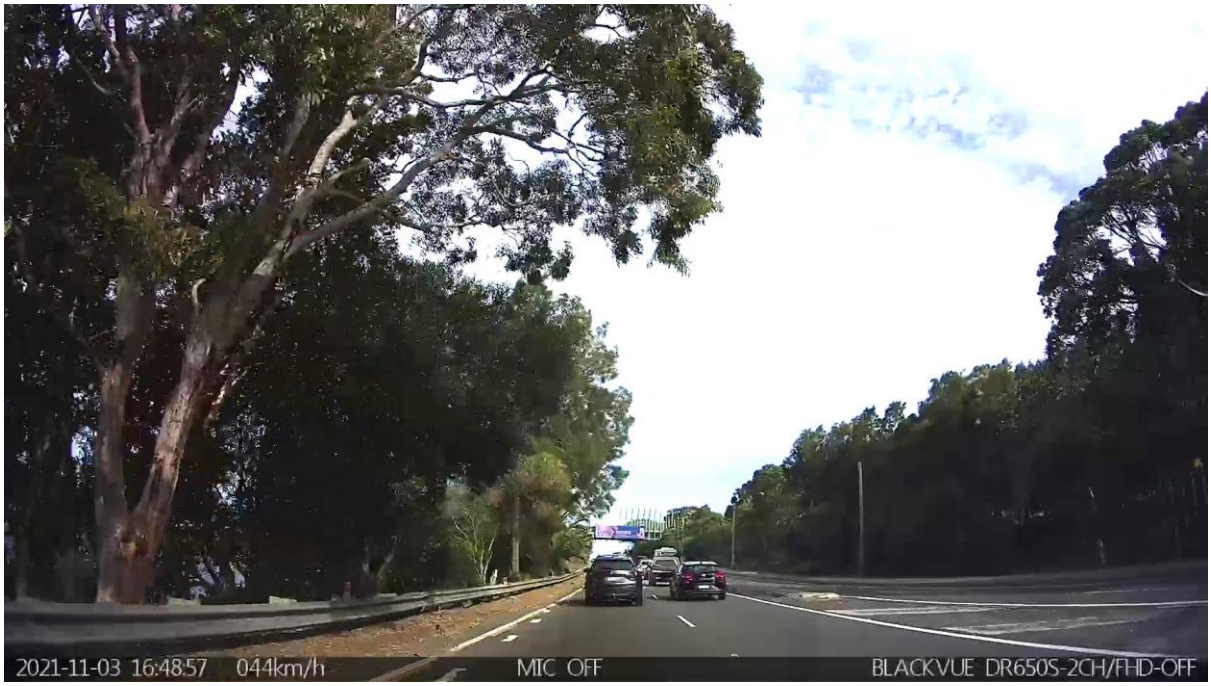


FIGURE 3.10: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE EB 150M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.11: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE EB 85M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.12: DASHCAM IMAGE – LANE 1 WENTWORTH AVENUE EB 30M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.13: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE EB 150M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.14: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE EB 85M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

FIGURE 3.15: DASHCAM IMAGE – LANE 2 WENTWORTH AVENUE EB 30M EAST OF SIGN PHOTOGRAPH TAKEN 03/11/2021

The photographs above demonstrate that at the approach distances shown including at the stopping sight distance, the visibility of the existing digital signs from the driver's perspective in Wentworth Avenue does not create a distraction to a driver.

3.3 CRASH DATA ANALYSIS

As part of this traffic and road safety assessment the crash data for 5-year period (01 January 2016 to 31 December 2020) for eastbound and westbound traffic within 200m of the existing signs, has been sourced from TfNSW to determine if there are any crash problems that have arisen since the installation of the digital sign in July 2017.

The area that the crash data was sourced for is shown in figure 3.16.

A detailed crash report and summary crash report for the crash data within the study area is provided in Appendix A.

FIGURE 3.16: CRASH DATA AREA
MAP SOURCE: GOOGLE MAPS

Analysis of the summary crash report for crashes that have occurred in the study area shown in figure 3.16 indicates that of the 3 reported crashes within the study area between 1st January 2016 and 31st December 2020, only one of these crashes was in a location where the digital sign may have been visible to the driver.

This crash did not involve any casualties. It is important to note also that the crash occurred at around midnight and the details of the driver at fault is not recorded which indicates that the driver may have not stopped to give details and that there may have been other contributing factors involved.

The crash data clearly indicates that the installation of the digital signs have not increased crashes and supports the conclusions of the road safety audit.

4 SEPP64 ASSESSMENT

4.1 COMPLIANCE WITH SECTION 2 OF GUIDELINES

Section 2.5.8 of the guidelines outlines the digital sign criteria that is used in the assessment of digital advertising signs which is provided below.

(a) Each advertisement must be displayed in a completely static manner, without any motion, for the approved dwell time as per criterion (d) below.

The proposed advertisements can be considered to be essentially static signs for the 10 second dwell time that uses digital LED technology to allow advertisements to be easily changed.

(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.

Each individual proposed advertisement will not relate or sequence to the subsequent advertisement and therefore driver will not to be required to anticipate the next advertisement.

(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.

The digital signs will not display advertisements that imitate traffic control devices.

(d) Dwell times for image display are:
(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 posted speed limit of Wentworth Avenue is 70km/h, and the existing and proposed dwell time is 10 seconds. The dwell time therefore complies with the requirements for posted speed limit of below 80km/h.

(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.

The transition time for the existing digital signs is no longer than 0.1 seconds. In the event of failure, the default image shows a black screen.

(f) Luminance levels must comply with the requirements in Section 3 of the guide.

The location of the existing digital signs is considered to be in Zone 3. The luminance specification for the proposed digital screen are as follows:

Lighting Condition	Max Permissible Luminance (cd/m^2)
Full sun on face of sign	No Limit
Day time luminance (typical sunny day)	6000
Morning and evening (twilight and overcast weather)	700
Night time	350

(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.

The proposed advertisements will not contain images that will distract drivers. The digital sign is essentially a static sign and will not contain elements that scroll, flicker, flash or contain any form of moving content during the display of each sign.

(h) The amount of text and information supplied on a sign should be kept to a minimum (for example no more than a driver can read at a short glance).

It is known that advertisements that contain substantial amounts of text are not effective and therefore text will be kept to a minimum and the emphasis being on still photographs.

(i) Any sign that is within 250 metres of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours.

The signs are not located where they could be visible from a school zone.

(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.

The signs are visible to both eastbound and westbound traffic in Wentworth Avenue as per the assessment carried out in section 3 of this report.

(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 driver's view to a single sign at any given time with a distance of no less than 150 metres 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.

The assessment carried out in section 3 demonstrates that the existing signs are not located within 150m of any other sign or within the same view of any other sign.

(m) Signs greater than or equal to 20sq metres 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.

The existing signs are 40.46m^2 each and therefore TfNSW concurrence will be required. It should be noted that the existing TfNSW concurrence permits the sign to be operational until 31/12/2025. The existing digital signs are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground and outside the clear zone.

(n) An electronic log of a signs 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 signs activity in case of a complaint.

The electronic log for the existing digital signs will be continued and is available to the Consent Authority and/or TfNSW 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's as well.

In accordance with section 3.5.1 the following Road Safety Audits (RSA) prepared by McLaren Traffic Engineering:

- Stage 2 Concept Design RSA dated 15th July 2016,
- Stage 4 6 Week Post Opening RSA dated 24th August 2017, and
- Stage 6 18 month Post Opening Audit dated 28th September 2018.

The installation of the signs has not impacted on road safety as indicated in the RSA's concluding statement:

'The brief provided has been examined and the site inspected both during clear daylight and night periods to determine the safety impacts of the subject digital signage.

This road safety audit has found no adverse impact on road safety associated with the subject and operational digital advertising sign.'

4.2 COMPLIANCE WITH SECTION 3 OF GUIDELINES

ROAD CLEARANCE

(a) The advertisement must not create a physical obstruction or hazard. For example:
(i) Does the sign obstruct the movement of pedestrians or bicycle riders? (e.g. telephone kiosks and other street furniture along roads and footpath areas)?
(ii) Does the sign protrude below a bridge or other structure so it could be hit by trucks or other tall vehicles? Will the clearance between the road surface and the bottom of the sign meet appropriate road standards for that particular road?
(iii) Does the sign protrude laterally into the transport corridor, so it could be hit by trucks or wide vehicles?

The existing digital signs are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground, outside the clear zone and are clear of pedestrian and cycle paths. The signs are wholly contained on the bridge.

(b) Where the sign supports are not frangible (breakable), the sign must be placed outside the clear zone in an acceptable location in accordance with Austroads Guide to Road Design (and RMS supplements) or behind an RMS-approved crash barrier.

The existing digital signs are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground, outside the clear zone and are clear of pedestrian and cycle paths. The signs are wholly contained on the bridge.

(c) Where a sign is proposed within the clear zone but behind an existing RMS-approved crash barrier, all its structures up to 5.8m in height (relative to the road level) are to comply with any applicable lateral clearances specified by Austroads Guide to Road Design (and RMS supplements) with respect to dynamic deflection and working width.

Not applicable as the signs are installed outside the clearzone.

(d) All signs that are permitted to hang over roads or footpaths should meet wind loading requirements as specified in AS 1170.1 and AS1170.2. All vertical clearances as specified above are regarded as being the height of the sign when under maximum vertical deflection.

Additional criteria for digital signs

Digital signs greater or equal to 20sqm must ensure the following clearances:

(a) 2.5m from lowest point of the sign above the road surface if located outside the clear zone

(b) 5.5m from lowest point of the sign above the road surface if located within the clear zone or the deflection zone of a safety barrier, if installed.

The existing digital signs are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground and outside the clear zone

LINE OF SITE

(a) An advertisement must not obstruct the driver's view of the road, particularly of other vehicles, bicycle riders or pedestrians at crossings.

The existing digital sign are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground and do not obstruct the drivers view of the road to

vehicles or pedestrians. Refer to section 3 of this report which outlines the road safety assessment undertaken in relation to stopping sight distance in accordance with Austroads.

(b) An advertisement must not obstruct a pedestrian or cyclist's view of the road.

The existing digital signs are installed on the existing bridge over Wentworth Avenue that links both sides of the Lakes Golf Course, approximately 6m above the ground and do not obstruct the view of pedestrians or cyclists.

(c) The advertisement should not be located in a position that has the potential to give incorrect information on the alignment of the road. In this context, the location and arrangement of signs' structures should not give visual clues to the driver suggesting that the road alignment is different to the actual alignment. An accurate photomontage should be used to assess this issue.

Section 3.2 of this report provides photos that provides a driver's perspective of the signs from various approach distances. The advertisements will not contain any messages that depict a road alignment or any traffic device.

(d) The advertisement should not distract a driver's attention away from the road environment for an extended length of time. For example:
(i) The sign should not be located in such a way that the driver's head is required to turn away from the road and the components of the traffic stream in order to view its display and/or message. All drivers should still be able to see the road when viewing the sign, as well as the main components of the traffic stream in peripheral view.
(ii) The sign should be oriented in a manner that does not create headlight reflections in the driver's line of sight. As a guideline, angling a sign five degrees away from right angles to the driver's line of sight can minimise headlight reflections. On a curved road alignment, this should be checked for the distance measured back from the sign that a car would travel in 2.5 seconds at the design speed.

Section 3.2 of this report provides photographs taken from the driver's perspective to the existing digital signs. The location of the digital signs from is in the main view of the traffic stream and does not interfere with the ability of

the driver to see the road ahead or interfere with the visibility of the traffic signals.

PROXIMITY TO DECISION MAKING POINTS AND CONFLICT POINTS

(a) The sign should not be located:
(i) less than the safe sight distance from an intersection, merge point, exit ramp, traffic control signal or sharp curves
(ii) less than the safe stopping sight distance from a marked foot crossing, pedestrian crossing, pedestrian refuge, cycle crossing, cycleway facility or hazard within the road environment
(iii) so that it is visible from the stem of a T-intersection.

The signs are located outside the stopping sight distance to any decision making point.

(b) The placement of a sign should not distract a driver at a critical time. In particular, signs should not obstruct a driver's view:
(i) of a road hazard
(ii) to an intersection
(iii) to a prescribed traffic control device (such as traffic signals, stop or give way signs or warning signs)
(iv) to an emergency vehicle access point or Type 2 driveways (wider than 6-9m) or higher.

Section 3.2 of this report provides photographs taken from the driver's perspective of the location of the existing digital signs. The photographs show that the location of the signs does not interfere with the visibility of the traffic signals and therefore is not considered to distract from the ability for a driver to view the traffic signals and stop if required.

SIGN SPACING

(a) 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.

The assessment carried out in section 3 demonstrates that the existing signs are not located within 150m of any other sign or within the same view of any other sign.

SIGN DESIGN AND OPERATION CRITERIA

(a) The advertisement must not distract a driver from, obstruct or reduce the visibility and effectiveness of, directional signs, traffic signals, prescribed traffic control devices, regulatory signs or advisory signs or obscure information about the road alignment.

Section 3.2 of this report provides photographs taken from the driver's perspective of the location of the existing digital signs. The photographs show that the location of the signs does not reduce visibility of the road alignment or the visibility of the traffic signals and therefore is not considered to distract from the ability for a driver to view the traffic signals and stop if required.

(b) The advertisement must not interfere with stopping sight distance for the road's design speed or the effectiveness of a prescribed traffic control device. For example:
(i) Could the advertisement be construed as giving instructions to traffic such as 'Stop', 'Halt' or 'Give Way'?
(ii) Does the advertisement imitate a prescribed traffic control device?
(iii) If the sign is in the vicinity of traffic lights, does the advertisement use red, amber or green circles, octagons, crosses or triangles or shapes or patterns that may result in the advertisement being mistaken for a traffic signal?

There are no traffic control devices with 200m of the existing signs. The advertisements will not contain any messages that depict road alignment, any traffic device, traffic signal nor use text to provide instruction to drivers.

Additional criteria for digital signs
(a) The image must not be capable of being mistaken:
(i) for a rail or traffic sign or signal because it has, e.g. red, amber or green circles, octagons, crosses or triangles or shapes or patterns that may result in the advertisement being mistaken for a traffic signal
(ii) as text providing driving instructions to drivers.

The advertisements will not contain any messages that depict road alignment, any traffic device, traffic signal nor use text to provide instruction to drivers.

(b) 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).

From experience, advertisements that contain substantial amounts of text are not effective and therefore text will be kept to a minimum and the emphasis being on still photographs and illustrations.

DWELL TIME AND TRANSITION TIME

(a) Each advertisement must be displayed in a completely static manner, without any motion, for the approved dwell time as per criterion (b) below.
(b) 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 posted speed limit of Wentworth Avenue is 70km/h, and the existing and proposed dwell time is 10 seconds. The dwell time therefore complies with the requirements for posted speed limit of below 80km/h.

(c) Any digital sign that is within 250 metres of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours.

The signs are not located where they could be visible from a school zone.

(d) Digital signs must not contain animated or video/movie style advertising or messages including live television, satellite, Internet or similar broadcasts.

The advertisements for the digital signs will only contain only still images.

(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.

The transition time for the existing digital signs is no longer than 0.1 seconds. In the event of failure, the default image shows a black screen.

ILLUMINATION AND REFLECTANCE

(a) Luminance levels must comply with the requirements in the table below.

Lighting condition	Zone 1 (cd/sqm)	Zones 2 and 3 (cd/sqm)	Zone 4 (cd/sqm)
Full sun on face of signage	No limit	No limit	No limit
Daytime luminance		6000	6000
Morning and evening twilight and inclement weather	700	700	500
Nighttime	350	350	200

The location of the proposed digital LED sign is considered to be in Zone 3. The luminance specification for the proposed digital screen are as follows:

Lighting Condition	Max Permissible Luminance (cd/m^2)
Full sun on face of sign	No Limit
Day time luminance (typical sunny day)	6000
Morning and evening (twilight and overcast weather)	700
Night time	350

(b) 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.

The proposed advertisements will not contain any flickering or flashing content and the luminance levels will in accordance with levels permissible for zone 3 and will not distract or dazzle drivers.

INTERACTION AND SEQUENCING

(a) The advertisement must not incorporate technology which interacts with in-vehicle electronic devices or mobile devices. This includes interactive technology or technology that enables opt-in direction communication with road users.

The existing digital signs are not capable of communicating or interacting with road users.

(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.

Each individual advertisement will not relate or sequence to the subsequent advertisement and therefore driver will not to be required to anticipate the next advertisement.

ROAD SAFETY REVIEW OF NEW OR MODIFIED SIGNS

RMS may review the crash history of any new or modified advertising signs after a three-year period to determine whether the sign has had an adverse effect on road safety. If RMS is of the opinion that a sign is a traffic hazard, RMS may direct the owner or occupier of the land on which the sign is situated or the person who erected the sign to screen, modify or remove the sign, regardless of whether or not the sign is the subject of a development consent under the Act or a consent under the Roads Act 1993.

Noted.

ROAD SAFETY REVIEW OF DIGITAL SIGNS

At any time, including where the speed limit in the area of the sign is changed, if a 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.

An electronic log of a digital 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.

Noted. The electronic log for the existing digital signs will be continued and is available to the Consent Authority and/or TfNSW in case of a complaint.

5 RESEARCH AND ROAD SAFETY STUDIES ON THE IMPACTS OF DIGITAL ADVERTISING ON DRIVERS

There is a common misconception that digital advertising signs increase driver distraction and reduce road safety. There have been many studies to determine the impact that of digital advertising on driver behaviour and attention. Th findings of the studies do not support this theory.

The OMA Evidence and Research Paper - Impacts of Digital Billboards on Driver Behaviour provided in Appendix C, provides a summary of the studies. The findings of these studies are summarised below.

1. The study by Klauer in 2006 on eye fixation found that:

- total eyes-off-road durations of greater than 2 seconds significantly increased individual near-crash/crash risk whereas eyeglance durations less than 2 seconds did not significantly increase risk relative to normal, baseline driving.

2. A 2012 study by FHA on driver distraction found that:

- drivers were more likely to glance at digital billboards for a slightly longer time than static billboards (average 0.335s). However, it concluded that there was no evidence indicating that (digital billboards) are associated with long glances away from the road that may reflect an increase in risk.

3. A study by Tantala and Tantala in 2010 regarding crash data study found:

- that the difference in crash data before and after the conversion was not statistically significant.
- the total number of accidents was approximately equivalent to what would have been expected with or without the introduction of the digital billboard meaning that the conversion to digital had no impact on the crash rates.

4. Monash University studies conducted in 2015 concluded that:

- there was not any difference in the impact of digital and static billboards.
- there was no difference in steering variation, variability of speed and the mean and variation of braking in the presence of billboards.

5. A study by Eyetracker in 2014 found that:

- while digital signage attracted more fixations than static signage, there was no difference in duration of these fixations and all fixations were under 2 seconds. As noted by the study by Klauer in 2006, this is the generally agreed amount of time fixations are required to be before they are considered distracting.
- there were far more fixations on traffic and on-premises signs than on roadside advertising signage.

6. A study by Carolyn Samsa in 2015 found that:

- the presence of billboards does not significantly affect the percentage of time drivers devoted to glancing at the forward roadway.
- digital billboards, were not more distracting than other types of signage.
- digital billboards do not draw drivers' attention away from the road for dangerously long periods of time.
- drivers maintained safe average headway in the presence of digital billboards.

7. OMA commissioned the Australian Road Research Board to observe driver behaviour in the presence of a digital billboard when that billboard was both on and off and at various dwell times. That study found that:

- at all dwell times vehicle lateral control performance either improved or was unaffected by the digital billboard's presence.
- results for stopping over the line where this performance indicator improved at all but one dwell time.

The above studies indicate that the documented evidence from many different driver behaviour studies undertaken both locally and worldwide do not support the perception that digital advertising signs increase driver distraction.

6 SUMMARY AND CONCLUSION

This traffic and road safety assessment for the existing digital signs has been shown to comply with the road safety criteria specified in the Department of Planning and Environment's 'TRANSPORT CORRIDOR OUTDOOR ADVERTISING AND SIGNAGE GUIDELINES – ASSESSING DEVELOPMENT APPLICATIONS UNDER SEPP 64 (NOVEMBER 2017)'.

The analysis of the crash history of the roads from where the proposed digital LED sign will be visible from indicates that there have been only 3 crashes occurring within the study area in the most recent 5 year period. Of these 3 crashes, only 1 crash is considered to be a crash where the sign would be potentially visible to the driver. This equates to a very low crash rate and considering that the existing signs has been in operation during since 2017, there are no indications in the crash history that the road safety has reduced by the installation of these signs.

This is also supported by the concluding statement in the Road Safety Audits prepared by McLaren Traffic Engineering:

'The brief provided has been examined and the site inspected both during clear daylight and night periods to determine the safety impacts of the subject digital signage.

This road safety audit has found no adverse impact on road safety associated with the subject and operational digital advertising sign.'

Based on the findings of this traffic and road safety assessment report it is our professional opinion that the proposed digital LED sign can be recommended for approval.

Navin Prasad (Bachelor of Engineering Technology – Civil Engineering)
Director
Traffic & Safety Solutions PTY LTD

APPENDIX A – TFNSW CRASH DATA


Crashes on Wentworth Avenue, Pagewood -
200m both sides of Pedestrian Bridge
from 01 Jan 2016 to 31 Dec 2020
N
Crash Severity
Fatal
Serious Injury
Moderate Injury
Minor/Other Injury
Non-casualty (towaway)
0 25 50 100 Meters
© Department of Finance, Services & Innovation 2018

2 casualties from **3** crashes

Summary crash report

Date of crash: 18/07/2017 – 26/09/2020

Summary

Year	# Crashes	# Casualties
2017	1	1
2018	1	1
2020	1	

Degree of crash - detailed	# Crashes	% of Total
Serious Injury	1	33.3%
Moderate Injury	1	33.3%
Non-casualty (towaway)	1	33.3%

Degree of casualty - detailed	# Casualties	% of Total
Seriously Injured	1	50.0%
Moderately Injured	1	50.0%

Road user class	# Casualties	# Casualties without safety device	% Casualties by class without safety device
Motor vehicle driver	1		
Motorcycle rider	1		
Total	**2**		

Crashes with speeding involved		Crashes with fatigue involved	
1	33.3%	0	0.0%

Without safety device includes: Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Crash

Type of crash	# Crashes	% of Total
Car crash	2	66.7 %
Motorcycle crash	1	33.3 %

RUM group	# Crashes	% of Total
Vehicles from same direction	1	33.3%
Off path, on straight	1	33.3%
Off path, on curve	1	33.3%

-Type of crash categories are not mutually exclusive and should not be summed
-Bus crash includes Light bus or Heavy bus
-Heavy truck crash includes Heavy rigid or Articulated truck
-Heavy vehicle crash includes Heavy truck or Heavy bus

Collision type	# Crashes	% of Total
Multi vehicle	1	33.3%
Single vehicle	2	66.7%

Road

Type of location group	# Crashes	% of Total
Non-intersection locations	3	100.0%

Intersection locations include crashes up to 10 metres from an intersection

Speed limit	# Crashes	% of Total
70 km/h	3	100.0%

Road classification (admin)	# Crashes	% of Total
State	3	100.0%

Data source	# Crashes	% of Total
Police investigated	3	100.0%

Road classification (legal)	# Crashes	% of Total
Other classified road	3	100.0%

Surface condition	# Crashes	% of Total
Dry	3	100.0%

When

One-hour intervals	# Crashes	% of Total
08:00 - 08:59	1	33.3%
12:00 - 12:59	1	33.3%
23:00 - Midnight	1	33.3%

Day of week	# Crashes	% of Total
Tuesday	1	33.3%
Thursday	1	33.3%
Saturday	1	33.3%

Public holiday period	# Crashes	% of Total

Weekend crashes		Weekday crashes	
1	33.3%	2	66.7%

School travel time	# Crashes	% of Total
Yes	1	33.3%
No	2	66.7%

School zone active	# Crashes	% of Total
Not a school zone	3	100.0%

School holiday period	# Crashes	% of Total
End term 3	1	33.3%

Weather and lighting

Weather	# Crashes	% of Total
Fine	3	100.0%

Natural lighting	# Crashes	% of Total
Daylight	2	66.7%
Darkness	1	33.3%

Street lighting	# Crashes	% of Total
On	1	33.3%
Off	1	33.3%
Nil	1	33.3%

Detailed Crash Report

TfNSW Region / LGA / Town / Street	Crash ID	Data Source	Date of crash	Day of Week	Time	Distance	Direction	ID Feature	Location type	Alignment	Weather	Surface condition	Speed limit	TU Type	TU Direction	TU Manoeuvre	Age / Gender	Road User Class	Degree of casualty	Degree of crash	Killed	Serious Injury	Moderate Injury	Minor Other Injury	Uncategorised Injury	Crash Factor
Greater Sydney Bayside EASTLAKES WENTWORTH AVE	1250540		E283396598					RUM: 30 Rear end					No. of TUs involved: 2													
														CAR	W in WENTWORTH AVE	Proceeding in lane	Unk U	MV driv.	N							
		P	26/09/20	Sat	2350	300 m	W	BAY ST	Div	Str	Fine	Dry	70	CAR	W in WENTWORTH AVE	Proceeding in lane	63 F	MV driv.	N	NC	0	0	0	0	0	
	1172925		E68177975					RUM: 81 Off left/rt bnd=>obj					No. of TUs involved: 1			Fence										
		P	01/02/18	Thu	0850	1 km	W	BANKS AVE	Div	Cur	Fine	Dry	70	CAR	E in WENTWORTH AVE	Proceeding in lane	20 M	MV driv.	S	SC	0	1	0	0	0	S
Greater Sydney Bayside PAGEWOOD WENTWORTH AVE	1146198		E64746835					RUM: 74 On road-out of cont.					No. of TUs involved: 1													
		P	18/07/17	Tue	1238	100 m	E	SOUTHERN CROSS DR	2-way	Str	Fine	Dry	70	M/C	W in WENTWORTH AVE	Proceeding in lane	50 M	MC rider	M	MC	0	0	1	0	0	

Report Totals

Crashes: 3 Fatal Crashes (FC): 0 Serious Injury Crashes (SC): 1 Moderate Injury Crashes (MC): 1 Minor/Other Injury Crashes (OC): 0 Uncategorised Injury Crashes (UC): 0 Non-Casualty Crashes (NC): 1

Killed (K): 0 Seriously Injured (S): 1 Moderately Injured (M): 1 Minor/Other Injured (O): 0 Uncategorised Injured (U): 0 Not Injured (N): 2

Report Filters

Dataset Filters

Crashes on Wentworth Avenue (200m either side of the Pedestrian Bridge), Pagewood from 01 Jan 2016 to 31 Dec 2020

Crash self reporting, including self reported injuries began in Oct 2014. Trends from 2014 are expected to vary from previous years. More unknowns are expected in self reported data.

APPENDIX B – ROAD SAFETY AUDITS

STAGE 2 CONCEPT DESIGN ROAD SAFETY AUDIT OF

PROPOSED CONVERSION OF EXISTING ROADSIDE SIGNAGE TO DIGITAL

AT WENTWORTH AVENUE GOLF COURSE OVERBRIDGE, EASTLAKES

Address: Shop 7, 720 Old Princes Highway Sutherland NSW 2232
Postal: P.O Box 66 Sutherland NSW 1499

Telephone: +61 2 8355 2440
Fax: +61 2 9521 7199
Web: www.mclarentraffic.com.au
Email: admin@mclarentraffic.com.au

Division of RAMTRANS Australia ABN: 45067491678

Transport Planning, Traffic Impact Assessments, Road Safety Audits, Expert Witness

16330.01FB - 15 July 2016

Development Type: **Proposed Conversion of Existing Roadside Signage to Digital**

Site Address: **Wentworth Avenue & Wentworth Avenue Overpass, Eastlakes**

Prepared for: **Outdoor Systems**

Document reference: **16330.01FB**

Status	Issue	Prepared By	Checked By	Date
Draft	A	TH	CM	24th June 2016
Draft	B	TH	CM	27th June 2016
Draft	C	TH	CM	29th June 2016
Draft	D	TH	CM	5th July 2016
Final	A	TH	CM	5th July 2016
Final	B	TH	CM	15th July 2016

TABLE OF CONTENTS

1 PROJECT OVERVIEW

1.1 Inception

Project	Proposed Conversion of Existing Roadside Signage to Digital at Wentworth Avenue Golf Course Overbridge, Eastlakes
Audit Reference	16330.01FB
Audit Stage	Stage 2 Concept Design
Client	Outdoor Systems
Project Manager/Lead Auditor	Craig M^{C}Laren
Audit Team	• Lead Auditor Mr Craig M^{C}Laren (Level 3) Road Safety Auditor Identification 02-0263 • Team Member Mr Thomas Heal (Level 1) Road Safety Auditor
Initial Meeting	N/a
Any previous audit conducted	No

1.2 Reference Materials

The following plans / information were reviewed as part of this concept design audit:

1. *Email from Andrew Tyquin dated 10 June 2016 and attachment.*

The Detailed Design RSA review of the intersection has been undertaken with due consideration to the following documents:

1. *"Road Safety Audit", AUSTROADS Publication No. AP-30/94, SAA HB43-1994.*
2. *"Road Safety Audit", AUSTROADS Publication No. AP-G30/02, SAI/NZS HB43-2001.*
3. *Guide to Road Safety Part 6: Road Safety Audit AUSTROADS Publication No. AGRS06/09*
4. *NSW Transport Roads & Traffic Authority Guidelines for Road Safety Audit Practices July 2011*
5. *State Environmental Planning Policy No 64--Advertising And Signage February 2014*
6. *Draft 2015 Transport Outdoor Advertising and Signage Guidelines NSW Dept. Planning and Environment December 2015 (Digital Guidelines)*
7. *Transport Corridor Outdoor Advertising And Signage Guidelines, Assessing Development Applications Under Sepp 64, NSW Department of Planning July 2007*
8. *Impact of Roadside Advertising on Road Safety, AUSTROADS Publication AP-R420-13, January 2013*

2 INTRODUCTION

2.1 Description

Mr Craig M^{C}Laren, an accredited Level 3 Road Safety Auditor with *M^{C}Laren Traffic Engineering,* was commissioned in June 2016 by Outdoor Systems to undertake a Stage 2 Concept Design Road Safety Audit of the Proposed Conversion of Existing Roadside Signage to Digital at Wentworth Avenue Golf Course Overbridge, Eastlakes.

The proposed design includes the replacement of advertising signage on the east and west facing sides of the existing Wentworth Avenue Golf Course Overbridge, visible to eastbound and westbound traffic streams travelling on Wentworth Avenue. No other alterations to the road environment are proposed. The email brief is provided in **Annexure A** for reference.

2.2 Purpose

The brief for the Stage 2 Concept Design Road Safety Audit is to:

- Identify relevant risks to all road users with respect to the proposed signage.
- Identify potential hazards due to obstruction of driver sight lines, driver distraction, conflict with road signage / controls or vehicle headlight reflection with respect to the proposed signage.
- Identify potential risks with regards to the potential characteristics of signage;
- Identify potential hazards introduced by proposed roadside furniture including sign supports, poles and other rigid (and non-rigid) street furniture.

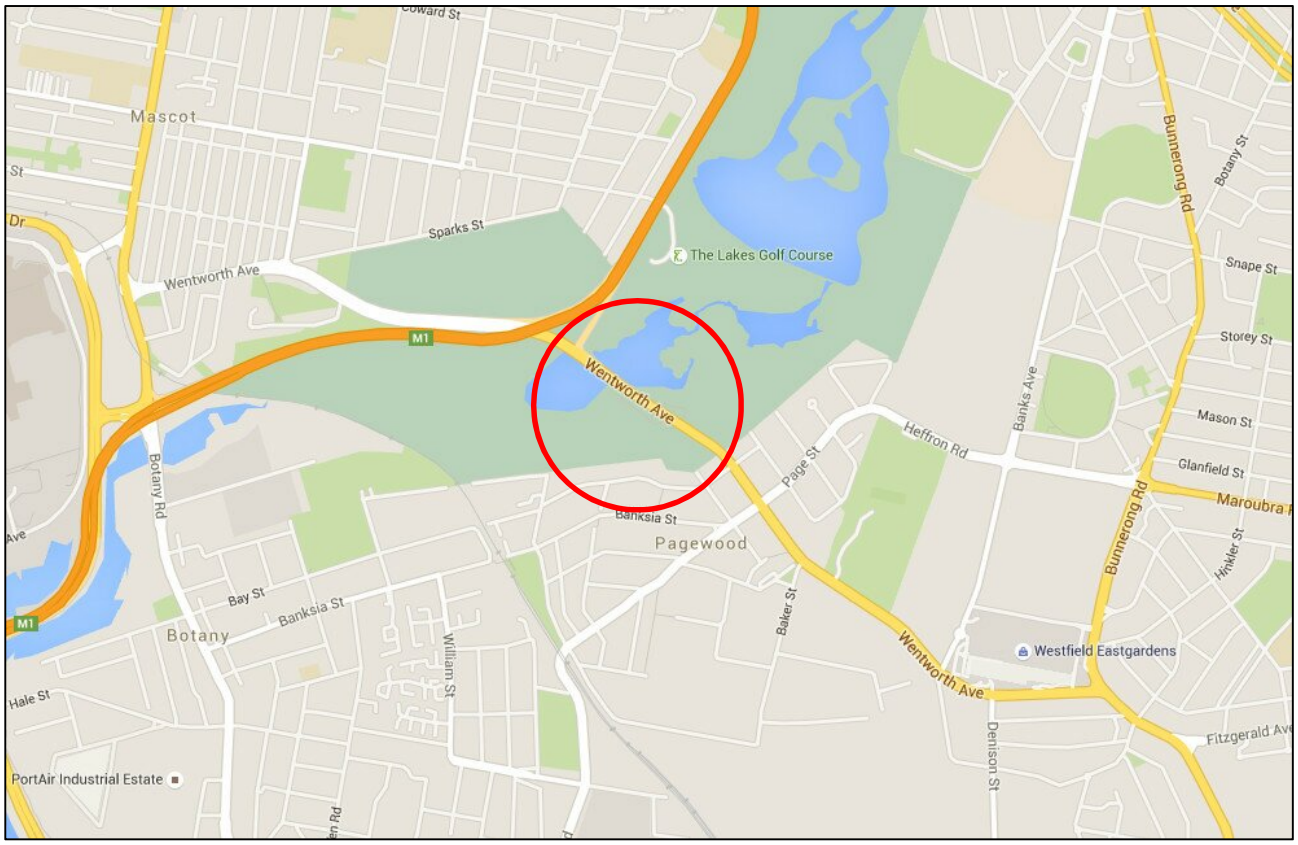
2.3 Existing Site Location & Facilities

The Stage 2 Audit is for the signage proposed on the overhead bridge located 450m to the east of the Southern Cross Drive overpass intersection on Wentworth Avenue, Eastlakes. The general area covered under this audit is shown in **Figure 1** and **Figure 2** below, whereby the extent of works depicted in these figures is for illustrative purposes only and does not reflect the actual limit of works.

The existing signage on the overpass is static and of 12.66m width and 3.34m height and is shown in **Figure 3** (east facing) and **Figure 4** (west facing) for reference. Both existing signs are illuminated during night hours.

Site Location

FIGURE 1: SITE CONTEXT – AERIAL PHOTO



Site Location

FIGURE 2: SITE CONTEXT – STREET MAP

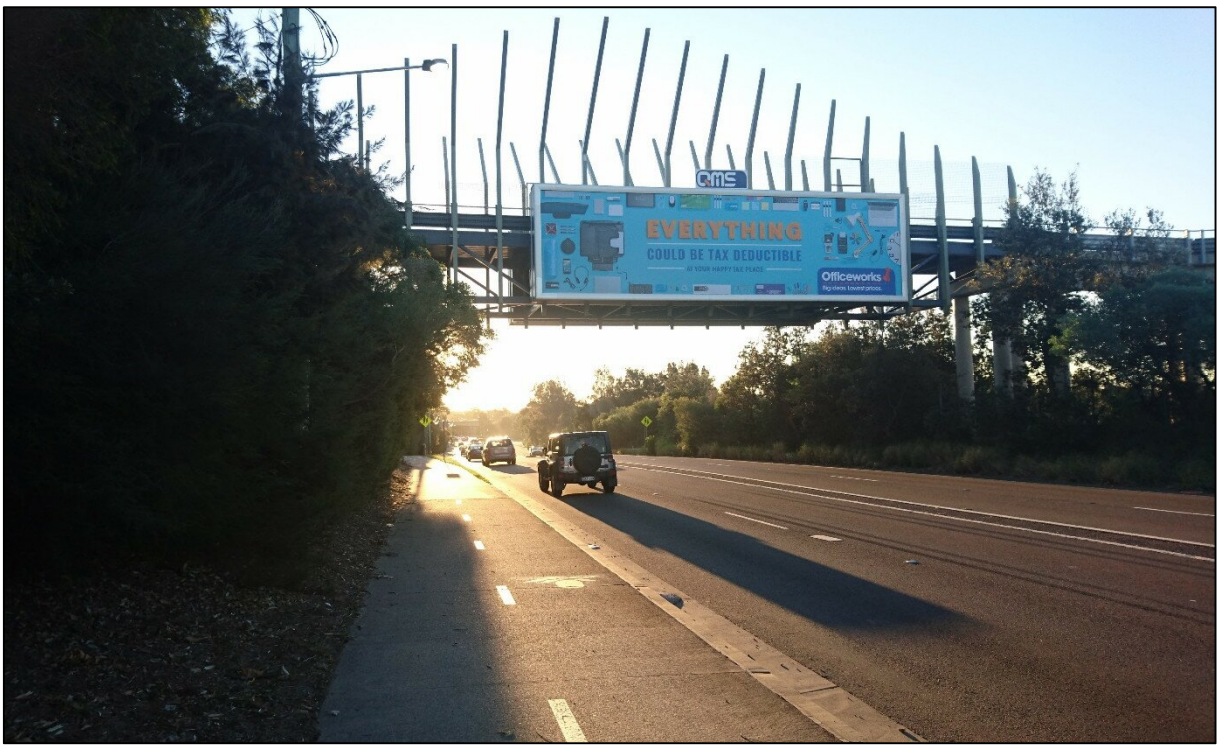
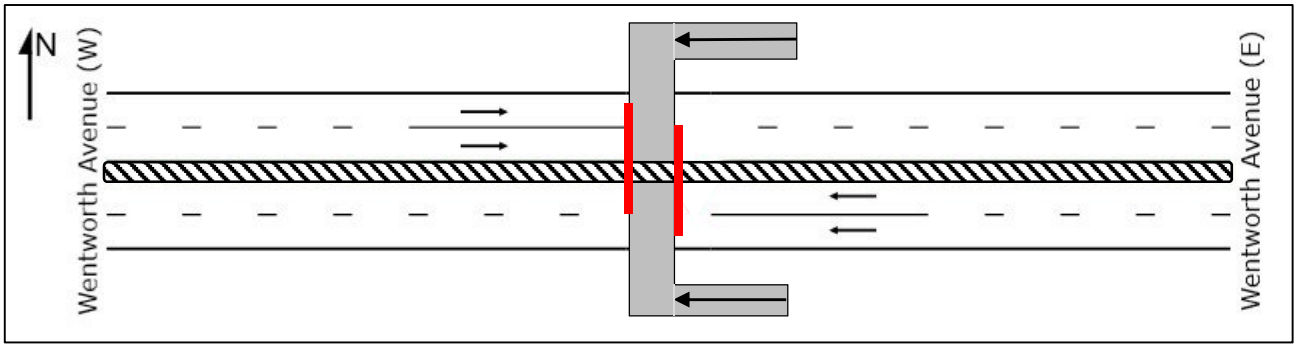


FIGURE 3: EXISTING EAST-FACING SIGNAGE

FIGURE 4: EXISTING WEST-FACING SIGNAGE

Currently Wentworth Avenue is signposted as 70km/h with approximately 16m width facilitating two traffic lanes in both directions and a separate shared pedestrian / cycling path of approximately 3m width along the southern side of the road. “Pedestrian Symbolic” signage was noted on both approaches to the overpass, however there is no pedestrian crossing. The Wentworth Avenue Overpass is a pedestrian bridge passing over Wentworth Avenue used by the public, golfers, golf course staff and their equipment from the Eastlake Golf Club.

The intersection layout is shown diagrammatically in **Figure 5**.



Approximate Signage Location

FIGURE 5: WENTWORTH AVENUE LAYOUT

2.4 Proposed Works/Upgrade

As shown, the proposed digital signage is to replace the existing static signage on the both sides of the overpass, visible to eastbound and westbound traffic along Wentworth Avenue.

Each of the proposed digital LED signs is 12.48m width by 3.2m height with a total area of 39.94m^2, and will operate in both daytime and night-time hours. Each existing advertising sign is 12.66m X 3.4m with an area of 43m^2.

The design of the signs will be in accordance with the digital sign criteria given in the *Draft 2015 Transport Outdoor Advertising and Signage Guidelines*, with the relevant extracts reproduced in **Annexure B** for reference.

3 ROAD SAFETY AUDIT PROCEDURE

3.1 Brief Description

In general, the *Stage 2 Concept Design Road Safety Audit (RSA)* concentrates on the existing road layout including the geometric design, traffic signage, traffic signal sequence, roadside furniture and line marking. The Stage 2 RSA identifies the potential safety hazards resulting from the implementation of roadside signage.

The Audit is to identify a broad range of potential safety hazards with respect to the above road features; identify the impacts to the safety of all road users of possible signage design features; improve safety of identified risks as a result of the overall audit findings.

The brief for the *Stage 2 Concept Design Road Safety Audit* is to:

- Identify relevant risks to all road users with respect to the proposed signage locations;
- Evaluate the road safety impacts of proposed sign features such as size and type;
- Provide findings which can be used in the development of detailed sign design to minimise safety impacts.

Following the subject *Stage 2 Concept Design RSA*, a *Stage 4 Pre-Opening Road Safety Audit* will be undertaken, which involves the assessment and reporting of the safety impacts of specific design features on the road environment once the signage has been implemented.

3.2 Site Inspection

The site was inspected during daylight and night hours on Monday 13th June 2016 and again during night hours on Tuesday 29th June 2016; the purpose of the site inspection is to observe the existing site from the perspective of all road users in order to identify current conditions and possible future impacts of the proposed signage.

4 SAFETY AUDIT FINDINGS & RECOMMENDATIONS

Section 4.1 documents the general findings of the specialised road safety audit. The audit brief and the CV's of the auditors are presented in **Annexure A** and **Annexure C** respectively.

This audit seeks to identify potential hazards and risks to road users that could arise from implementation of signage in the proposed location, including identification of impacts of design features including but not limited to signage height, width, angle and colours.

A *Stage 2 Concept Design Road Safety Audit* presents findings based on the preliminary sign design and identifies features that may be relevant during the detailed design stage. The findings of the report should be taken into consideration by the designer to achieve the best outcome in terms of road safety.

Any further Road Safety Audit assessments at later stages are to be undertaken in accordance with the checklists outlined in Schedule 1 of *SEPP 64 Advertising and Signage* and Section 11 of *Austroads Part 6: Road Safety Audit*.

4.1 General Findings

The following sub-sections provide general issues as identified by the Auditing team.

4.1.1 Conflict with Traffic Signals

The placement of the signage is such that it is directly behind the west-facing traffic signals, approximately 300m away, for eastbound vehicles in the median lane at the Wentworth Avenue / Southern Cross Drive off-ramp junction, as shown in **Figure 6** & **Figure 7**.

The existing, static signage is lit and does not appear similar to the traffic signal lights, however any signage in the subject location (static or digital), *if displaying primarily red, green or amber colours which is strictly contrary to the signage relevant controls and guidelines and is not proposed*, could be mistaken for a traffic signal lamp and cause drivers to fail to stop or brake unexpectedly, raising the risk of "right near" collisions and rear-end collisions respectively.

It has been indicated by the proponent that the future signage design will conform to the criteria included in the *Draft 2015 Transport Outdoor Advertising and Signage Guidelines,* in terms of the sign's contents, brightness, refresh time and reflectiveness and as a result there will be *no impact on road safety* resulting from the proposed digital signage.

FIGURE 6: SIGNAGE FROM WENTWORTH AVE / SOUTHERN CROSS DRIVE JUNCTION – DAYTIME

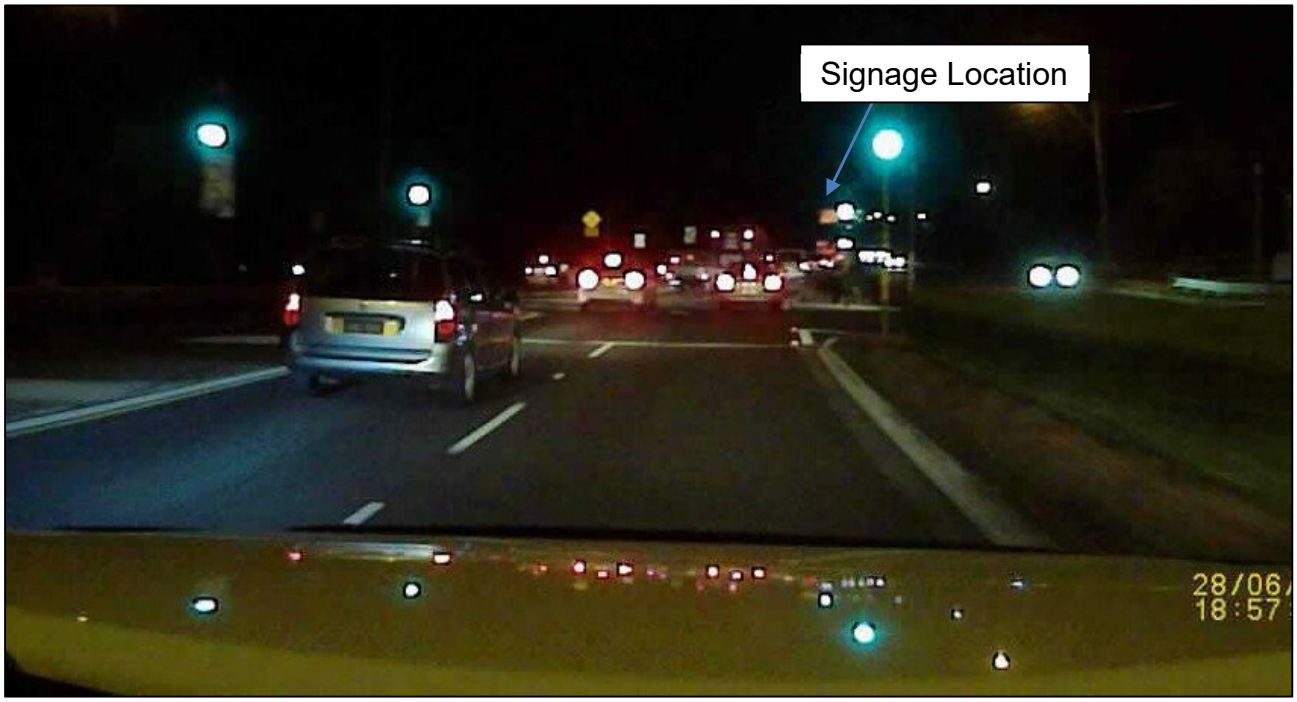


FIGURE 7: SIGNAGE FROM WENTWORTH AVENUE / SOUTHERN CROSS DRIVE JUNCTION – NIGHT TIME

4.1.2 Driver Distraction

Both the existing east-facing and west-facing signage is lit during night hours and the conversion to digital signage will not introduce a new feature to the road landscape. It is considered that there will be no unacceptable impact to road safety if the sign's contents, brightness, refresh time, dwell time and reflectiveness conform to the relevant standards and guidelines which can be expected. A *Stage 4 Pre-Opening* RSA will be undertaken to verify that this is the case.

5 CONCLUDING STATEMENT

The brief reproduced in **Annexure A** has been examined and the site inspected both during clear daylight and night periods to best determine the design features and site characteristics that could affect road safety.

The road safety audit findings are contained in **Section 4** of this report.

The design factors mentioned in this audit are based upon the independent opinions and judgements of the authors. It should be noted, however, that it is ultimately the responsibility of the Project Manager to determine how best to respond to identified road safety issues.

……..
Craig M^{C}Laren
(RMS Accredited Level 3 Road Safety Auditor) 15 July 2016.

……..
Thomas Heal
(RMS Accredited Level 1 Road Safety Auditor) 15 July 2016.

ANNEXURE A: EMAIL BRIEF
(SHEET 1 OF 2)

Gmail **Craig McLaren <mclarentrafficengineering01@gmail.com>**

Eastlake, Wentworth Ave - Road Safety Report

4 messages

Andrew Tyquin <andrewt@outdoorsystems.com.au> Fri, Jun 10, 2016 at 10:27 AM
To: "admin@mcarentraffic.com.au" <admin@mcarentraffic.com.au>
Cc: "Craig McLaren (craig@mclarentraffic.com.au)" <craig@mclarentraffic.com.au>, Brian Tyquin <briant@outdoorsystems.com.au>

Hi Craig

As discussed we are going to convert the existing static advertising signs on the bridge, to digital and require safety report to address any road safety impact.

The existing signs are 12.66m x 3.34m each and the digital LED signs will be 12.48m x 3.2m (W x H) ;Total sqm: 39,94 sqm

Would it be possible to have you report by the 26th June or earlier as we want to get the Sec96 application to Botany C asap.

Let me know if there is anything you need?

Regards

Andrew Tyquin

OUTDOOR SYSTEMS

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m +61 438 081 769

www.outdoorsystems.com.au

Andrew Tyquin <andrewt@outdoorsystems.com.au> Fri, Jun 10, 2016 at 10:45 AM
To: "admin@mclarentraffic.com.au" <admin@mclarentraffic.com.au>
Cc: "Craig McLaren (craig@mclarentraffic.com.au)" <craig@mclarentraffic.com.au>, Brian Tyquin <briant@outdoorsystems.com.au>

[Quoted text hidden]

Andrew Tyquin <andrewt@outdoorsystems.com.au> Wed, Jun 15, 2016 at 11:35 AM
To: "admin@mclarentraffic.com.au" <admin@mclarentraffic.com.au>
Cc: "Craig McLaren (craig@mclarentraffic.com.au)" <craig@mclarentraffic.com.au>, Brian Tyquin

ANNEXURE A: EMAIL BRIEF
(SHEET 2 OF 2)

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 1 OF 3)

2.5.8 Digital signs

In addition to meeting the relevant SEPP 64 assessment criteria, design, road safety and any public benefit test requirements under the Guidelines, the consent authority must be satisfied that the digital sign meets the following criteria:

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
(a) Each advertisement must be displayed in a completely static manner, without any motion, for the approved dwell time as per criterion (d) below.	✓	✓
(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.	✓	✓
(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, or (ii) as text providing driving instructions to drivers.	✓	✓
(d) Dwell times for image display are: (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.	✓	✓
(e) The transition time between messages must be no longer than 0.1 seconds.	✓	✓
(f) Luminance levels must comply with the requirements in Table 3 below.	✓	✓
(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.	✓	✓
(h) The amount of text and information supplied on a sign should be kept to a minimum (for example no more than a driver can read at a short glance). Text should preferably be displayed in the same font and size. Table 6 in Section 3 of these Guidelines provides further guidance.	✓	✓
(i) Any sign that is within 250 metres of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours.	✓	✓
(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.	✓	✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 2 OF 3)

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
(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 which may result in a change to the dwell time or removal of the sign.	✓	✓
(l) Sign spacing should limit drivers view to a single sign at any given time with a distance of no less than 150 metres 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.		✓
(m) Signs greater than or equal to 20sq metres must obtain RMS concurrence AND must ensure the following minimum vertical clearances; • 2.5m from lowest point of the sign above the road surface if located outside the clear zone. • 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 (e.g. 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.		✓
(n) An electronic log of a signs 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 signs activity in case of a complaint.		✓
(o) A road safety check which focuses on the effects of the placement and operation of all signs over 20sq metres 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. 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.		✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 3 OF 3)

Table 3: LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS

LUMINANCE LEVELS – Luminance means the objective brightness of a surface as measured by a photometer, expressed in candelas per square meter (cd/m2). Levels differ as digital signs will appear brighter when light levels in the area are low. Luminance levels should comply with Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting which recommends the following levels:

Lighting Condition	*Zone 1*	*Zones 2 and 3*	*Zone 4*
Full Sun on face of Signage	No limit	Maximum Output	Maximum Output
Day Time Luminance		6000 cd/m2	6000 cd/m2
Morning and Evening Twilight and Inclement Weather		700 cd/m2	500 cd/m2
Night Time		350 cd/m2	
Night Time		350 cd/m2	

Zone 1 covers areas with generally very high off-street ambient lighting e.g. display centres similar to Kings Cross, central city locations

Zone 2 covers areas with generally high off-street ambient lighting e.g. some major shopping/commercial centres with a significant number of off-street illuminated advertising devices and lights.

Zone 3 covers areas with generally medium off-street ambient lighting e.g. small to medium shopping/ commercial centres.

Zone 4 covers areas with generally low levels of off-street ambient lighting e.g. most rural areas, many residential areas.

2.5.9 Moving Signs

Moving or mechanical signs display images which change through movement of the sign structure only, for example, scrolling or trivision signs.

In addition to meeting the relevant SEPP 64 assessment criteria, design, road safety and public benefit test requirements under these Guidelines, moving signs that face the road reserve and are visible to drivers will also be required to meet the following criteria:

(a) The display must be completely static from its first appearance to the commencement of a change to another display;

(b) Dwell times for image display are to be a total of 10 seconds which includes 3 seconds to scroll.

(c) The image must not be capable of being mistaken:

  (i) for a rail or traffic sign or signal 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 traffic signal, or

  (ii) as text providing driving instructions to drivers.

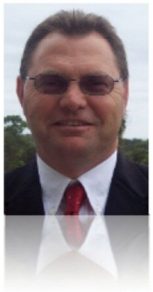
(d) Light levels are to be consistent with Section 3.2.5 and Table 5 of these Guidelines.

2.5.10 Video and animated electronic signs

Video and animated electronic signs containing animated or video/movie style advertising or messages including; live television, satellite, internet or similar broadcast; either permanent or portable; that face the road reserve and are visible to drivers are prohibited.

ANNEXURE C: CIRRICULUM VITAE
(SHEET 1 OF 2)

Craig McLaren (Director)



Craig is an acknowledged traffic consultant since the company inception in 1995. The company's primary function has been to serve both the public and private sectors focusing on traffic impact assessments, transport planning, special event transport planning, local area traffic management, road safety and expert evidence at Land and Environment Court, Supreme Court and the Commission of Inquiry.

Qualifications

Bachelor of Civil Engineering, UNSW, 1985

Graduate Diploma in Traffic Engineering, University of New South Wales, 1991

Accredited Level 3 Road Safety Auditor, 1998

Traffic Control Plan Certifier (Orange Card), 2012

Affiliations:

Member, Australian Institute of Traffic Planning and Management - AITPM

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Experience:

MCLAREN TRAFFIC ENGINEERING

1995 to date:

Director and experienced traffic engineer responsible for the conduct of all facets of traffic impact assessment ranging from report preparation, design advice and giving evidence at the Land and Environment Court.

SINCLAIR KNIGHT MERZ

1994 to 1995:

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TRANSPORTATION PLANNING WORKSHOP

1989 to 1994:

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ROADS AND TRAFFIC AUTHORITY, NSW

1988 to 1989:

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OVE ARUP TRANSPORTATION PLANNING

1985 to 1988:

Traffic Engineer. Involved in the preparation of traffic impact reports for a wide range of projects.

GUTTERIDGE HASKINS & DAVEY

1980 to 1982:

Trainee Civil Engineer. Involved in assisting with road and subdivision design and field surveying.

Papers at Conferences

"Safe & Liveable Communities, Can You Have Both?" Georgia Institute of Transportation Engineers, St Simons Island, Georgia USA July 1999.

ANNEXURE C: CIRRICULUM VITAE
(SHEET 2 OF 2)

Thomas Heal (Traffic Engineer)

Thomas is a graduate traffic engineer with experience in consulting with the public and private sectors on matters of transport planning, traffic impact assessment, road & car park design and road safety auditing.

Qualifications

Bachelor of Civil Engineering, University of Sydney, 2015

IPWEA Accredited Level 1 Road Safety Auditor, 2015

Papers/Theses

"Optimising the Design Methods for the Configuration of Anchor Bolts in Steel Column Base Plate Connections", Undergraduate Thesis at University of Sydney, 2014.

Experience:

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2015 to date:

Undergraduate Intern and Graduate Traffic Engineer engaged in traffic and transport planning, traffic impact assessment, road safety auditing and provision of detailed design advice. Assisted in the preparation of reports and expert evidence to the Land and Environment Court.

Curriculum Vitae December 2015

6-WEEK POST-OPENING ROAD SAFETY AUDIT OF

DIGITAL ROAD SIGNAGE

AT WENTWORTH AVENUE GOLF COURSE OVERBRIDGE, EASTLAKES

Address: Shop 7, 720 Old Princes Highway Sutherland NSW 2232
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Telephone: +61 2 8355 2440
Fax: +61 2 9521 7199
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Email: admin@mclarentraffic.com.au

Division of RAMTRANS Australia ABN: 45067491678

Transport Planning, Traffic Impact Assessments, Road Safety Audits, Expert Witness

17401.01FA - 24th August 2017

Development Type: **Proposed Conversion of Existing Roadside Signage to Digital**

Site Address: **Wentworth Avenue & Wentworth Avenue Overpass, Eastlakes**

Prepared for: **Outdoor Systems**

Document reference: **17401.01FA**

Status	Issue	Prepared By	Checked By	Date
Draft	A	TH/MM	CM	24th August 2017
Final	A	MM	CM	24th August 2017

TABLE OF CONTENTS

1 PROJECT OVERVIEW

1.1 Inception

Project	Digital Road Signage at Wentworth Avenue Golf Course Overbridge, Eastlakes
Audit Reference	17401.01FA
Audit Stage	6-week Post-Opening
Client	Outdoor Systems
Project Manager	Outdoor Systems
Audit Team	• Lead Auditor Mr Craig M^{C}Laren (Level 3) Road Safety Auditor ID: 02-0263 • Team Member Mr Thomas Heal (Level 1) Road Safety Auditor ID: 02-1075 • Team Member Mr Matthew McCarthy (Level 1) Road Safety Auditor ID: 02-1197
Initial Meeting	N/a
Any previous audit conducted	No

1.2 Reference Materials

The 6-week post-opening Road Safety Audit of the signage has been undertaken with due consideration to the following documents:

1. *"Road Safety Audit", AUSTROADS Publication No. AP-30/94, SAA HB43-1994.*
2. *"Road Safety Audit", AUSTROADS Publication No. AP-G30/02, SAI/NZS HB43-2001.*
3. *Guide to Road Safety Part 6: Road Safety Audit AUSTROADS Publication No. AGRS06/09*
4. *NSW Transport Roads & Traffic Authority Guidelines for Road Safety Audit Practices July 2011*
5. *State Environmental Planning Policy No 64--Advertising And Signage February 2014*
6. *Draft 2015 Transport Outdoor Advertising and Signage Guidelines NSW Dept. Planning and Environment December 2015 (Digital Guidelines)*
7. *Transport Corridor Outdoor Advertising And Signage Guidelines, Assessing Development Applications Under Sepp 64, NSW Department of Planning July 2007*
8. *Impact of Roadside Advertising on Road Safety, AUSTROADS Publication AP-R420-13, January 2013*

2 INTRODUCTION

2.1 Description

Mr Craig M^{C}Laren, an accredited Level 3 Road Safety Auditor with *M^{C}Laren Traffic Engineering,* was commissioned in June 2017 by Outdoor Systems to undertake a 6-Week Post-Opening Road Safety Audit of the Digital Road Signage at Wentworth Avenue Golf Course Overbridge, Eastlakes.

The signage is positioned on both the east and west facing sides of the existing Wentworth Avenue Golf Course Overbridge, visible to eastbound and westbound traffic streams travelling on Wentworth Avenue. No other alterations to the road environment will be examined as part of this Audit.

2.2 Purpose

The brief for the 6-Week Post-Opening Road Safety Audit is to:

- Identify relevant risks to all road users with respect to the signage;
- Identify potential hazards due to obstruction of driver sight lines, driver distraction, conflict with road signage / controls or vehicle headlight reflection with respect to the signage.
- Identify potential risks with regards to the digital characteristics of the signage;
- Identify potential hazards introduced by roadside furniture including sign supports, poles and other rigid (and non-rigid) street furniture.

It should be noted that while it is preferred that a Pre-Opening audit be undertaken to identify any risks prior to the opening of road facilities to the public, in some situations it is not feasible or justified to isolate the road environment to undertake a pre-opening audit. As such, an audit conducted 6-weeks after the date that the signage first became operational is considered to achieve the same objectives without undue risk to road users.

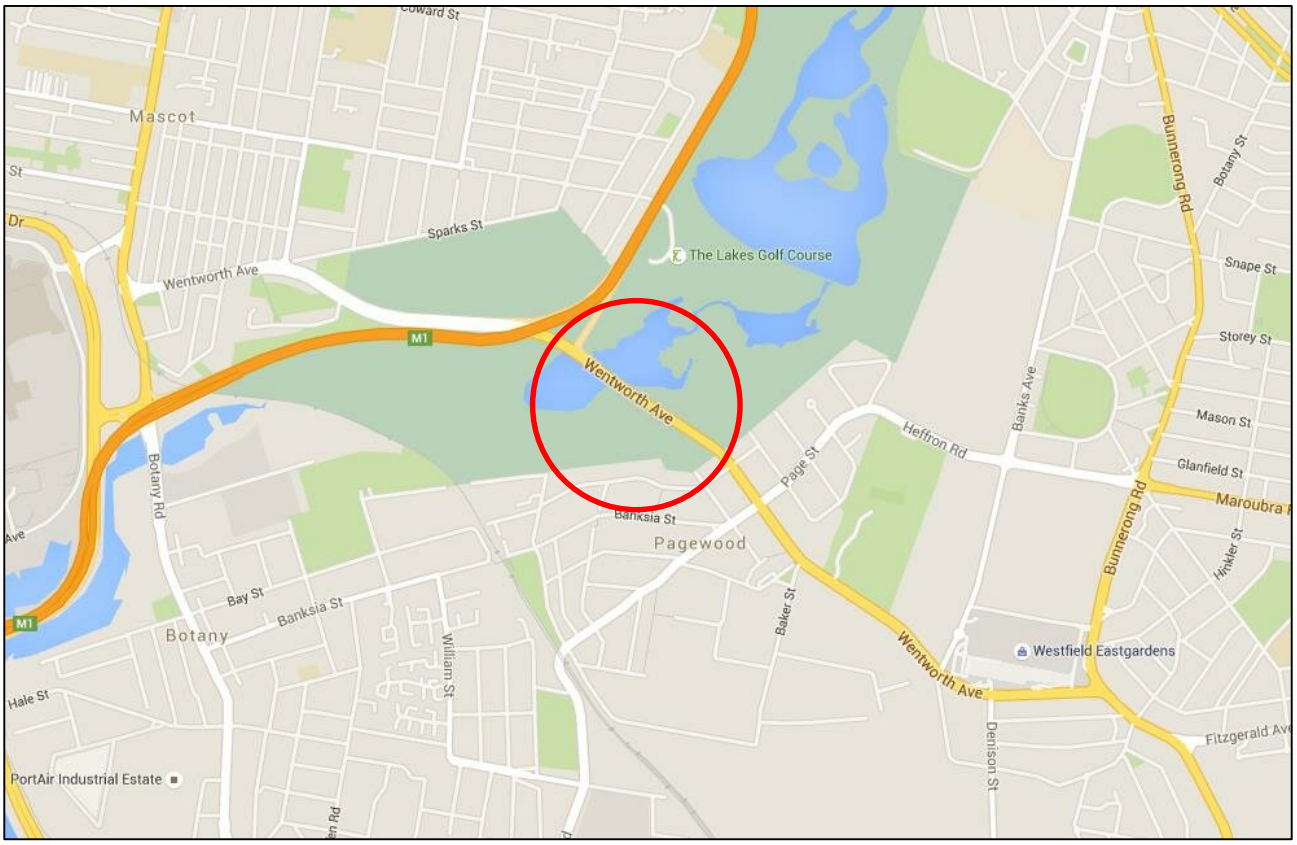
2.3 Existing Site Location & Facilities

The road safety audit examines the digital signage on the overhead bridge located 450m to the east of the Southern Cross Drive overpass intersection on Wentworth Avenue, Eastlakes. The general area covered under this audit is shown in **Figure 1** and **Figure 2** below, whereby the extent of works depicted in these figures is for illustrative purposes only and does not reflect the actual limit of the Audit.

The digital signage on the overpass has a dwell time of 10 seconds and has physical dimensions of 12.48m width x 3.2m height and is shown in **Figure 3** (east facing) and **Figure 4** (west facing) for reference. Both signs operate in both day and night hours.

Site Location

FIGURE 1: SITE CONTEXT – AERIAL PHOTO



Site Location

FIGURE 2: SITE CONTEXT – STREET MAP

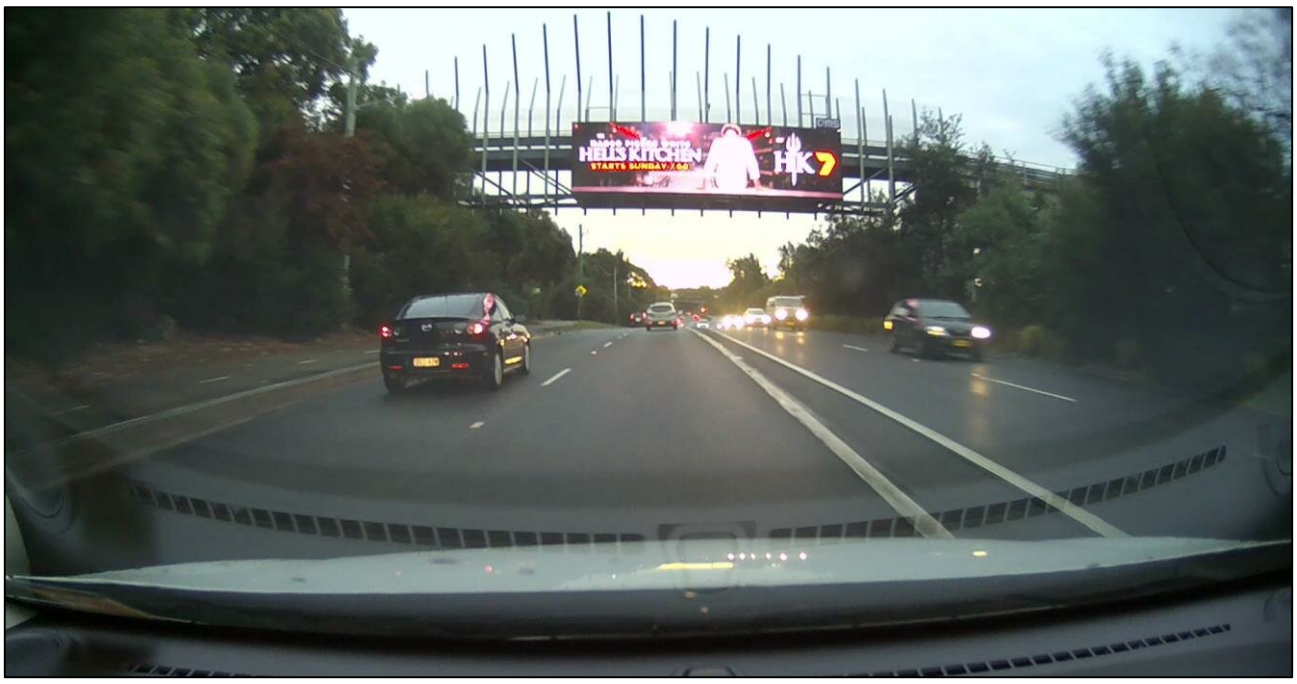


FIGURE 3: EXISTING EAST-FACING SIGNAGE

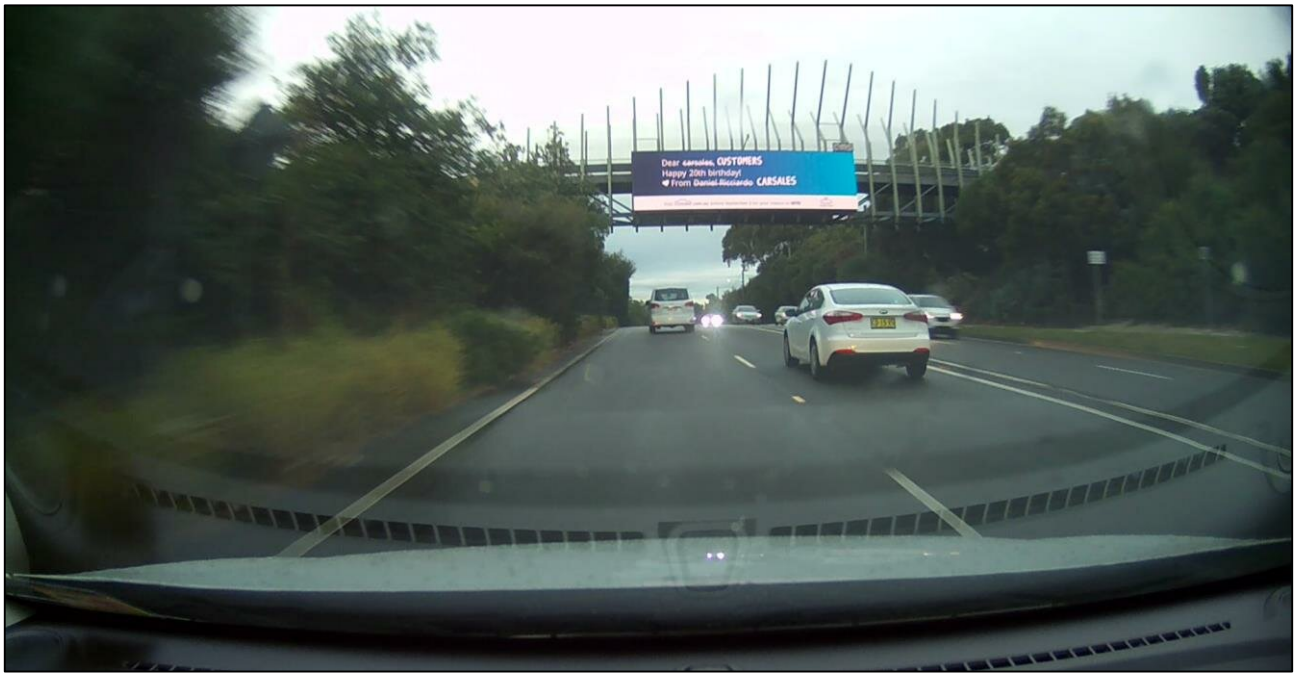
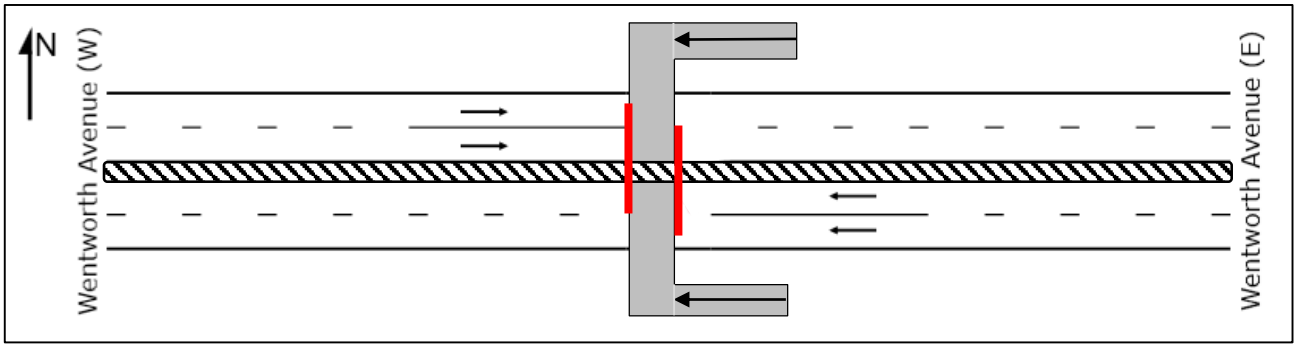


FIGURE 4: EXISTING WEST-FACING SIGNAGE

Currently Wentworth Avenue has a posted speed limit of 70km/h with a carriageway width of approximately 16m facilitating two movement traffic lanes in both directions and a separate shared pedestrian / cycle path of approximately 3m width along the southern side of the road. “Pedestrian Symbolic” signage (Sign Reference R3-1) was noted on both approaches to the overpass, however there is no pedestrian crossing. The Wentworth Avenue Overpass is a pedestrian bridge passing over Wentworth Avenue used by the public, golfers, golf course staff and their equipment from the Eastlake Golf Club.

The overpass and signage layout is shown diagrammatically in **Figure 3**.



Approximate Signage Location

FIGURE 3: WENTWORTH AVENUE LAYOUT

3 ROAD SAFETY AUDIT PROCEDURE

3.1 Brief Description

In general, a Stage 4 Pre-Opening (or 6-week Post-Opening) Road Safety Audit concentrates on the existing road layout including the geometric design, traffic signage, traffic signal sequence, roadside furniture and line marking. This Stage 4 RSA assesses whether any safety hazards arise from the implementation of roadside digital signage.

It should be noted that while it is preferred that a Pre-Opening audit be undertaken to identify any risks prior to the opening of road facilities to the public, in some situations it is not feasible or justified to isolate the road environment to undertake a pre-opening audit. As such, an audit conducted 6-weeks after the date that the signage first became operational is considered to achieve the same objectives without undue risk to road users.

The Audit is to identify a broad range of potential safety hazards with respect to the above road features, identify the impacts to the safety of all road users of signage design features and improve safety of identified risks as a result of the overall audit findings.

The brief for the Stage 4 Pre-Opening (or 6-week Post-Opening) Road Safety Audit is to:

- Identify relevant risks to all road users with respect to the signage;
- Identify potential hazards due to obstruction of driver sight lines, driver distraction, conflict with road signage / controls or vehicle headlight reflection with respect to the signage.
- Identify potential risks with regards to the digital characteristics of the signage;
- Identify potential hazards introduced by roadside furniture including sign supports, poles and other rigid (and non-rigid) street furniture.

Following the subject *Stage 4 Pre-Opening Road Safety (or 6-week Post-Opening) Audit,* an *18-Month Finalisation Road Safety Audit* will be undertaken, which involves the assessment and reporting of the safety impacts of specific design features on the road environment once the signage has been implemented and road users have had time to acclimatise to its presence.

3.2 Site Inspection

The site was inspected during daylight and night hours on Monday 31st August 2017. The purpose of the site inspection is to observe the existing site from the perspective of all road users in order to identify current conditions and possible future impacts of the signage display.

4 SAFETY AUDIT FINDINGS & RECOMMENDATIONS

Section 4.1 documents the general findings of the specialised road safety audit. The audit brief and the CV's of the auditors are presented in **Annexure A** and **Annexure B** respectively.

This audit seeks to identify potential hazards and risks to road users that could arise from signage in the identified location, including identification of impacts of design features including but not limited to signage height, width, angle and colours.

A *Stage 4 Pre-Opening RSA* presents findings based on the placement and operation of the sign. The findings of the report should be taken into consideration by the operator to achieve the best outcome in terms of road safety.

This Road Safety Audit assessment has been undertaken in accordance with the checklists contained in **Annexure B** which is extracted from "*Transport Corridor Outdoor Advertising and Signage Guidelines – November 2015*".

4.1 General Findings

The following sub-sections provide general issues as identified by the Auditing team.

4.1.1 Conflict with Traffic Signals

The placement of the signage is such that it is directly behind the west-facing traffic signals, approximately 300m away, for eastbound vehicles in the median lane at the Wentworth Avenue / Southern Cross Drive off-ramp junction, as shown in **Figure 6** & **Figure 7**.

The signage is well lit and does not appear similar to the traffic signal lights, particularly considering the shape of the sign (long, rectangular). However, the digital signage does emit light (projected rather than reflected as is the case with a static, lit sign). This is particularly well illustrated in **Figure 7**, although it should be noted that the display of the sign appeared blue to the driver rather than almost green as it appears in the image, which distinguished the sign from the traffic signal lamp. Any signage in the subject location (static or digital), *if displaying primarily red, green or amber colours which is strictly contrary to the signage relevant controls and guidelines and should not be displayed*, as it could be mistaken for a traffic signal lamp and cause drivers to fail to stop or brake unexpectedly, raising the risk of "right near" collisions and rear-end collisions respectively.

The design of the sign, in terms of the sign's contents, brightness, refresh time and reflectiveness appear to be consistent with the tabulated criteria contained on pages 22 to 24 of the *Draft 2015 Transport Outdoor Advertising and Signage Guidelines* (refer to **Annexure B** for extract*).* This ensures that the content displayed on the sign is consistent with the aforementioned document such that, the signage does not adversely impact road safety.

FIGURE 6: SIGNAGE FROM WENTWORTH AVE / SOUTHERN CROSS DRIVE JUNCTION – DAYTIME

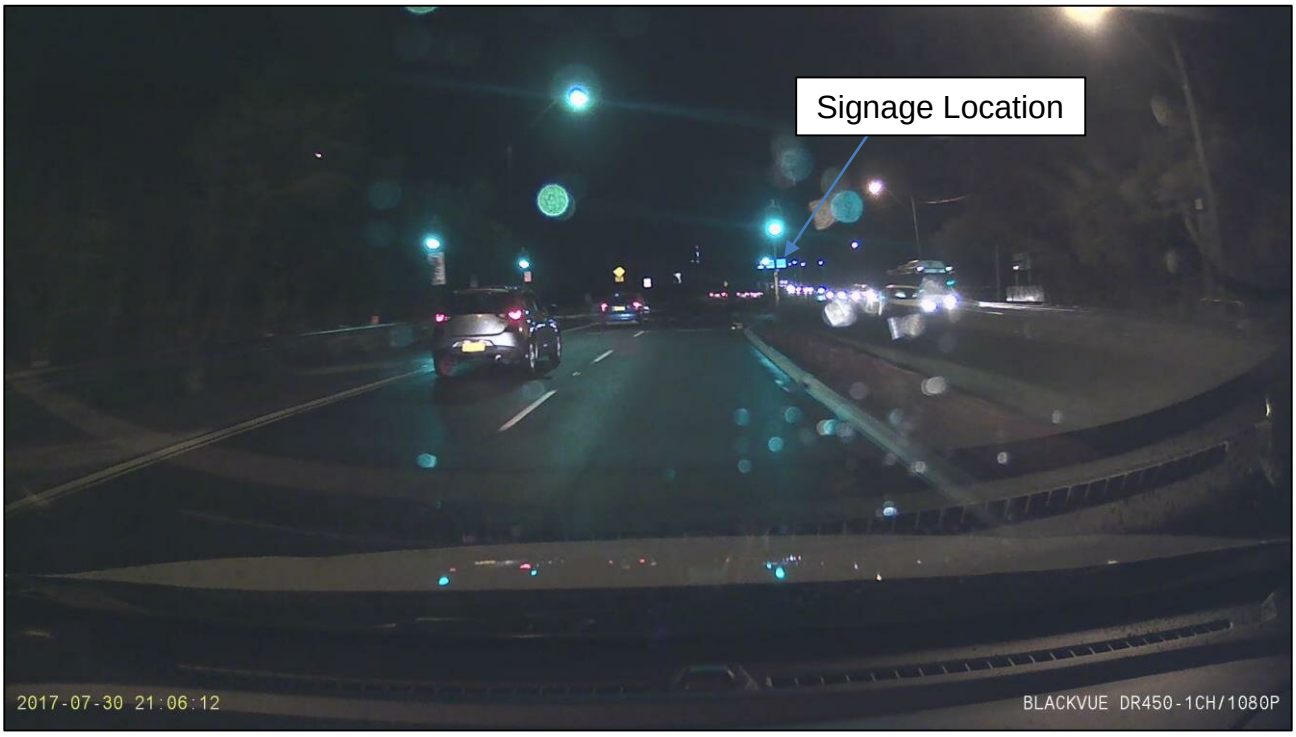


FIGURE 7: SIGNAGE FROM WENTWORTH AVENUE / SOUTHERN CROSS DRIVE JUNCTION – NIGHT TIME

4.1.2 Driver Distraction

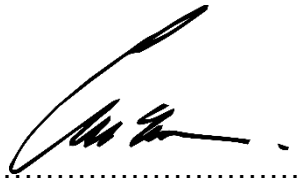
Both the existing east-facing and west-facing signage is lit during night hours but is not of a level of brightness that makes the sign dazzling (too bright) or difficult to read (too dark). The sign is not distracting when transitioning from one image to another, given that the change is instantaneous and the driver of the vehicle during the audit observed that on several occasions the change in image was not noticed immediately. It is considered, therefore, that the sign does not have an unacceptable impact on road safety.

5 CONCLUDING STATEMENT

The brief provided has been examined and the site inspected both during clear daylight and night periods to determine the safety impacts of the subject digital signage.

This road safety audit has found no adverse impact on road safety associated with the subject and operational digital advertising sign. The road safety audit inspection details and findings are contained in **Section 4** of this report.

It should be noted that the road safety audit findings are based upon the independent opinions and judgements of the authors. It should be noted, however, that in the event that potential road safety issues are identified within the audit findings, then it is ultimately the responsibility of the Project Manager to determine how best to respond to identified road safety issues.

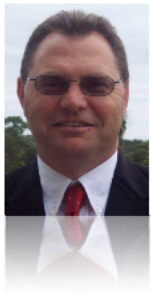


……..
Craig M^{C}Laren
(RMS Accredited Level 3 Road Safety Auditor) 24th August 2017.

……..
Thomas Heal
(RMS Accredited Level 1 Road Safety Auditor) 24th August 2017.

……..
Matthew McCarthy
(RMS Accredited Level 1 Road Safety Auditor) 24th August 2017.

Craig McLaren (Director)



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Curriculum Vitae December 2015

Matthew McCarthy (Traffic Engineer)

Qualifications

Bachelor of Civil Engineering,
University of New South Wales Australia
2013

Masters of Engineering Science (Civil)
Majoring in Transport Engineering
University of New South Wales Australia
2015

RMS Accredited level 1 Road Safety Auditor

Experience

MCLAREN TRAFFIC ENGINEERING
2016 to date

Graduate Traffic Engineer for the preparation and review of traffic impact assessments for a wide range of land uses and scales. Duites also include traffic modelling and analysis, preparation of road safety audits, engaged in traffic and transport planning, and provision of detailed design advice for small and large scale developments as well as liaising with clients and team members on projects.

Skills

- AutoCAD 2016, including vehicle tracking
- Sidra Intersection Modelling 7.0
- Invarian Rapid Plan
- Aimsun

McLaren Traffic Engineering
Shop 7, 716-720 Old Princes Hwy, Sutherland NSW 2232
Ph 61-2-8355-2440

1

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 1 OF 3)

2.5.8 Digital signs

In addition to meeting the relevant SEPP 64 assessment criteria, design, road safety and any public benefit test requirements under the Guidelines, the consent authority must be satisfied that the digital sign meets the following criteria:

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
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(d) Dwell times for image display are: (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.	✓	✓
(e) The transition time between messages must be no longer than 0.1 seconds.	✓	✓
(f) Luminance levels must comply with the requirements in Table 3 below.	✓	✓
(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.	✓	✓
(h) The amount of text and information supplied on a sign should be kept to a minimum (for example no more than a driver can read at a short glance). Text should preferably be displayed in the same font and size. Table 6 in Section 3 of these Guidelines provides further guidance.	✓	✓
(i) Any sign that is within 250 metres of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours.	✓	✓
(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.	✓	✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 2 OF 3)

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
(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 which may result in a change to the dwell time or removal of the sign.	✓	✓
(l) Sign spacing should limit drivers view to a single sign at any given time with a distance of no less than 150 metres 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.		✓
(m) Signs greater than or equal to 20sq metres must obtain RMS concurrence AND must ensure the following minimum vertical clearances; • 2.5m from lowest point of the sign above the road surface if located outside the clear zone. • 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 (e.g. 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.		✓
(n) An electronic log of a signs 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 signs activity in case of a complaint.		✓
(o) A road safety check which focuses on the effects of the placement and operation of all signs over 20sq metres 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. 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.		✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 3 OF 3)

Table 3: LUMINANCE LEVELS FOR DIGITAL ADVERTISEMENTS

LUMINANCE LEVELS – Luminance means the objective brightness of a surface as measured by a photometer, expressed in candelas per square meter (cd/m2). Levels differ as digital signs will appear brighter when light levels in the area are low. Luminance levels should comply with Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting which recommends the following levels:

Lighting Condition	*Zone 1*	*Zones 2 and 3*	*Zone 4*
Full Sun on face of Signage	No limit	Maximum Output	Maximum Output
Day Time Luminance		6000 cd/m2	6000 cd/m2
Morning and Evening Twilight and Inclement Weather		700 cd/m2	500 cd/m2
Night Time		350 cd/m2	
Night Time		350 cd/m2	

Zone 1 covers areas with generally very high off-street ambient lighting e.g. display centres similar to Kings Cross, central city locations

Zone 2 covers areas with generally high off-street ambient lighting e.g. some major shopping/commercial centres with a significant number of off-street illuminated advertising devices and lights.

Zone 3 covers areas with generally medium off-street ambient lighting e.g. small to medium shopping/ commercial centres.

Zone 4 covers areas with generally low levels of off-street ambient lighting e.g. most rural areas, many residential areas.

2.5.9 Moving Signs

Moving or mechanical signs display images which change through movement of the sign structure only, for example, scrolling or trivision signs.

In addition to meeting the relevant SEPP 64 assessment criteria, design, road safety and public benefit test requirements under these Guidelines, moving signs that face the road reserve and are visible to drivers will also be required to meet the following criteria:

(a) The display must be completely static from its first appearance to the commencement of a change to another display;

(b) Dwell times for image display are to be a total of 10 seconds which includes 3 seconds to scroll.

(c) The image must not be capable of being mistaken:

  (i) for a rail or traffic sign or signal 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 traffic signal, or

  (ii) as text providing driving instructions to drivers.

(d) Light levels are to be consistent with Section 3.2.5 and Table 5 of these Guidelines.

2.5.10 Video and animated electronic signs

Video and animated electronic signs containing animated or video/movie style advertising or messages including; live television, satellite, internet or similar broadcast; either permanent or portable; that face the road reserve and are visible to drivers are prohibited.

18-MONTH POST-OPENING ROAD SAFETY AUDIT OF DIGITAL ROAD SIGNAGE AT WENTWORTH AVENUE GOLF COURSE OVERBRIDGE, EASTLAKES

Address: Shop 7, 720 Old Princes Highway Sutherland NSW 2232
Postal: P.O Box 66 Sutherland NSW 1499

Telephone: +61 2 8355 2440
Fax: +61 2 9521 7199
Web: www.mclarentraffic.com.au
Email: admin@mclarentraffic.com.au

Division of RAMTRANS Australia ABN: 45067491678

Transport Planning, Traffic Impact Assessments, Road Safety Audits, Expert Witness

17401.02FA - 24 September 2018

Development Type:	**Proposed Conversion of Existing Roadside Signage to Digital**
Site Address:	**Wentworth Avenue & Wentworth Avenue Overpass, Eastlakes**
Prepared for:	**Outdoor Systems**
Document reference:	**17401.02FA**

Status	Issue	Prepared By	Checked By	Date
Draft	**A**	**ME**	**TH**	**24 September 2018**
Final	**A**	**TH**		**24 September 2018**

TABLE OF CONTENTS

1 PROJECT OVERVIEW

1.1 Inception

Project	Digital Road Signage at Wentworth Avenue Golf Course Overbridge, Eastlakes
Audit Reference	17401.02DA
Audit Stage	18-Month Post-Opening
Client	Outdoor Systems
Project Manager	Outdoor Systems
Audit Team	• Lead Auditor Mr Craig M^{C}Laren (Level 3) Road Safety Auditor ID: 02-0263 • Team Member Mr Thomas Heal (Level 1) Road Safety Auditor ID: 02-1075
Initial Meeting	N/a
Any previous audit conducted	No

1.2 Reference Materials

The 18-month post-opening Road Safety Audit of the signage has been undertaken with due consideration to the following documents:

1. *"Road Safety Audit", AUSTROADS Publication No. AP-30/94, SAA HB43-1994.*
2. *"Road Safety Audit", AUSTROADS Publication No. AP-G30/02, SAI/NZS HB43-2001.*
3. *Guide to Road Safety Part 6: Road Safety Audit AUSTROADS Publication No. AGRS06/09*
4. *NSW Transport Roads & Traffic Authority Guidelines for Road Safety Audit Practices July 2011*
5. *State Environmental Planning Policy No 64--Advertising And Signage February 2014*
6. *Transport Corridor Outdoor Advertising and Signage Guidelines Department of Planning and Environment November 2017*
7. *Impact of Roadside Advertising on Road Safety, AUSTROADS Publication AP-R420-13, January 2013*

2 INTRODUCTION

2.1 Description

Mr Craig M^{C}Laren, an accredited Level 3 Road Safety Auditor with *M^{C}Laren Traffic Engineering,* was commissioned in June 2017 by Outdoor Systems to undertake an 18-Month Post-Opening Road Safety Audit of the Digital Road Signage at Wentworth Avenue Golf Course Overbridge, Eastlakes. This road safety audit has been completed subsequent to a 6-week post-opening audit which was undertaken by *M^{C}Laren Traffic Engineering*, report reference *17401.01FA* dated 24 August 2017.

The signage is positioned on both the east and west facing sides of the existing Wentworth Avenue Golf Course Overbridge, visible to eastbound and westbound traffic streams travelling on Wentworth Avenue. No other alterations to the road environment will be examined as part of this Audit.

2.2 Purpose

The brief for the 18-Month Post-Opening Road Safety Audit is to:

- Identify relevant risks to all road users with respect to the signage;
- Identify potential hazards due to obstruction of driver sight lines, driver distraction, conflict with road signage / controls or vehicle headlight reflection with respect to the signage.
- Identify potential risks with regards to the digital characteristics of the signage;
- Identify potential hazards introduced by roadside furniture including sign supports, poles and other rigid (and non-rigid) street furniture.

This 18-month audit was undertaken after a 6-week audit, to ensure continued safety of road operations in the area due to the installation of the digital signage on both sides of the overhead bridge along Wentworth Avenue, Eastlakes.

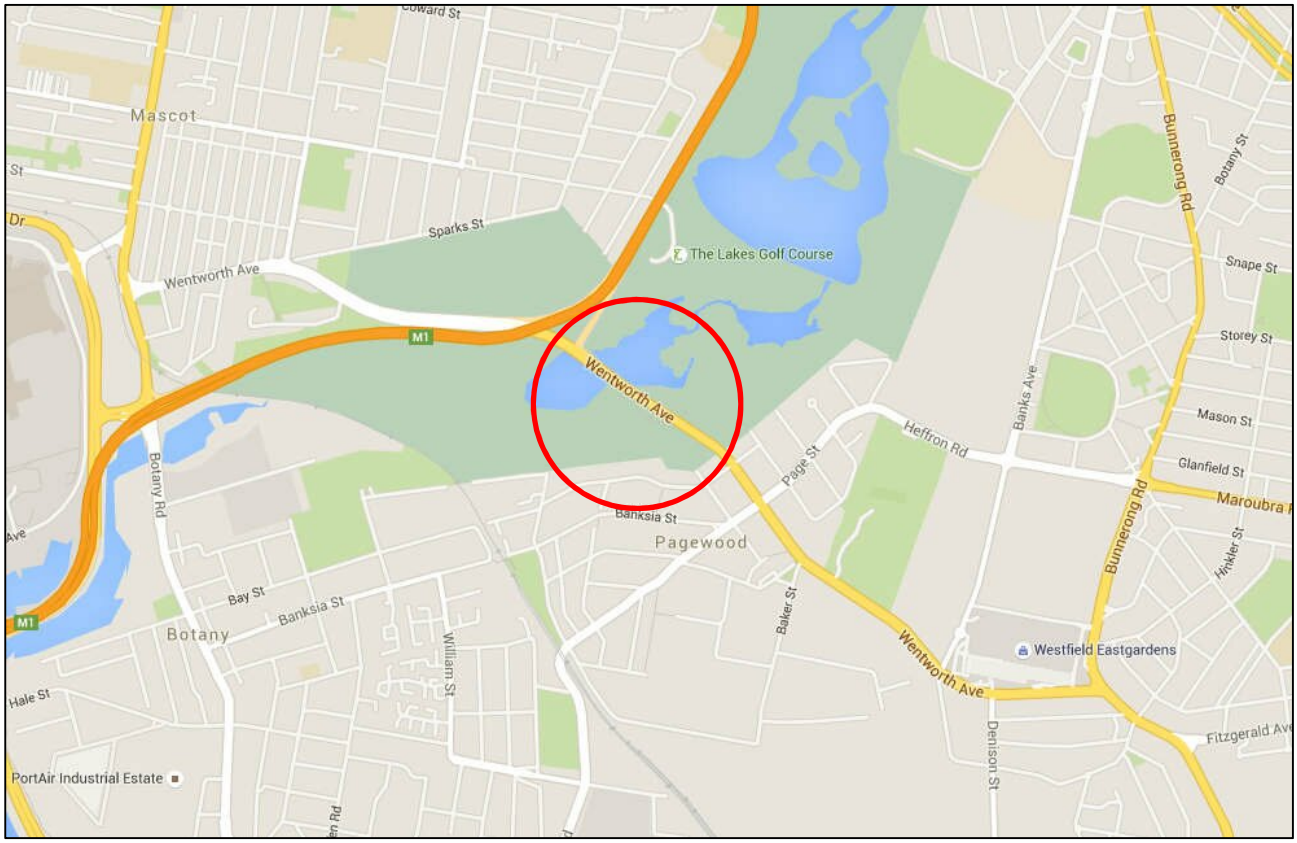
2.3 Existing Site Location & Facilities

The road safety audit examines the digital signage on the overhead bridge located 450m to the east of the Southern Cross Drive overpass intersection on Wentworth Avenue, Eastlakes. The general area covered under this audit is shown in **Figure 1** and **Figure 2** below, whereby the extent of works depicted in these figures is for illustrative purposes only and does not reflect the actual limit of the Audit.

The digital signage on the overpass has a dwell time of 10 seconds and has physical dimensions of 12.48m width x 3.2m height and is shown in **Figure 3** (east facing) and **Figure 4** (west facing) for reference. Both signs operate in both day and night hours.

Site Location

FIGURE 1: SITE CONTEXT – AERIAL PHOTO



Site Location

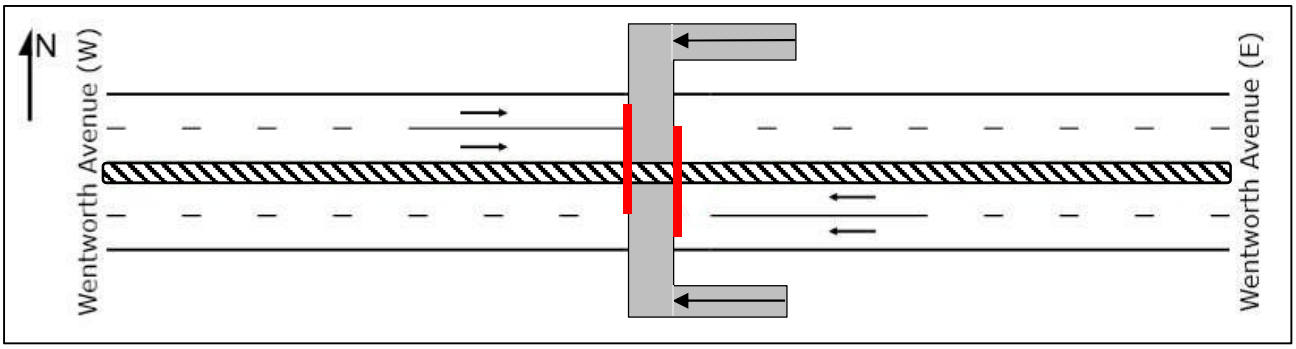
FIGURE 2: SITE CONTEXT – STREET MAP

FIGURE 3: EXISTING EAST-FACING SIGNAGE

FIGURE 4: EXISTING WEST-FACING SIGNAGE

Currently Wentworth Avenue has a posted speed limit of 70km/h with a carriageway width of approximately 16m facilitating two movement traffic lanes in both directions and a separate shared pedestrian / cycle path of approximately 3m width along the southern side of the road. “Pedestrian Symbolic” signage (Sign Reference R3-1) was noted on both approaches to the overpass, however there is no pedestrian crossing. The Wentworth Avenue Overpass is a pedestrian bridge passing over Wentworth Avenue used by the public, golfers, golf course staff and their equipment from the Eastlake Golf Club.

The overpass and signage layout is shown diagrammatically in **Figure 3**.



Approximate Signage Location

FIGURE 3: WENTWORTH AVENUE LAYOUT

3 ROAD SAFETY AUDIT PROCEDURE

3.1 Brief Description

In general, a Stage 6 Existing Road (or 18-month Post-Opening) Road Safety Audit concentrates on the existing road layout including the geometric design, traffic signage, traffic signal sequence, roadside furniture and line marking. This Stage 6 RSA assesses whether any safety hazards arise from the implementation of roadside digital signage.

The Audit is to identify a broad range of potential safety hazards with respect to the above road features, identify the impacts to the safety of all road users of signage design features and improve safety of identified risks as a result of the overall audit findings.

The brief for the Stage 6 Existing Road (or 18-month Post-Opening) Road Safety Audit is to:

- Identify relevant risks to all road users with respect to the signage;
- Identify potential hazards due to obstruction of driver sight lines, driver distraction, conflict with road signage / controls or vehicle headlight reflection with respect to the signage.
- Identify potential risks with regards to the digital characteristics of the signage;
- Identify potential hazards introduced by roadside furniture including sign supports, poles and other rigid (and non-rigid) street furniture.

3.2 Site Inspection

The site was inspected during daylight and night hours on Monday 31st August 2017 for the 6-week post-opening audit and on Thursday 13th September 2018 to inform this 18-month post-opening audit. The purpose of the site inspection is to observe the existing site from the perspective of all road users in order to identify current conditions and possible future impacts of the signage display.

4 SAFETY AUDIT FINDINGS & RECOMMENDATIONS

Section 4.1 documents the general findings of the specialised road safety audit. The audit brief and the CV's of the auditors are presented in **Annexure A** and **Annexure B** respectively.

This audit seeks to identify potential hazards and risks to road users that could arise from signage in the identified location, including identification of impacts of design features including but not limited to signage height, width, angle and colours.

A *Stage 6 Existing Road RSA* presents findings based on the placement and operation of the sign. The findings of the report should be taken into consideration by the operator to achieve the best outcome in terms of road safety.

This Road Safety Audit assessment has been undertaken in accordance with the checklists contained in **Annexure B** which is extracted from *"Transport Corridor Outdoor Advertising and Signage Guidelines Department of Planning and Environment November 2017"*.

4.1 General Findings

The following sub-sections provide general issues as identified by the Auditing team.

4.1.1 Conflict with Traffic Signals

The placement of the signage is such that it is directly behind the west-facing traffic signals, approximately 300m away, for eastbound vehicles in the median lane at the Wentworth Avenue / Southern Cross Drive off-ramp junction, as shown in **Figure 6** & **Figure 7**.

The signage is well lit and does not appear similar to the traffic signal lights, particularly considering the shape of the sign (long, rectangular). However, the digital signage does emit light (projected rather than reflected as is the case with a static, lit sign). This is particularly well illustrated in **Figure 7**. Any signage in the subject location (static or digital), *if displaying primarily red, green or amber colours which is strictly contrary to the signage relevant controls and guidelines and should not be displayed*, as it could be mistaken for a traffic signal lamp and cause drivers to fail to stop or brake unexpectedly, raising the risk of "right near" collisions and rear-end collisions respectively.

The design of the sign, in terms of the sign's contents, brightness, refresh time and reflectiveness appear to be consistent with the tabulated criteria contained on pages 22 to 24 of the *Draft 2015 Transport Outdoor Advertising and Signage Guidelines* (refer to **Annexure B** for extract*).* This ensures that the content displayed on the sign is consistent with the aforementioned document such that the signage does not adversely impact road safety.

FIGURE 6: SIGNAGE FROM WENTWORTH AVE / SOUTHERN CROSS DRIVE JUNCTION – DAYTIME

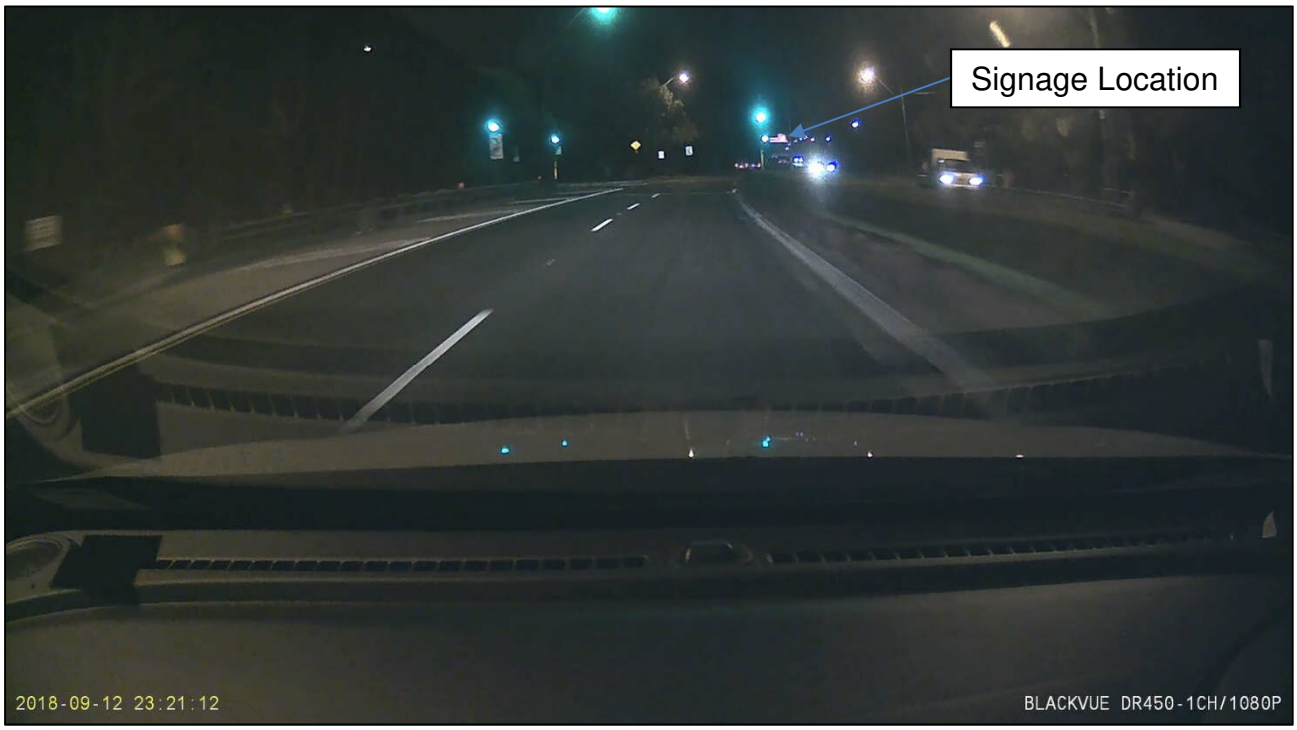


FIGURE 7: SIGNAGE FROM WENTWORTH AVENUE / SOUTHERN CROSS DRIVE JUNCTION – NIGHT TIME

4.1.2 Driver Distraction

Both the existing east-facing and west-facing signage is lit during night hours but is not of a level of brightness that makes the sign dazzling (too bright) or difficult to read (too dark). The sign is not distracting when transitioning from one image to another, given that the change is instantaneous and the driver of the vehicle during the audit observed that on several occasions the change in image was not noticed immediately. It is considered, therefore, that the sign does not have an unacceptable impact on road safety.

4.1.3 Signage Defect

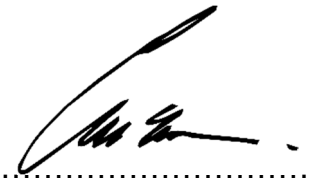
It was noticed at the time of the 18-month inspection that a portion of the west-facing sign in the top left corner was inoperable and was completely blacked out. This sign outage did not cause any road safety issues and if the sign was operating as expected (i.e. fully illuminated) no road safety issues would result.

5 CONCLUDING STATEMENT

The brief provided has been examined and the site inspected both during clear daylight and night periods to determine the safety impacts of the subject digital signage.

This road safety audit has found no adverse impact on road safety associated with the subject and operational digital advertising sign. The road safety audit inspection details and findings are contained in **Section 4** of this report.

It should be noted that the road safety audit findings are based upon the independent opinions and judgements of the authors. It should be noted, however, that in the event that potential road safety issues are identified within the audit findings, then it is ultimately the responsibility of the Project Manager to determine how best to respond to identified road safety issues.

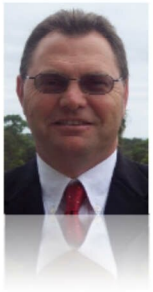


……..
Craig McLaren
(RMS Accredited Level 3 Road Safety Auditor) 24 September 2018.

……..
Thomas Steal
(RMS Accredited Level 1 Road Safety Auditor) 24 September 2018.

ANNEXURE A: CIRRICULUM VITAE
(SHEET 1 OF 2)

Craig McLaren (Director)



Craig is an acknowledged traffic consultant since the company inception in 1995. The company's primary function has been to serve both the public and private sectors focusing on traffic impact assessments, transport planning, special event transport planning, local area traffic management, road safety and expert evidence at Land and Environment Court, Supreme Court and the Commission of Inquiry.

Qualifications

Bachelor of Civil Engineering, UNSW, 1985

Graduate Diploma in Traffic Engineering, University of New South Wales, 1991

Accredited Level 3 Road Safety Auditor, 1998

Traffic Control Plan Certifier (Orange Card), 2012

Affiliations:

Member, Australian Institute of Traffic Planning and Management - AITPM

Member, Institute of Transportation Engineers USA (Australian Branch) – ITE

Experience:

MCLAREN TRAFFIC ENGINEERING

1995 to date:

Director and experienced traffic engineer responsible for the conduct of all facets of traffic impact assessment ranging from report preparation, design advice and giving evidence at the Land and Environment Court.

SINCLAIR KNIGHT MERZ

1994 to 1995:

Executive Traffic Engineer. Responsible for the conduct of all facets of traffic impact assessment ranging from report preparation, design advice and giving evidence at the Land and Environment Court.

TRANSPORTATION PLANNING WORKSHOP

1989 to 1994:

Senior Associate. Responsible for the conduct of a vast number of traffic impact assessment report and gained invaluable experience in giving expert evidence before the Land and Environment Court.

ROADS AND TRAFFIC AUTHORITY, NSW

1988 to 1989:

Traffic Engineer, Traffic Engineering Section, involved in traffic/transport research, policy development and assisting councils in the application of the Authority's guidelines.

OVE ARUP TRANSPORTATION PLANNING

1985 to 1988:

Traffic Engineer. Involved in the preparation of traffic impact reports for a wide range of projects.

GUTTERIDGE HASKINS & DAVEY

1980 to 1982:

Trainee Civil Engineer. Involved in assisting with road and subdivision design and field surveying.

Papers at Conferences

"Safe & Liveable Communities, Can You Have Both?" Georgia Institute of Transportation Engineers, St Simons Island, Georgia USA July 1999.

Thomas Steal (Senior Traffic Engineer)

Experienced traffic engineer with extensive experience in consulting with the public and private sectors on matters of transport planning, construction traffic management, traffic impact assessment, road & car park design and road safety auditing.

Appears regularly to represent applicants at Joint Regional Planning Panel and Planning Assessment Commission Meetings to provide expert comments on the traffic, parking and safety impacts of developments.

Has appeared on numerous occasions as an Expert Witness before the Land and Environment Court, representing both Councils and Developers on a range of development types.

Qualifications

Bachelor of Civil Engineering, University of Sydney, 2015

IPWEA Accredited Level 1 Road Safety Auditor, 2015

RMS Accredited Work Zone Traffic Management Plan Designer and Inspector

Experience:

McLAREN TRAFFIC ENGINEERING

2015 to date, roles including:

- Road Safety Auditing
- Construction Traffic Management Plans
- Traffic Impact Assessment
- Concept Road and Parking Design
- Expert Witness
- SIDRA and Aimsun Modelling
- Development of Traffic Engineering Methodology
- Transport Planning
- Expert Advice at Public Meetings

Significant Projects and Matters:

Woolooware Bay Town Centre incl. ~800 Residential Units and Shopping Centre;

Rezoning for up to 3500 Residental Lots in Wallalong;

New Public School in Cecil Park for 630 children;

New Private Hospital in Terrey Hills;

Conservatorium and Planetarium in Orange;

Road Safety Audits of Digital Signage throughout the Ryde Local Government Area;

Various Audits of Roads, Intersections and Bicycle Paths in Bega Shire

Aged Care Development in Sans Souci (provided evidence for Hearing);

Proposed Expansion of Church in Cecil Park (provided evidence for Hearing)

Curriculum Vitae August 2018

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 1 OF 3)

2.5.8 Digital signs

In addition to meeting the relevant SEPP 64 assessment criteria, design, road safety and any public benefit test requirements under the Guidelines, the consent authority must be satisfied that the digital sign meets the following criteria:

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
(a) Each advertisement must be displayed in a completely static manner, without any motion, for the approved dwell time as per criterion (d) below.	✓	✓
(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.	✓	✓
(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, or (ii) as text providing driving instructions to drivers.	✓	✓
(d) Dwell times for image display are: (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.	✓	✓
(e) The transition time between messages must be no longer than 0.1 seconds.	✓	✓
(f) Luminance levels must comply with the requirements in Table 3 below.	✓	✓
(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.	✓	✓
(h) The amount of text and information supplied on a sign should be kept to a minimum (for example no more than a driver can read at a short glance). Text should preferably be displayed in the same font and size. Table 6 in Section 3 of these Guidelines provides further guidance.	✓	✓
(i) Any sign that is within 250 metres of a classified road and is visible from a school zone must be switched to a fixed display during school zone hours.	✓	✓
(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.	✓	✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 2 OF 3)

Criteria	Applies to signs less than 20sq metres	Applies to signs greater than or equal to 20sq metres
(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 which may result in a change to the dwell time or removal of the sign.	✓	✓
(l) Sign spacing should limit drivers view to a single sign at any given time with a distance of no less than 150 metres 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.		✓
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(n) An electronic log of a signs 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 signs activity in case of a complaint.		✓
(o) A road safety check which focuses on the effects of the placement and operation of all signs over 20sq metres 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. 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.		✓

ANNEXURE B: DIGITAL SIGN CRITERIA
(SHEET 3 OF 3)

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LUMINANCE LEVELS – Luminance means the objective brightness of a surface as measured by a photometer, expressed in candelas per square meter (cd/m2). Levels differ as digital signs will appear brighter when light levels in the area are low. Luminance levels should comply with Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting which recommends the following levels:

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  (ii) as text providing driving instructions to drivers.

(d) Light levels are to be consistent with Section 3.2.5 and Table 5 of these Guidelines.

2.5.10 Video and animated electronic signs

Video and animated electronic signs containing animated or video/movie style advertising or messages including; live television, satellite, internet or similar broadcast; either permanent or portable; that face the road reserve and are visible to drivers are prohibited.

APPENDIX C –DIGITAL SIGN RESEARCH

Impacts of Digital Billboards on Driver Behaviour

Evidence and Research

Introduction

There is an overarching assumption that billboards at the roadside should, by their very nature, be distracting as they are designed to get the attention of those passing by (Roberts, Boddington and Rodwell 2013, 10). This assumption has driven much of the state and federal legislation and regulation regarding Out of Home (OOH) advertising at the roadside.

This paper demonstrates that although thought on this matter can be divergent, in-field, real world studies show that the supposed distraction provided by OOH advertising does not eventuate.

About OOH Advertising and the OMA

OMA members advertise third party products on digital and traditional signs across a variety of OOH formats and locations, including airports; buses; bus, train and tram stations; office buildings and lifts; pedestrian bridges; shopping centres; taxis; trains; trams and street furniture.

OMA members make significant economic contributions to government and the community, contributing close to $647 million to Australia's GDP and supporting approximately 4,500 jobs. Most OMA members are Australian owned and operated, with profits going back to the Australian economy. The industry also provides a revenue stream to government and private landholders alike, returning 50% of revenue in rent and taxes.

In 2019, OMA members donated $87 million in media services and advertising placement to over 230 community groups and charities.

The industry also delivers essential services and savings. The OOH advertising industry built and, now cleans and maintains $352 million of public infrastructure across Australia. The over 17,000 pieces of public infrastructure delivered by the OOH advertising industry make our cities more user-friendly. The industry also invests in innovation and provides digital utility such as Wi-Fi and wayfinding services.

Types of roadside OOH

Billboards

OOH advertising is varied; however, the most obvious example of roadside advertising is the billboard.

Typically, billboards are either attached to another structure like a building or are free standing. They come in many sizes with the most common being $18m^2$ or $42.41m^2$. Billboards also fall into two main display types – static or digital. Static billboards are poster like and semi-permanently affixed to the billboard structure requiring manpower to manually erect advertisements. Digital billboards are made of LED screens which display content digitally. Digital billboards can display multiple different pieces of content and can be updated remotely.

Other types of roadside advertising

Roadside advertising consists of more than just billboards with bus and tram shelters, pay phones and kiosks.

On premise advertising

On premise advertising are any signs that are attached to a business premises for the specific purpose of advertising that business or its products. It includes in store/window posters, A frame signs, awning signage and business signage. On premise advertising is not considered OOH as it is generally treated differently in legislation.

What is distracted driving?

Regan et al note in their taxonomy of driver distraction that "there is increasing evidence that driver distraction and driver inattention are major contributing factors in car and truck crashes and incidents" (Regan, Hallett and Gordon 2011, 1771). However, what research about roadside advertising attempts to uncover is whether billboards are, in fact, distracting.

Noting that distraction is just a form of driver inattention (Regan, Hallett and Gordon 2011, 1780), the taxonomy notes that driver distraction is "the diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving" (Regan, Hallett and Gordon 2011, 1776). This is important to note because the research outlined in this paper suggests that activities that are required for safe operation of the vehicle take precedent over other activities like looking at billboards for any period of time that is significant.

To determine how distracting a behaviour is, studies tend to use the amount of time something is looked at, known as a fixation. Many studies have sought to determine how long a fixation is required to be to be distracting however the work of Klauer is most often quoted. In that research, it was found that "total eyes-off-road durations of greater than 2 seconds significantly increased individual near-crash/crash risk whereas eyeglance durations less than
2 seconds did not significantly increase risk relative to normal, baseline driving" (Klauer, et al. 2006, xi).

Driver attention around billboards

The key question asked in the research is whether any advertising at the roadside is distracting to drivers.

In this regard, there is a significant divergence of academic thought. For example, where one study found that "high levels of visual and cognitive demand can result in a greater level of lane deviation and shorter headways" (Samsa 2015, 2) others found only minor differences in speed and lane deviation (Samsa 2015, 2). Some studies, in fact, did not find any significant changes in regards to speed, lateral placement of the vehicle or headway at any stage when drivers were passing digital billboards on a motorway (Samsa 2015, 2).

A 2011 study in the US initially made the proposition that the presence of OOH advertising at the roadside "distracted eye movements from the road ahead and delayed responses to road signs" (Edquist, et al. 2011, 624). However, this makes a large assumption about the impact of short glances and, as noted above, glance duration is an important factor in determining how distracting something might be.

Further, research demonstrates that mental load is also an important factor in considering whether something is distracting or not. In a large study by the US Federal Highway Administration (FHA) it was noted that "gaze allocation is principally controlled by the requirements of the task" (W. A. Perez, M. Bertola, et al. 2012, 55).

In that study, conducted in field, it was found that drivers gazed away from the forward roadway, even when there weren't billboards present (W. A. Perez, M. Bertola, et al. 2012, 54). Ultimately, that study found that there were no fixations of more than 2 seconds were observed for either digital or static billboards (Ibid).

This means that drivers self-regulate their attention depending on the cognitive load required, prioritising driving and safety tasks over outside distractions.

This was confirmed in a 2015 study by Monash University which found that "current driving demands appeared to be influencing whether and how much attention drivers paid to the billboards, rather than the billboards influencing driver behaviour" (Stephens, et al. 2015, viii).

In the Edquist study, where assumptions were made about the power of roadside advertising to distract, the authors themselves noted that their simulation involved a low cognitive load and driving environment "in which drivers were able to devote their attention to the forward roadway 56% of the time" (Edquist, et al. 2011, 625). This was compared to the Klauer study where participants were only able to devote their attention to the forward roadway 47% of the time (Edquist, et al. 2011, 625). The Edquist study concludes that "this may have lessened the effects of the billboards in distracting attention from the forward roadway" (Edquist, et al. 2011, 625).

This was also demonstrated in a study where drivers were asked to recall billboards, they had seen during an in field study. It was found that there was stronger recall for any particular billboard when the driving demand was low (Young, et al. 2015, 9). The researchers concluded that this confirmed "a form of driver self-regulation, whereby drivers are capable of adapting their visual and cognitive attention in relation to billboards, paying more attention to them when driving is less demanding and paying less attention when demand increases" (Young, et al. 2015, 9).

Is digital more distracting than static?

According to the 2012 FHA study, drivers were more likely to glance at digital billboards for a slightly longer time than static billboards (average 0.335) (W. A. Perez, M. Bertola, et al. 2012, 54). However, it concluded that there was no "evidence indicating that (digital billboards) are associated with long glances away from the road that may reflect an increase in risk" (W. A. Perez, M. Bertola, et al. 2012, 54).

This can be seen evidenced in a crash data study comparing crash data before and after a billboard was converted to digital. This study found that the difference in crash data before and after the conversion was not statistically significant (Tantala and Tantala 2010, 40). The same report shows that the total number of accidents is approximately equivalent to what would have been expected with or without the introduction of the digital billboard (Tantala and Tantala 2010, 40) meaning that the conversion to digital had no impact on the crash rates.

This study also concluded that there was no difference in crash data for a billboard with a 6 second dwell time versus a billboard with an 8-10 second dwell time (Tantala and Tantala 2010, 24).

These results have been replicated in a number of Australian studies such as two Monash University studies conducted in 2015 where one concluded that there was not any difference in the impact of

digital and static billboards (Stephens, et al. 2015, viii) and the other found that there was no difference in steering variation (Young, et al. 2015, 6), variability of speed and the mean and variation of braking (Young, et al. 2015, 5) in the presence of billboards.

The OMA's research

Because the research in this area is so varied, many of which were and because the real world implications of simulator studies are not always clear, the OMA has commissioned several pieces of research.

First a 2014 study by eyetracker found that while digital signage attracted more fixations than static signage, there was no difference in duration of these fixations and all fixations were under 2 seconds. (Vu, Zhang and Brawn 2014, 5). As noted previously, this is the generally agreed amount of time fixations are required to be before they are considered distracting.

Equally that study found that there were far more fixations on traffic and on-premise signs than on roadside advertising signage (Vu, Zhang and Brawn 2014, 45).

Next, Carolyn Samsa was commissioned to study driver's visual behaviour in both on road and simulated environments concluding that the presence of billboards do not "significantly affect the percentage of time drivers devoted to glancing at the forward roadway" (Samsa 2015, 2).

Ultimately, that research found that digital billboards, were not more distracting than other types of signage and that "digital billboards do not draw drivers' attention away from the road for dangerously long periods of time" (Samsa 2015, 10). It also concluded that drivers maintained safe average headway in the presence of digital billboards (Samsa 2015, 10).

Although it was noted that there was some lane deviation observed, Samsa concluded that there was no currently accepted definition as to how much lateral deviation is considered dangerous and could lead to lane departures (Samsa 2015, 7).

Finally, the OMA worked with the Australian Road Research Board to observe driver behaviour in the presence of a digital billboard when that billboard was both on and off and at various dwell times. That study found that at all dwell times "vehicle lateral control performance either improved or was unaffected by the digital billboards presence" (Goodsell and Roberts 2018, 19). The research also found similar results for stopping over the line where this performance indicator improved at all but one dwell time (Goodsell and Roberts 2018, 19).

Future research options

The OMA is committed to further research in the area of road safety in the presence of OOH advertising. The OMA is currently working with state governments around Australia on cooperative research into crash and driver performance around digital signage.

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"see through your customers' eyes"

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Eyetracker Report:

Outdoor Media Association: Driver Attention Study

OMA: Driver Attention Study

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February 2014

OUTDOOR MEDIA ASSOCIATION

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Report Overview

1. Key Findings
2. Background and Objectives
3. Methodology
4. Detailed Results:
    - Viewing Behaviour
    - Driver Performance
5. Qualitative Assessment of Effective Signage
6. References
7. Appendix - Additional Results

Key Findings

- There are mixed findings when comparing 3rd party to on-premise signage for both viewing behaviour and driver performance:
  - Significant differences were found between 3rd party and on-premise signage for some measures of viewing behaviour and driver performance. While some of these results suggest an adverse impact on driver behaviour, the practical significance of these small effects remain to be interpreted in the context of driver safety.
  - Analysis of 3rd party signage showed that there were no differences in viewing behaviour and driver performance between digital and static signage.
- Fixation analysis revealed that, on average, digital signage attracted more fixations than static signage. However, there was no difference in the duration of these fixations between these two types of signage. All fixations on digital signage observed in this study were under 2000ms.
- An encouraging finding for out-of-home media effectiveness is that a significant proportion of fixations were found to be under 200ms (approximately 50% of all fixations), 'hits' which are currently being excluded within MOVE.

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1. Background and Objectives

Background – Existing Driver Attention Research

Research on the impact of advertising signs on driver attention is inconclusive. There are methodological issues with a large number of available research papers e.g. they are mostly laboratory or simulator-based. Until recently, eye tracking technology constraints have meant that conducting live or on-road studies was not possible.

Background – Research Into Digital Advertising

In addition, there has been a lack of research into the effects of digital advertising signage specifically. Regulation against digital advertising has been based on the argument that the dynamic nature of digital advertising is more likely to distract drivers by capturing their attention (e.g. due to motion and abrupt visual onsets).

It has also been argued that digital advertising signage is likely to attract longer fixations (where a person's eye movement pauses on a specific place or object) resulting in a driver's attention being 'off-road'.

Research Objectives

Project Aim:

- Explore the relationship between drivers' viewing behaviour towards outdoor advertising signs and their subsequent driving performance, in a live, real world environment.

Research Questions:

- Does viewing behaviour and driver performance differ significantly in the presence of 3rd party compared to on-premise signage?
- Does viewing behaviour and driver performance differ significantly in the presence of digital compared to static signage?

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2. Methodology

Participant Recruitment Criteria

- A total of 29 participants were included in the study.
- There was a roughly equal split between male and female.
- Participants were aged 25-54 years and held a valid Queensland driving license. They each had a minimum of five years driving experience.
- Participants had normal or corrected to normal eyesight.
- Participants were naïve as to the purpose of the study.
- Participants were unfamiliar with the chosen route. This was defined as “live outside the area by more than 10km, never driven route or have not driven route in the last 6 months”.
- Participants were pre-recruited via a screener for the above characteristics and paid an incentive for taking part in a 2 hour session.

Session Format

- Participants were met at the Zillmere IAG car park and given instructions regarding the session requirements. Participants were given the opportunity to withdraw from the study at any time.
- Participants were fitted with the eye tracking glasses and an individual calibration procedure was conducted to ensure accurate Point of Gaze (POG) recording.
- Following the instructions and calibration procedure, participants were required to drive a practice route of the Zillmere area. This 20 minute practice drive allowed participants to get used to wearing the eye tracking glasses and become familiar with driving the test vehicle.
- A facilitator was present in the front passenger seat of the vehicle to provide instructions and route guidance where required. A technician was also present in the rear passenger seat to supervise the use of the eye tracker.
- Following the practice drive, participants drove the test route. The entire drive took approximately 90 minutes, depending on traffic.
- Finally, participants completed a 10 minute survey to record their demographic information.

Technology – ASL Mobile Eye XG

We used mobile eye tracking technology to capture natural viewing behaviour while driving.

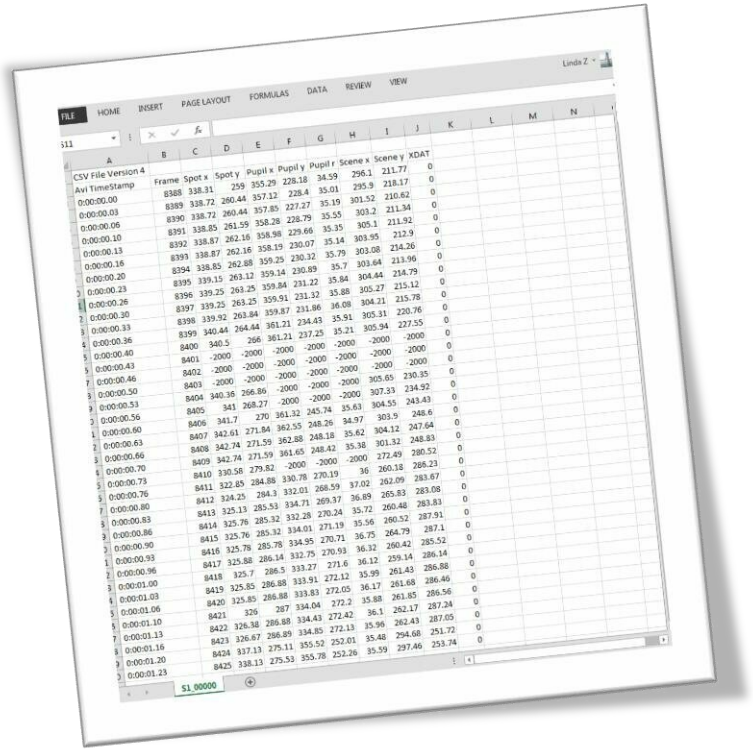
The benefits of using the Mobile Eye XG include:

- High definition recording
- Lightweight & portable
- Wireless transmission
- Unobstructed peripheral vision
- Works in outdoor lighting conditions
- Shatterproof safety frames
- Samples at 30hz

Technology – ASL Mobile Eye XG

The outputs from the Mobile Eye XG eye tracker include a video with the participant's point of gaze (POG) cross-hair and a corresponding data file. These outputs were generated for each participant and analysed offline.

*Sample compressed eye tracking video footage**



Sample data file

*Video download link: https://www.dropbox.com/s/3mzb2eau0x3l0v8/S3%20Sample%20Output.avi

Technology – The Instrumented Vehicle

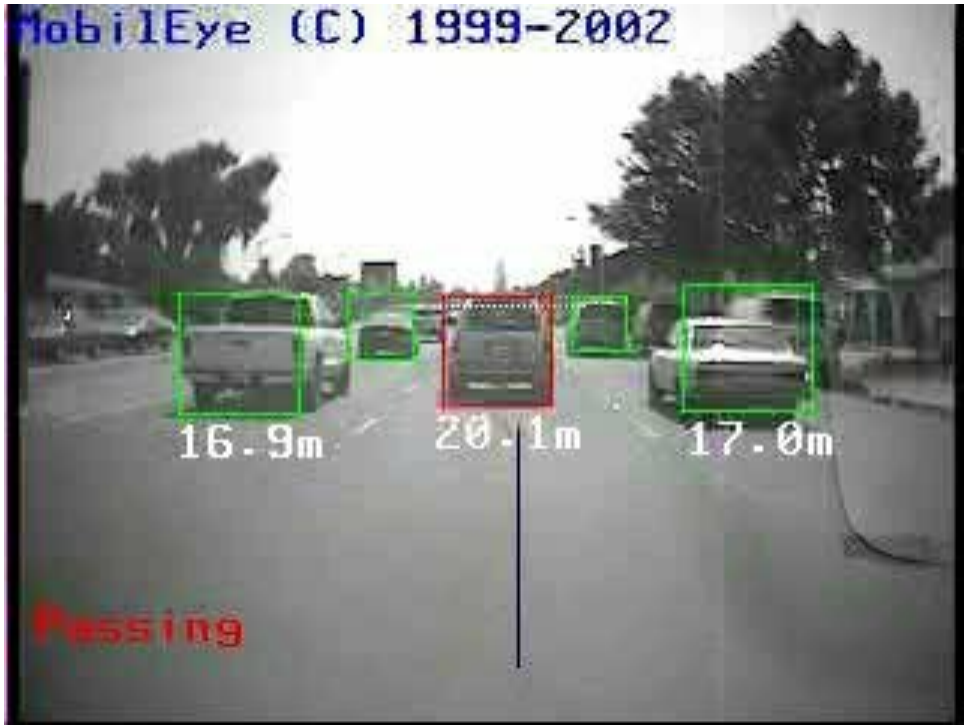
A white 2010 Toyota Corolla sedan with automatic transmission was used as the test vehicle. The vehicle was fitted with the Mobileye collision warning technology and the RaceLogic VBOX performance measurement system.

Cameras were included in the wing mirror to record lane position and behind the rear view mirror to record vehicle headway. A roof-mounted sensor provided GPS location information.

The data from the different technologies was integrated and recorded within the VBOX system that was installed within the passenger glove compartment.

Technology – Mobileye Technology

The Mobileye collision warning system detects lane (lateral deviation) position and vehicle headway. The system was customised so that the raw data was recorded and subsequently synchronised with the eye tracking and GPS data.



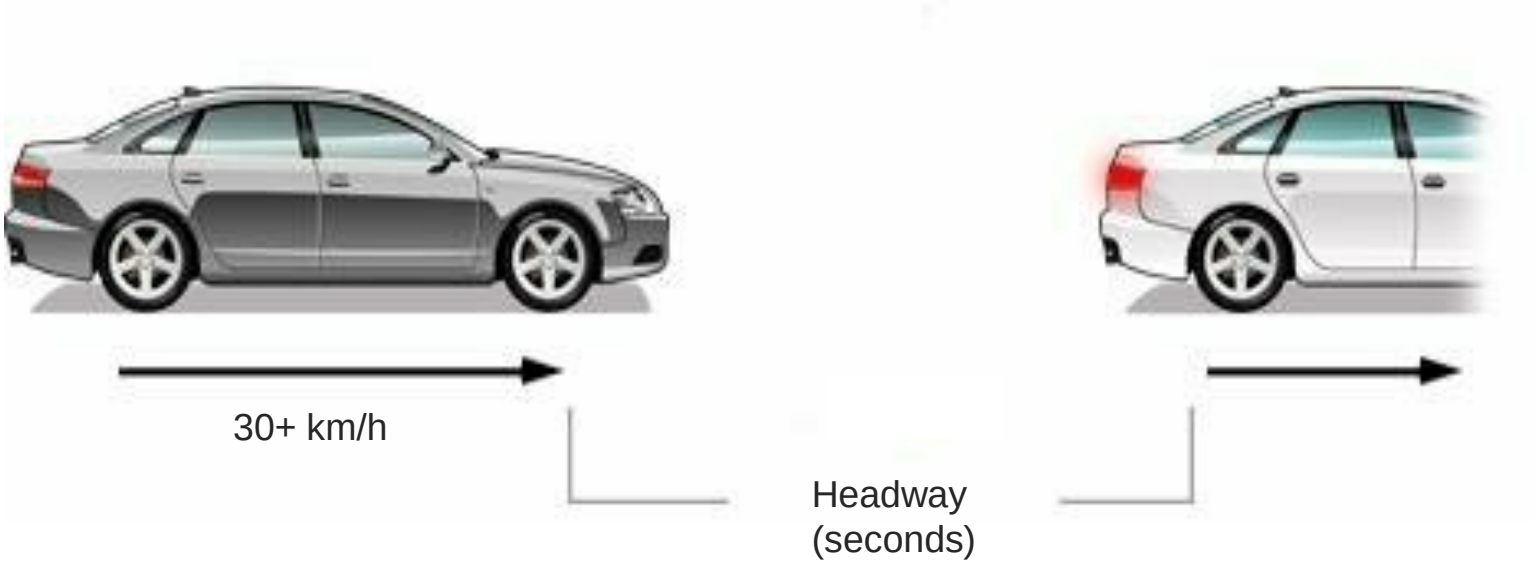
Video download link: https://www.dropbox.com/s/1ezvf98l80d04g9/acc24-46.mpeg

Driver Performance – Headway

Headway is one way of measuring driver performance. In this study, we analysed headway in two different ways:

1. Average headway is the average distance between the test vehicle and the vehicle ahead. Poor driver performance could be defined when average headway falls below a certain threshold.

2. Standard deviation of headway represents how well a driver maintains a constant headway with the vehicle ahead. For example, high deviation of headway could indicate that the driver is failing to adjust to traffic conditions.



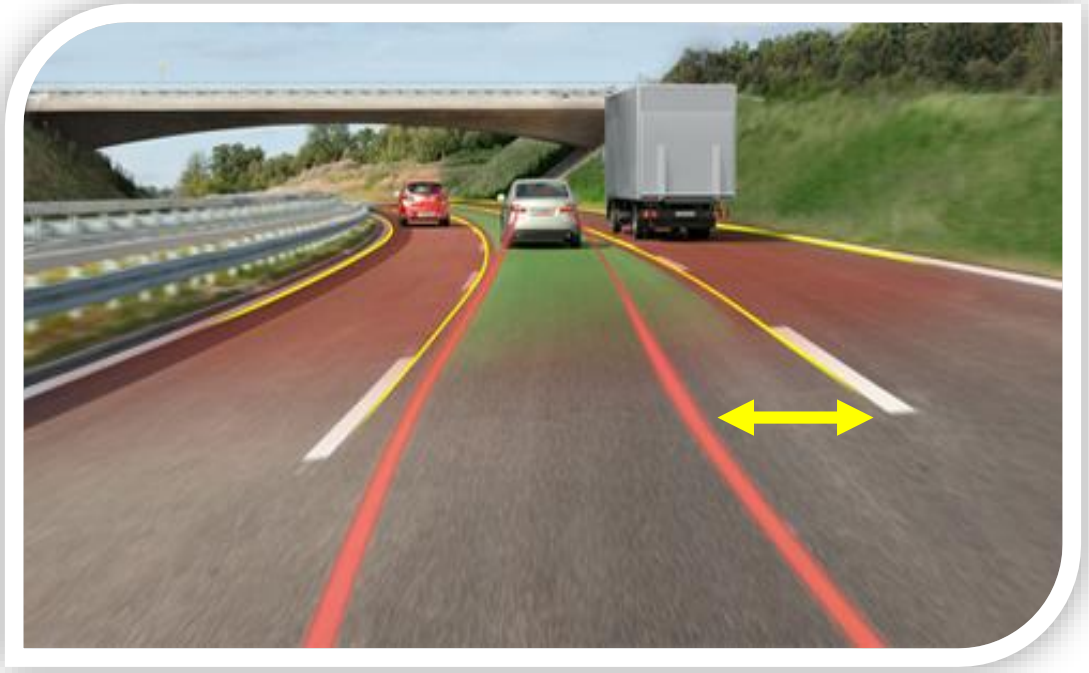
http://www.euroncap.com/results/aeb/testresults.aspx

Driver Performance – Lane Deviation

Lane deviation is the standard deviation of lane position (lateral position). Standard deviation of the right lane position was selected as the primary measure due to the following:

1. Greater frequency and visibility of right lane markings and;

2. Tendency for Australian drivers to use right-lane markings preferentially for lane keeping.



http://www.bosch-automotivetechnology.com/media/db_application/stage_components/safety/spurhalteassistent.jpg

Driver Performance – Lane Deviation

Sample screenshot outputs from VBOX showing headway and lane position

Technology – Synchronising the Data Streams

The eye tracking system and collision warning system had independent clocks which meant that each data stream was recorded with independent timestamps.

In order to synchronise the data streams, we used a clapper board. By recording this event in both camera sources, we were able to synchronise timestamps with the UTC (Coordinated Universal Time) clock used within the VBOX system.

Frame from Mobile Eye XG

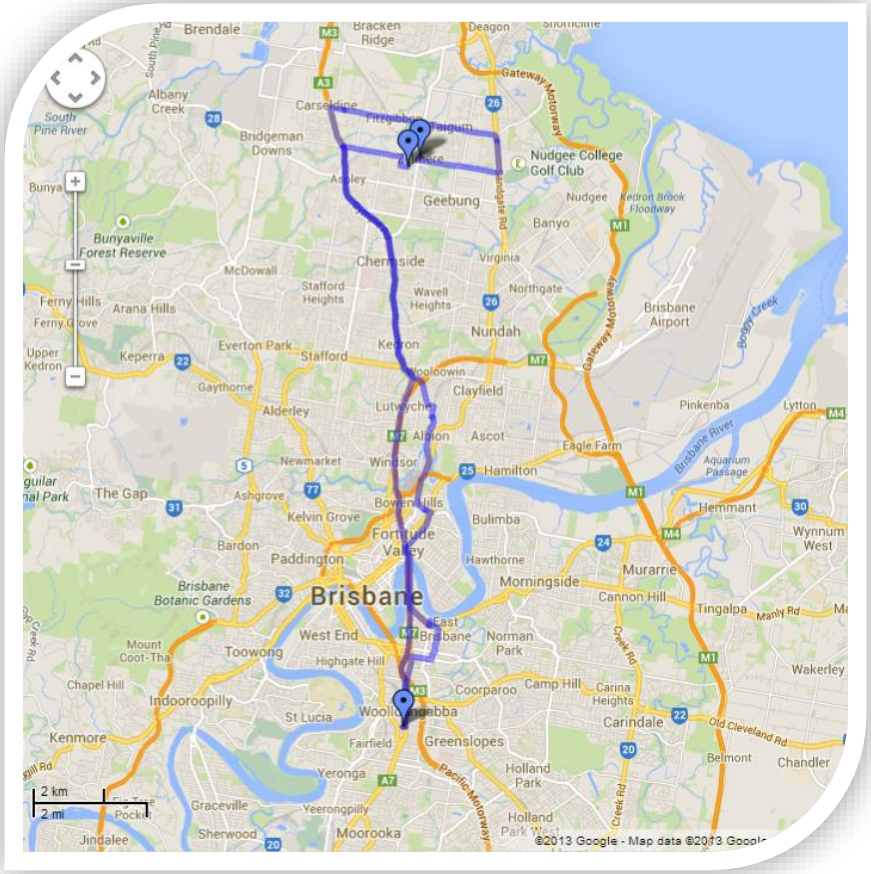
Synchronised frame from VBOX

Fieldwork Location and Driving Route

The fieldwork was conducted in Brisbane where a number of digital billboards are located within the CBD.

A route was selected that included digital, static and on-premise signage in areas of high and low density.

The route started in Zilmere, continued south through the CBD as far as Woolloongabba, before returning to Zilmere. The total driving time was approximately 2 hours (including a practice drive).



The Brisbane Driving Route

Segmenting the Driving Route

In order to answer our research questions, a number of segments of the overall route were identified for comparison.

We identified segments of the route that contained digital signage to compare against those that included static signage. We also identified segments that included on-premise signage as an additional comparison group. It is important to note that digital and static segments also contained on-premise signage.

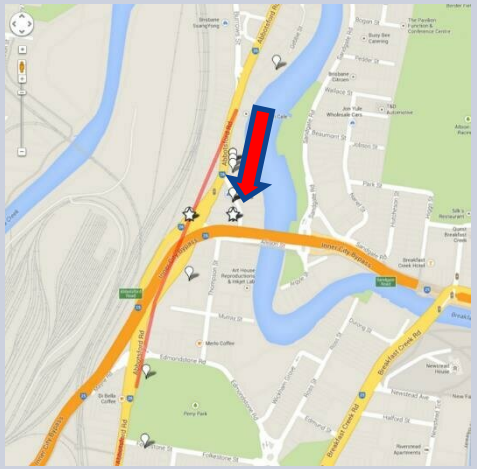
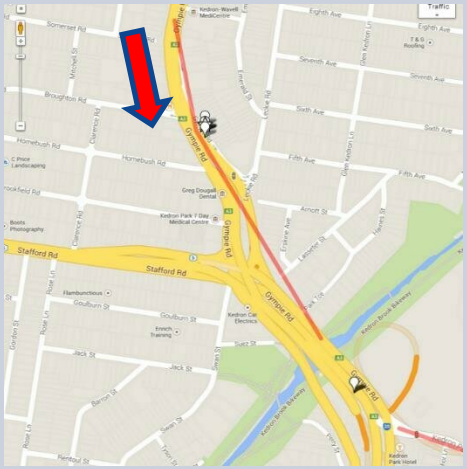
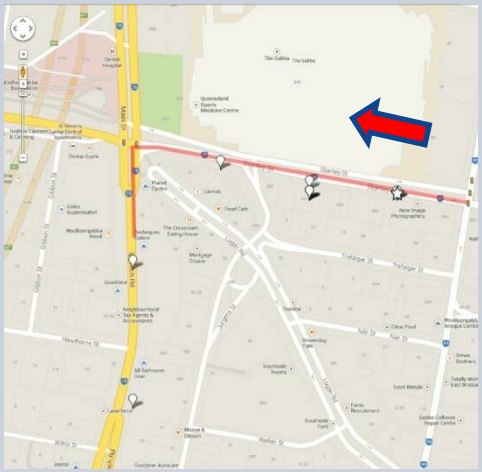
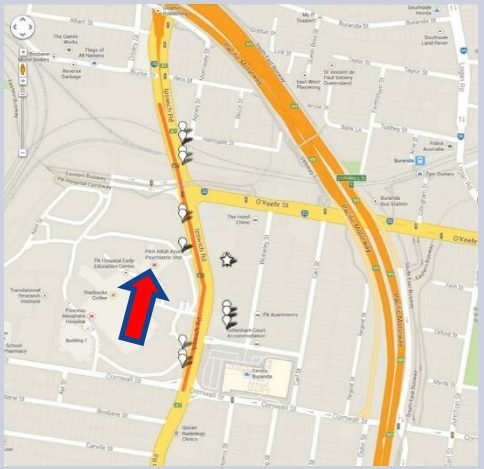
In addition, the digital, static and on-premise segments were further classified as ‘heavy’ or ‘light’ in signage density. This results in a total of eight route segments which were labelled according to the following table.

	Digital Signage		Static Signage	On-premise Signage
Heavy Density	Segment 2	Segment 3	Segment 5	Segment 6
Light Density	Segment 1	Segment 4	Segment 7	Segment 8

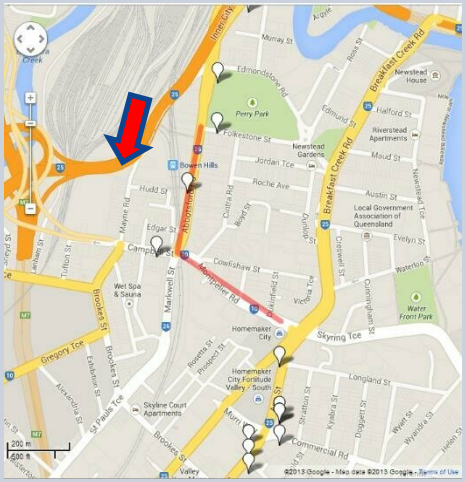
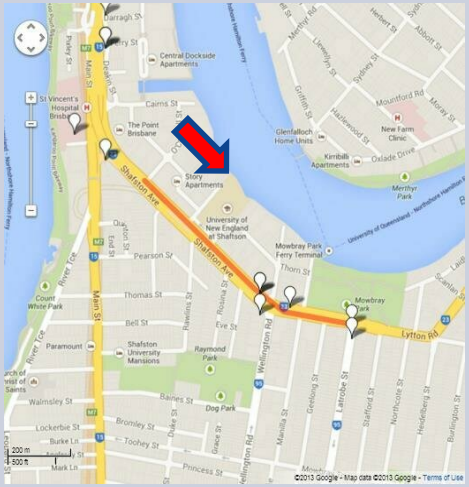
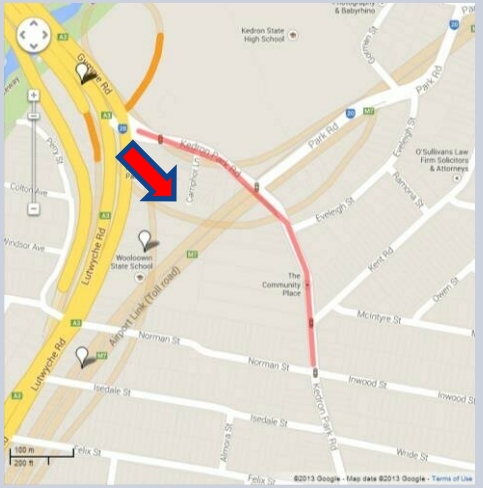
Segmenting the Driving Route - Digital Segments

Digital Signage 1	Digital Signage 2	Digital Signage 3	Digital Signage 4
			
Digital – Light Density	Digital – Heavy Density	Digital – Heavy Density	Digital – Light Density

Maps of Route – Digital Segments

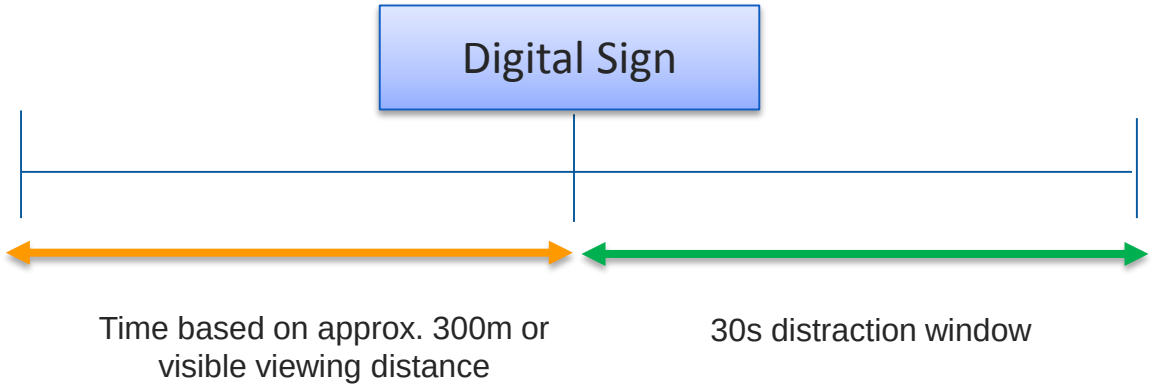
Segment 1	Segment 2	Segment 3	Segment 4
			
Digital – Light Density	Digital – Heavy Density	Digital – Heavy Density	Digital – Light Density
Abbotsford Rd	Gympie Rd	Stanley St (Gabba)	Ipswich Rd

Maps of Route – Comparison Segments

Segment 5	Segment 6	Segment 7	Segment 8
			
Static – Heavy Density	On-premise – Heavy Density	Static – Light Density	On-premise – Light Density
Abbotsford Rd / Montpelier Rd	Gympie Rd	Shafston Ave	Kedron Park Rd

Route Segmentation – Time Duration

The time duration of the digital segments (1-4) were determined by the following criteria:



The time duration of the comparison segments (6-8) were determined by the following criteria:

	Static	On-premise
Heavy Density	(5) Average of digital heavy segments	(6) Average of digital heavy segments
Light Density	(7) Average of digital light segments	(8) Average of digital light segments

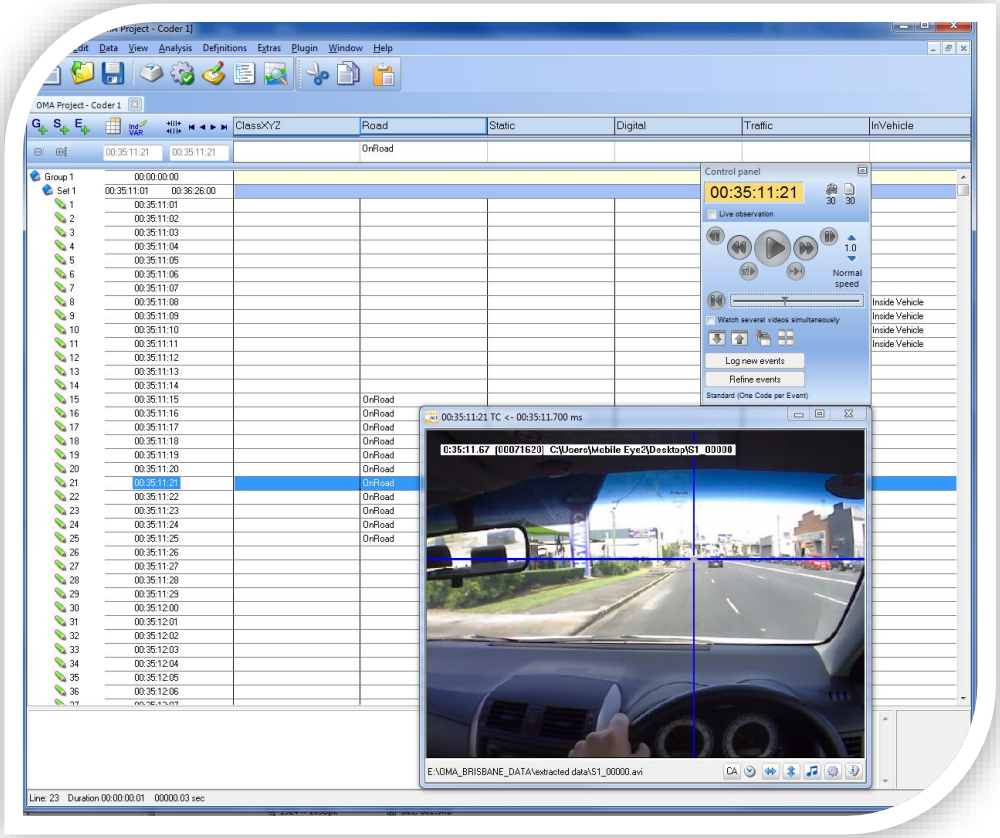
Eye Tracking Data Coding

One of the challenges with analysing mobile eye tracking video is that each participant's recorded footage is dynamic and unique. This means that it is difficult to use eye tracking analysis software which allows Areas of Interest (AOIs) to be overlaid on scene elements and regions.

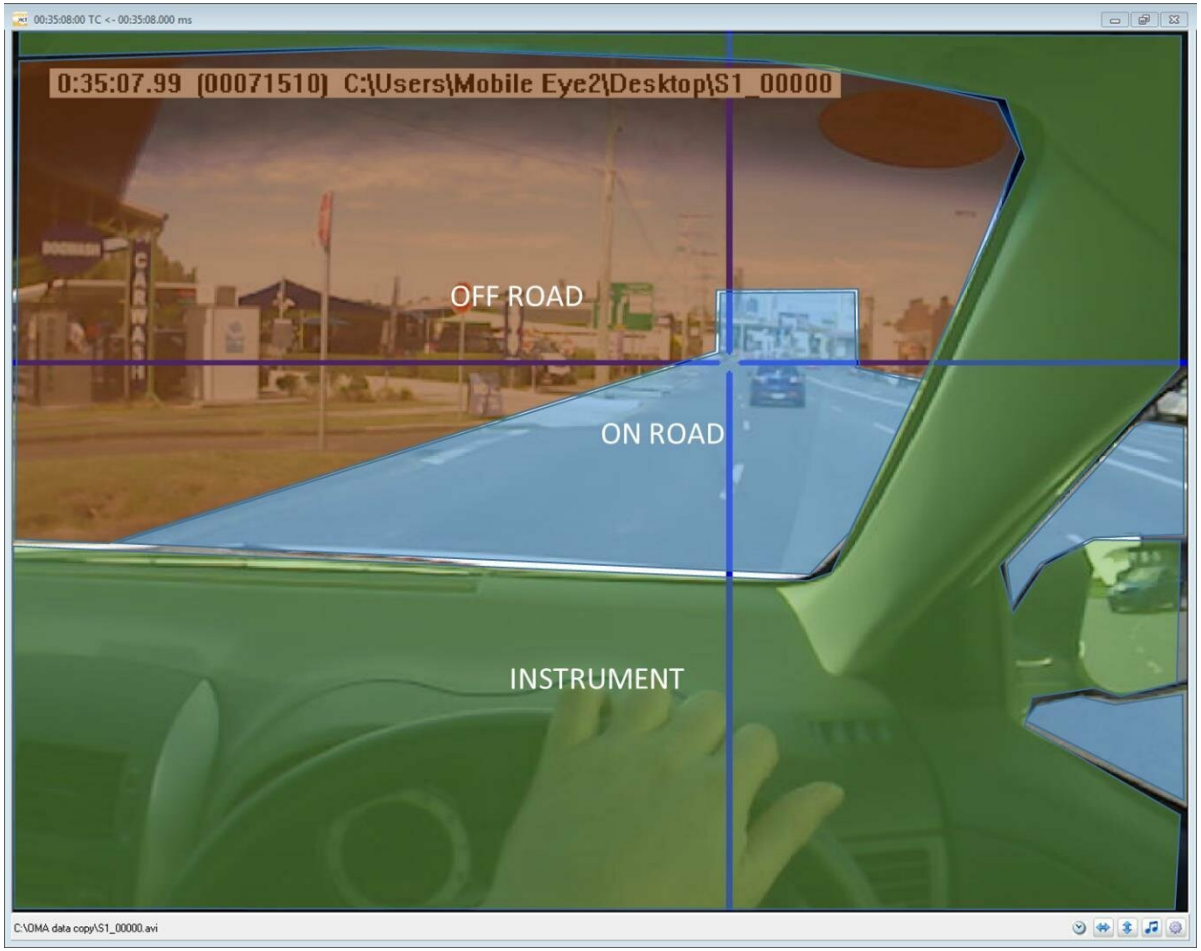
As a result, an observational encoding approach was taken, using specialist behavioural encoding software (Mangold Interact).

To reduce any bias in the analysis, two highly trained naïve encoders analysed the footage frame-by-frame based on an agreed coding scheme.

All analyses were conducted to meet academic publication standards.

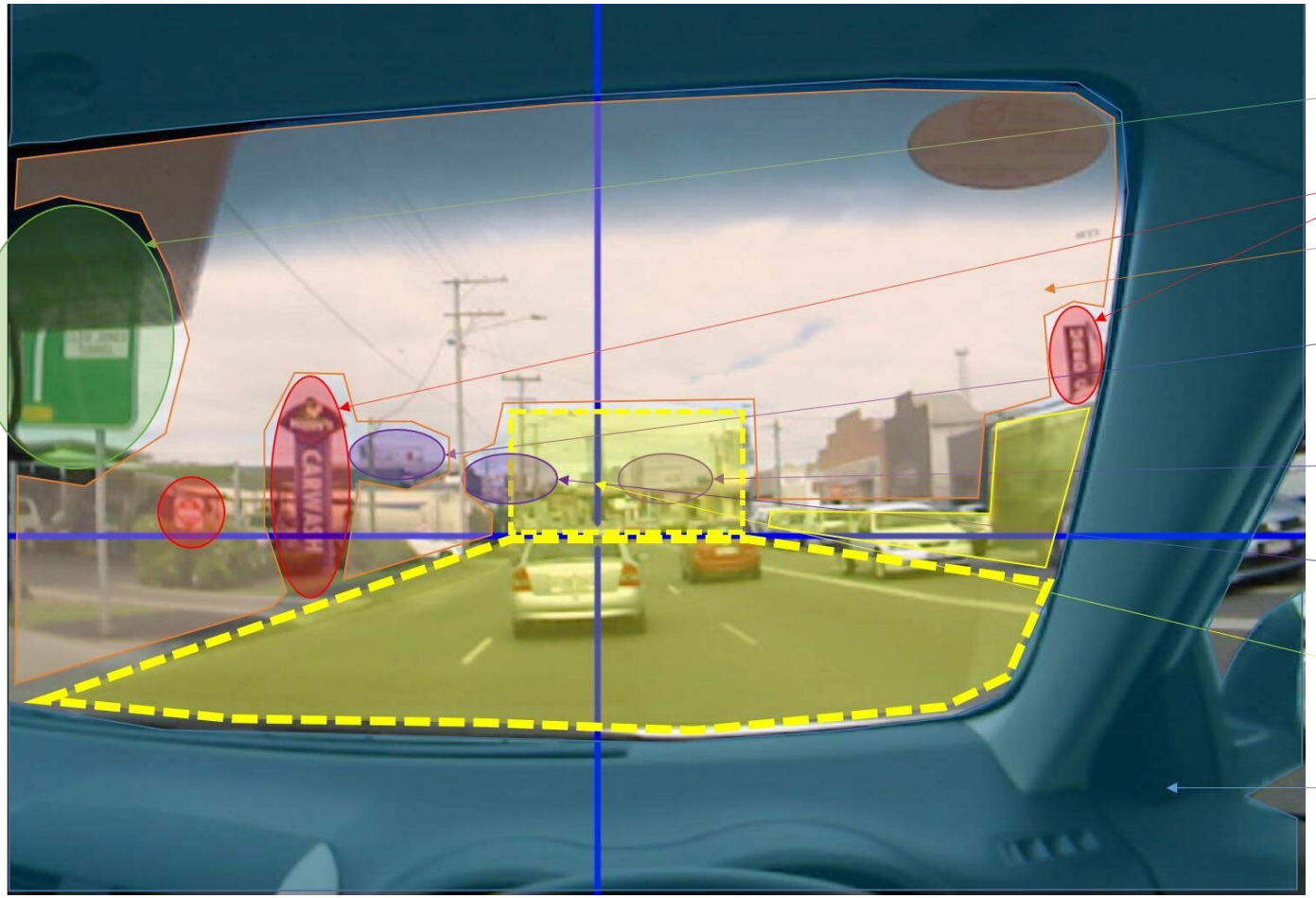


Coding Schemes – Macro Level



At a macro level, we designated areas of the scene to be **ON-ROAD** and **OFF-ROAD**.

Coding Schemes – Micro Level



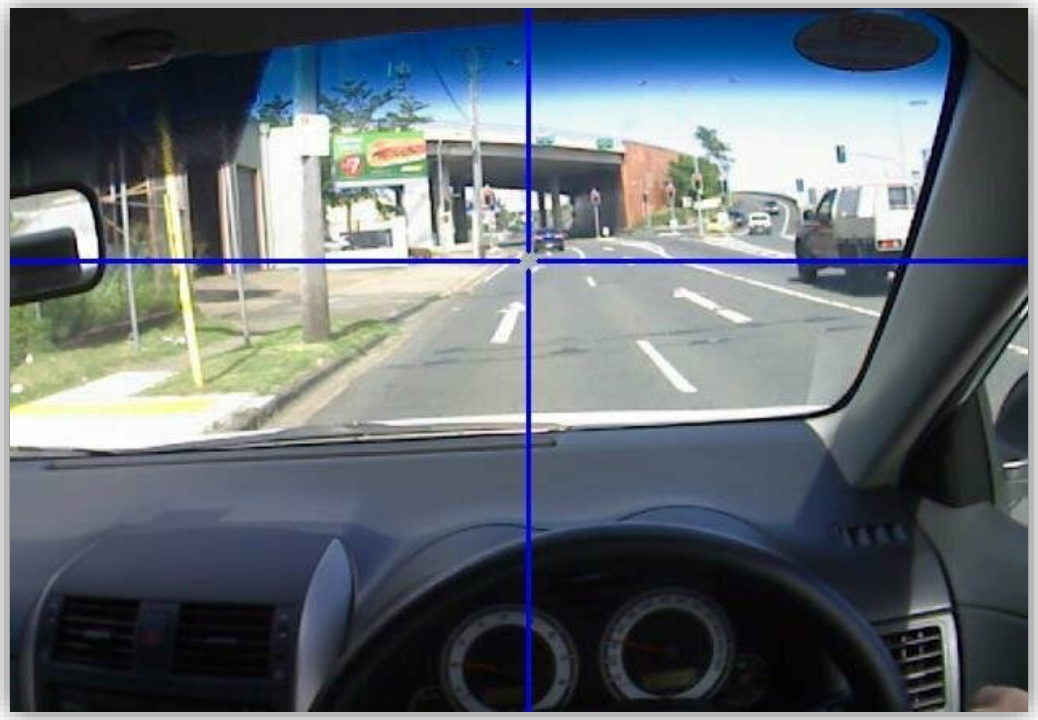
At a micro level, the coding scheme captures the different types of signage viewed.

Visual Behaviour – Dwell Times

Dwell time is the total time spent looking at a particular category. That is, we analysed the point of gaze (POG) crosshair for every single frame. This is the most granular analysis of the eye tracking data possible.

For dwell time analysis, the coding categories were grouped to either On-road or Off-road viewing behaviour:

On-road	Off-road
On-road	Digital
Box On-road	Static
Traffic Signs	On-premise
Inside Vehicle	Off-road



Visual Behaviour – Fixations

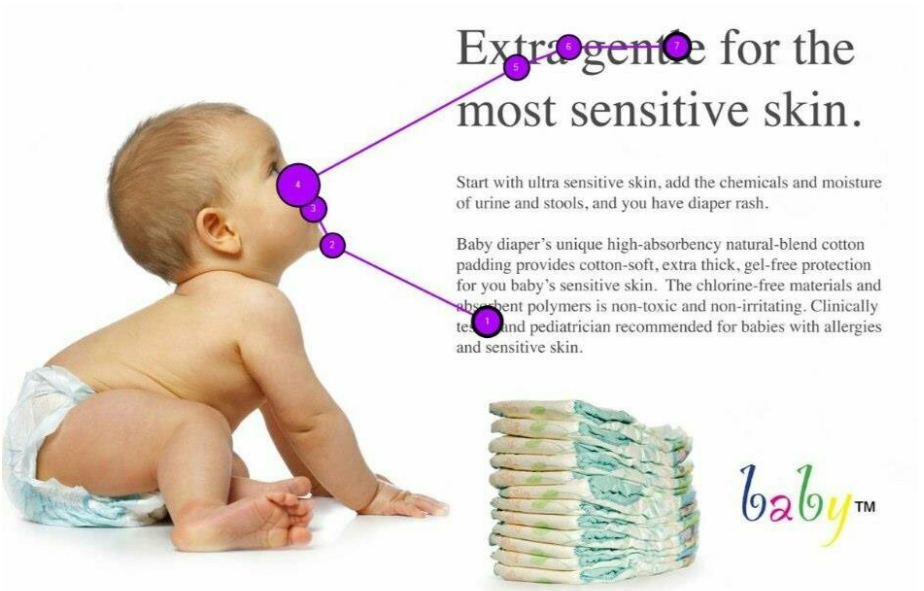
Broadly speaking, eye tracking data can be divided into two components:

1. Eye movements (sometimes referred to saccades)
2. Fixations

Fixation is the maintenance of visual gaze on a specific region or object in the visual field.

Fixation data is highly correlated with the allocation of attention. In fact, there is evidence that when our eyes are moving, our entire visual system is ‘switched off’ (saccadic suppression).

Therefore, it is conventional to use fixations to analyse attention allocated to signs.



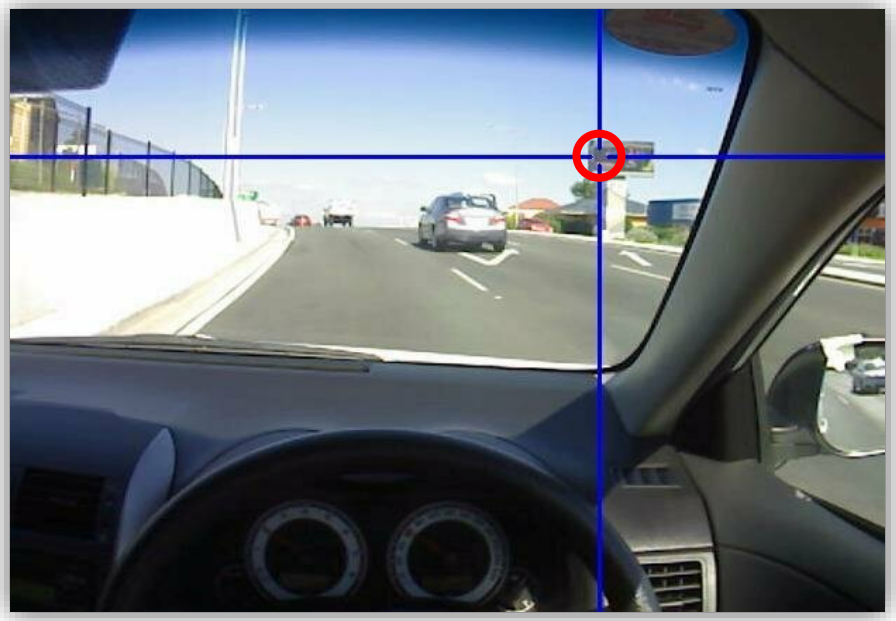
http://alexwhite.org/2011/10/you-look-where-they-look-research-on-design/

Classification of Fixations

In order to determine what constitutes a fixation, certain parameters must be established based on the time spent in a defined region e.g. it has been conventional to consider eye dwells on something for 200ms or longer to be classified as a fixation.

More recently, it has been suggested that fixations shorter than 200ms are possible. For this study, we set our threshold at 100ms (or 3 frames).

The first parse of the data involved a frame-by-frame classification of the point of gaze (POG) data. A second parse involved matching the classified data to a fixation file, that was generated via ASL Results analysis software using pre-determined parameters.



Sample screenshot of fixation on sign

Inter-Rater Reliability (IRR)

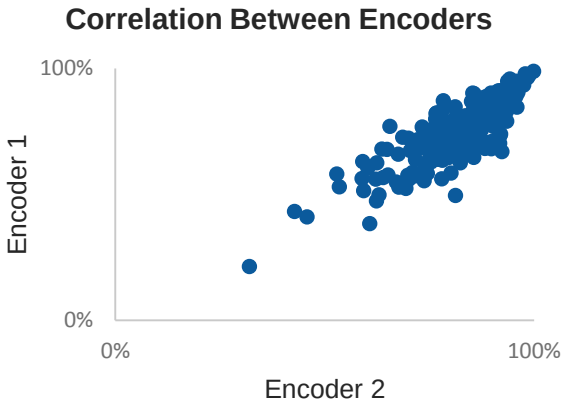
A potential issue with using observational encoding (involving human judgement calls) is the potential for divergent classifications.

The accepted way to quantify the degree of convergence/divergence between the two encoders is the calculation of inter-reliability (IRR). IRR demonstrates the consistency among observational ratings provided by multiple coders.

Two methods were used to show that encoders were scoring consistently:

1. The Kappa statistic was calculated based on the fixation analysis. It was found that encoders were in substantial agreement with each other (K = .689, p<.001 for comparison, K = .65 in Hanowski, R.J., et al (2006)).

2. The Intra-class Correlation statistic was calculated based on the on-road dwell times. It was also found here that encoders were consistent with each other (r = .812, p<.001 for comparison, r = .86 in Hanowski, R.J., et al (2006)).



Statistical Corrections

Statistical corrections are typically required from more recent studies involving multiple comparisons.

We have applied a conservative criteria to what is considered 'statistically significant' to the following four comparisons (α=0.05/4):

Comparisons
3rd Party vs On-premise
Digital v Static
Digital v On-premise
Static v On-premise

Our conservative correction is the Bonferroni correction procedure (Dunn, 1961), where α is adjusted based on the number of comparisons (i.e. k=4 in the current study). This procedure has also been used in similar driver studies such as Crandall et al. (2006).

After corrections, some comparisons of interest were not significant. This may not be the case if the OMA decides to apply a different correction procedure. Uncorrected results are also disclosed for reference purposes.

Note: In some of the analyses, participants were excluded where there was insufficient data in every condition for comparison.

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3. Detailed Results

Comparing 3rd Party and On-premise Signage

Does viewing behaviour differ significantly in the presence of 3rd party compared to on-premise signage?

To answer this question, we used the following metrics:

- Total dwell time on-road (%)
- Fixation duration (ms)

Does driver performance differ significantly in the presence of 3rd party compared to on-premise signage?

To answer this question, we used the following metrics:

- Vehicle headway (s)
- Lane deviation (m)

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Driver Attention

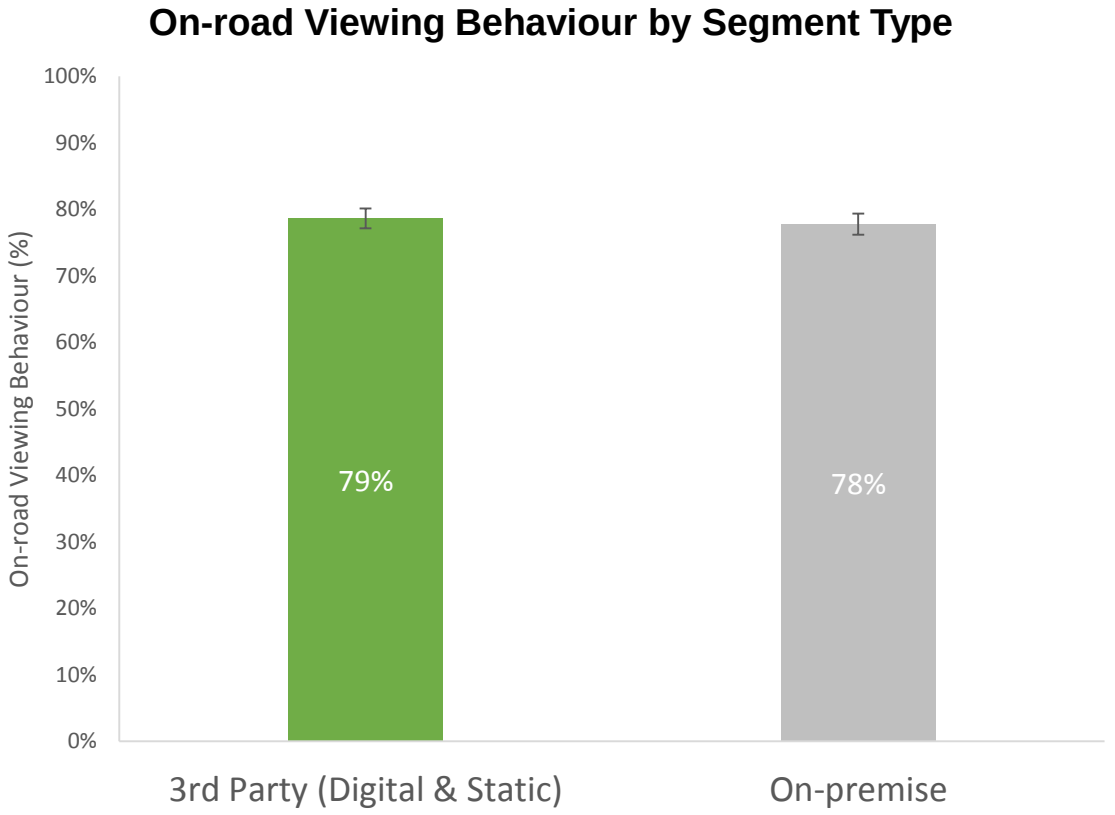
Dwell Time Analysis by Segment Type

Does on-road viewing differ significantly in the presence of 3rd party compared to on-premise signage?

Discussion:

This graph shows the percentage time spent looking on-road in the presence of different sign types. It can be seen that there is no statistically significant difference in on-road viewing behaviour between the two conditions.

There is no evidence to suggest drivers spend less time with their eyes on-road in the presence of 3rd party compared to on-premise signage.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
3rd Party v On-premise	F(1,26)=0.808, p=.377	Not Significant	Not Significant

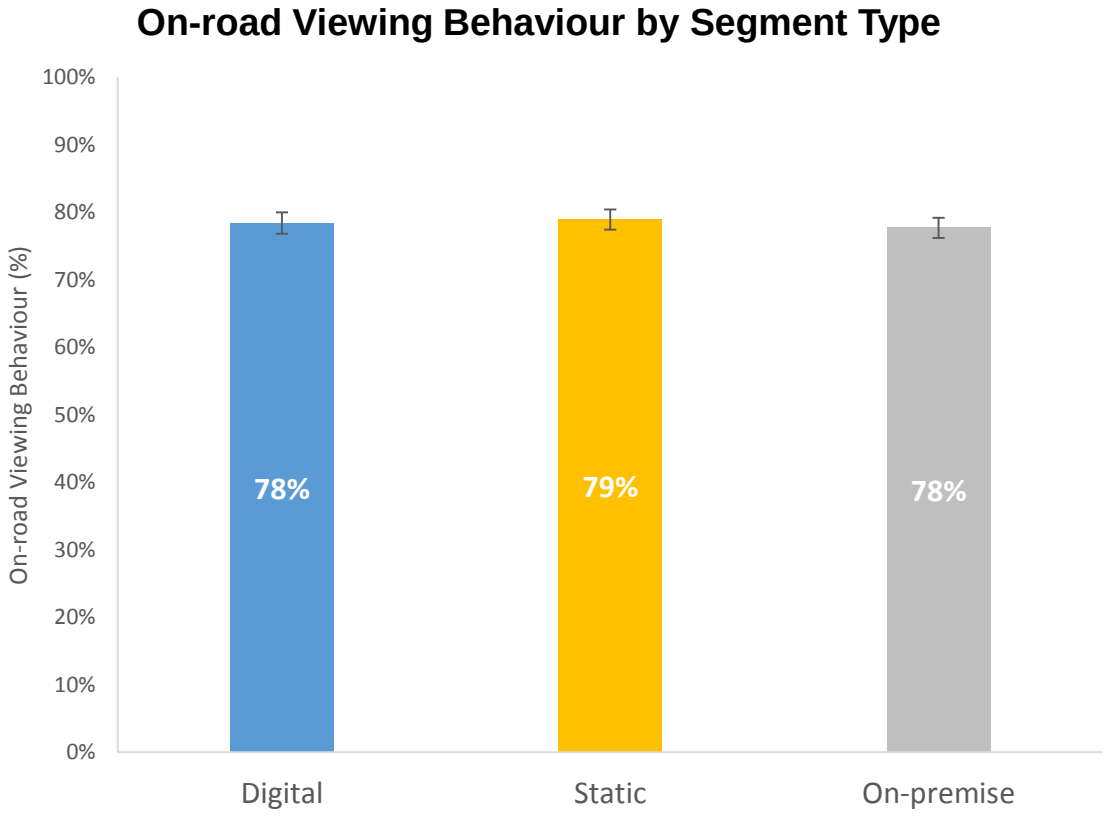
Dwell Time Analysis by Segment Type

Does on-road viewing differ significantly in the presence of digital compared to static signage?

Discussion:

This graph shows the percentage time spent looking on-road in the presence of different sign types. It can be seen that there is no statistically significant difference in on-road viewing behaviour between the three conditions.

There is no evidence to suggest drivers spend less time with their eyes on-road in the presence of digital or static signage when compared to on-premise signage, or with each other.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
Digital v Static	F(1,26)=.095, p=.760	Not Significant	Not Significant
Digital v On-premise	F(1,26)=.383, p=.541	Not Significant	Not Significant
Static v On-premise	F(1,26)=.692, p=.413	Not Significant	Not Significant

Preliminary Fixation Analysis by Sign Type

Does average fixation duration differ between signage types?

Discussion:

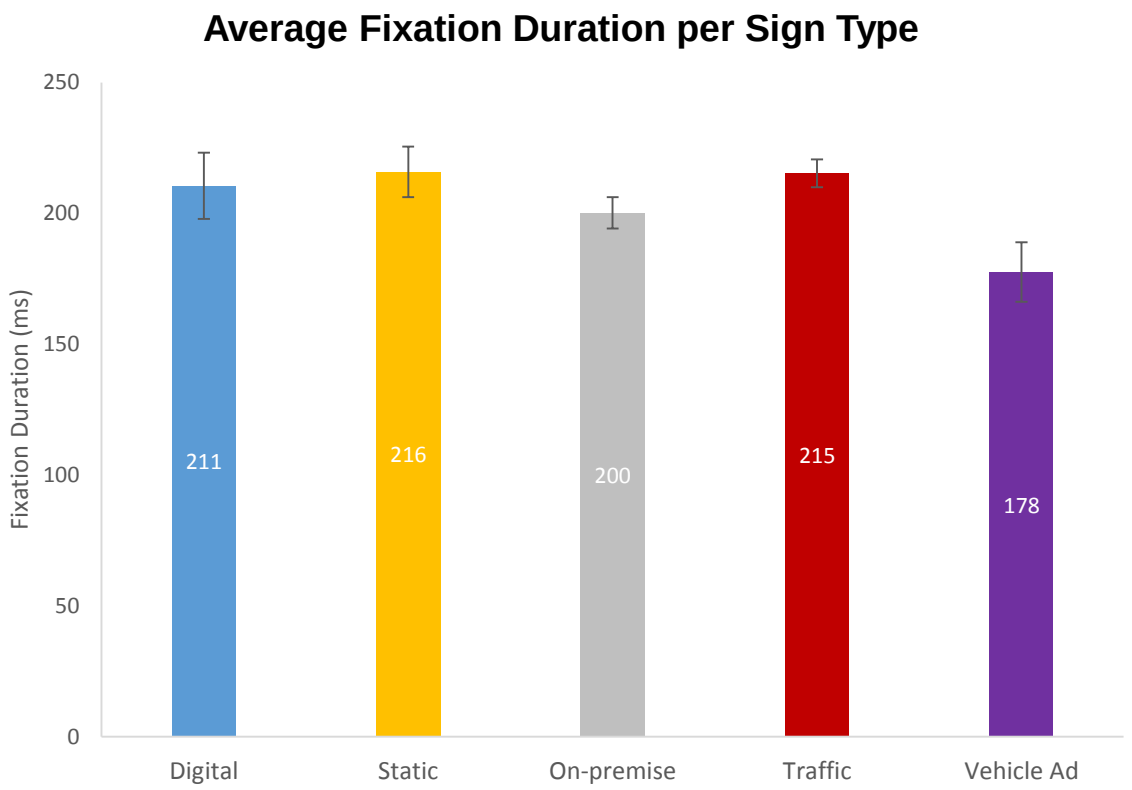
This graph shows the average fixation duration for different sign types.

Based on the preliminary fixation data* there were no differences in fixation duration between digital, static and on-premise signs.

Fixation data is also shown for traffic and vehicle ads for reference purposes only.**

*Fixation classifications that were mutually agreed between the two encoders.

**Comparisons involving traffic and vehicle ads were excluded to maximise statistical power.



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Fixation Classification Adjustment

Where divergent classifications between encoders occurred, a ‘sign priority’ approach was adopted where disputed fixations were reclassified based on their ranking in the table below:

Ranking	Sign Classification
1	Disputed Digital signs
2	Disputed Static signs
3	Disputed Traffic signs
4	Disputed On-premise
5	Disputed Vehicle Ads
6	On / Off-road / Inside Vehicle

For example, if one encoder classified a fixation as On-road and another classified it as static sign. The fixation will be reclassified as a static sign.

Fixations were classified in this way in order to guard against the possibility of a reviewer suggesting that we selectively disregarded fixations that were classified as on signs by either encoder. For example, it could be suggested that long fixations that would have contributed to a higher average fixation duration may have been disregarded.

Ultimately, this approach ensures that we do not underestimate hits on 3rd party signs, which reflects a conservative position when subjected to peer review.

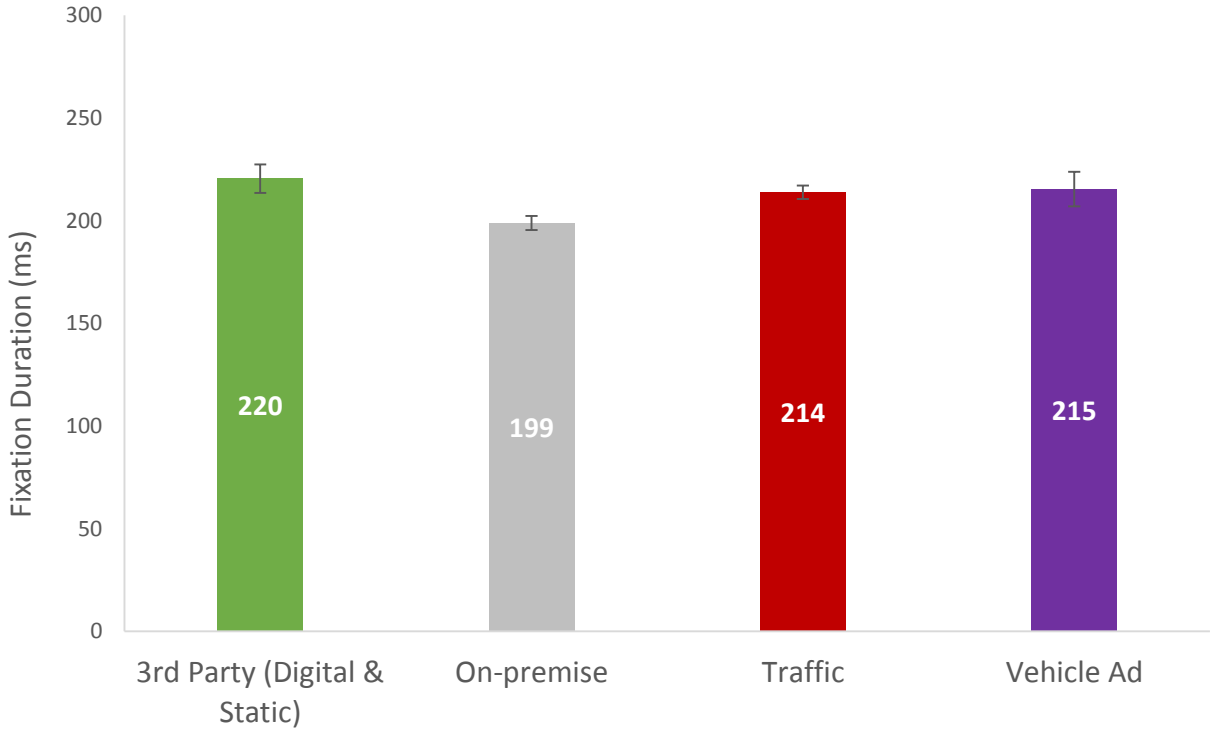
Average Fixation Analysis by Sign Type

Does average fixation duration differ significantly between 3rd party and on-premise signage?

Discussion:

This graph shows the average fixation duration for different signage types. The results show that while fixation duration on 3rd party signage was on average longer, this difference is not statistically significant when using the Bonferroni correction.

Average Fixation Duration per Sign Type*



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
3rd Party v On-premise	F(1,1550)=4.809, p=.029	Not Significant	Significant

*Based on fixation data adjusted for 'sign priority'

Average Fixation Analysis by Sign Type

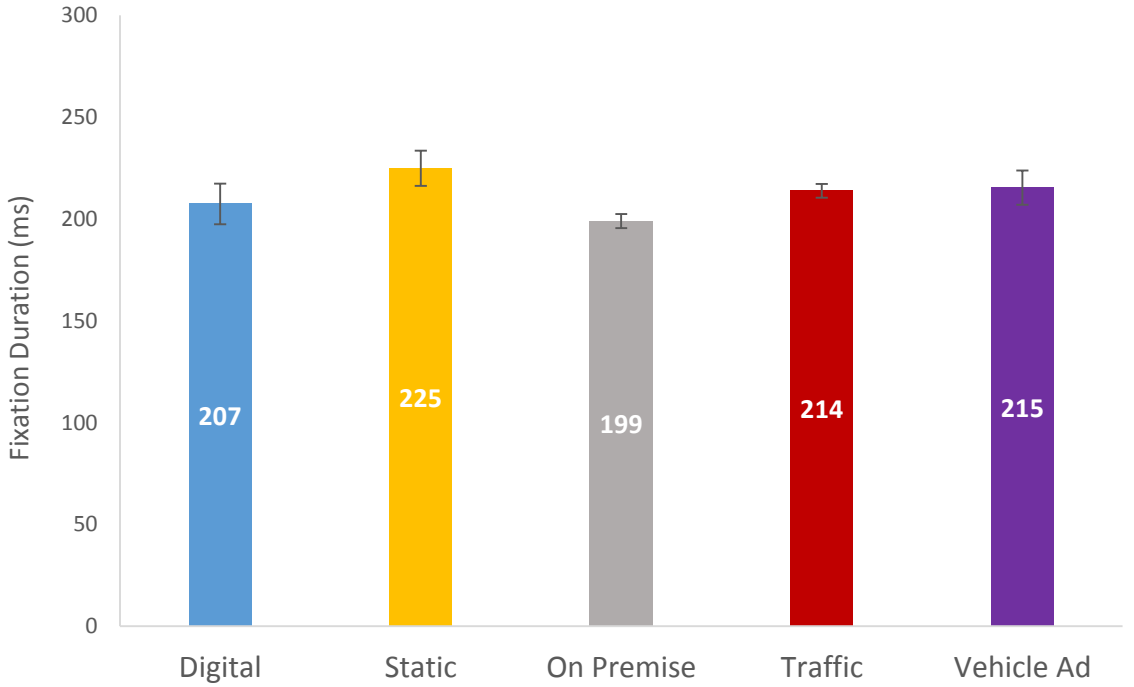
Does average fixation duration differ significantly between digital and static signage?

Discussion:

This graph shows the average fixation duration for different sign types. The results show that there is no statistically significant difference in average fixation duration between digital and static signage.

However, the results indicate that fixations on static signage were on average longer than fixations on on-premise signage. This difference was statistically significant.

Average Fixation Duration per Sign Type*



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
Digital v Static	F(1,568)=1.780, p=.183	Not Significant	Not Significant
Digital v On-premise	F(1, 1125) = .490 p=.485	Not Significant	Not Significant
Static v On-premise	F(1,1407)=10.847, p<.001	Significant	Significant

*Based on fixation data adjusted for 'sign priority'

Median Fixation Analysis by Sign Type

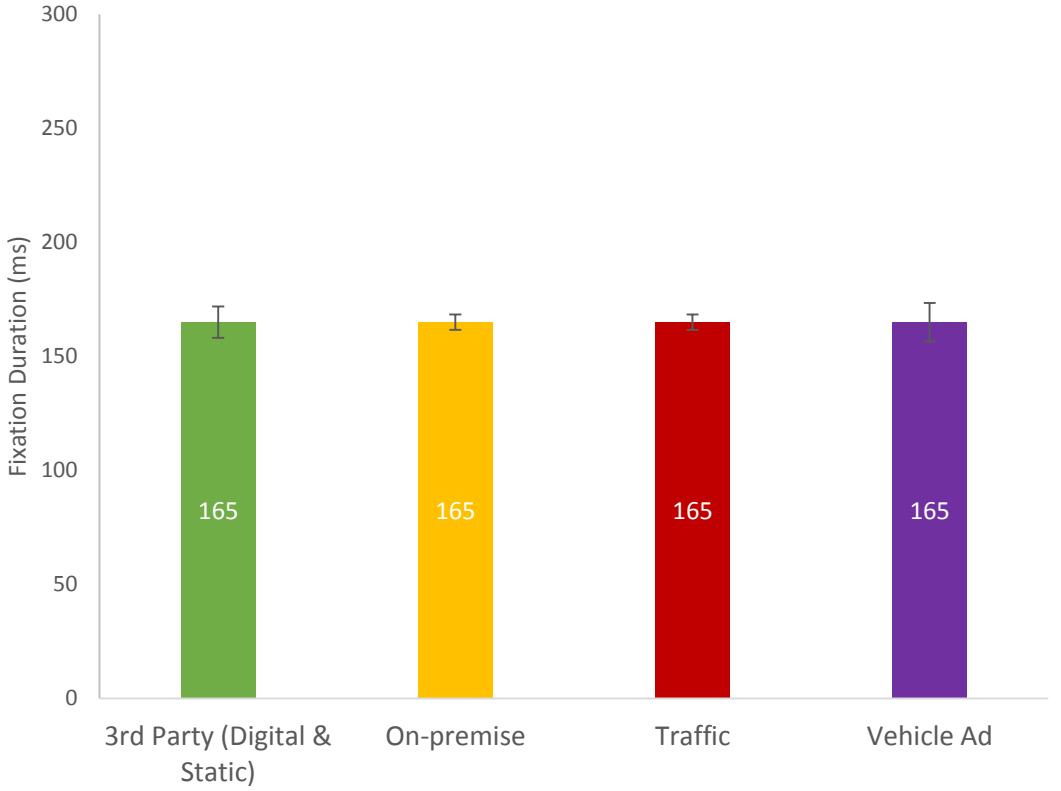
Does median fixation duration differ between signage types?

Discussion:

Typically, median scores are also used to report fixation durations because it is arguably a better measure of central tendency than a mean average score when the data is positively skewed.

Visual inspection of the median clearly shows there are no differences between all sign types.

Median Fixation Duration per Sign Type*



*Based on fixation data adjusted for 'sign priority'

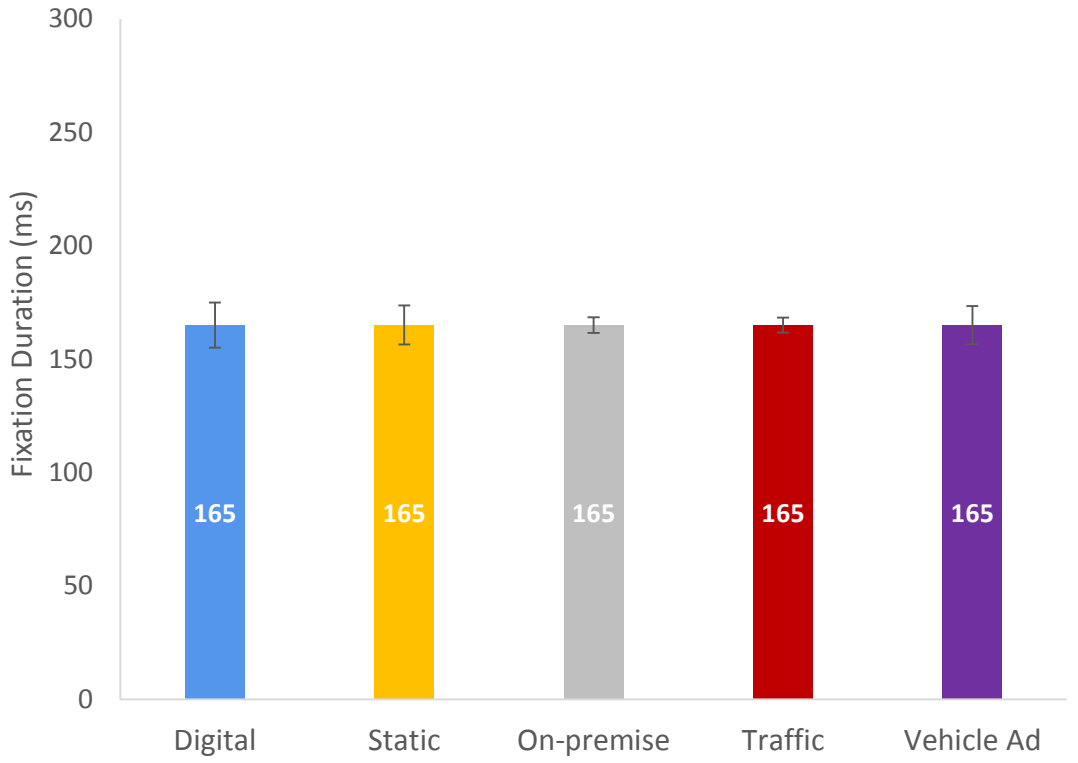
Median Fixation Analysis by Sign Type

Does median fixation duration differ between signage types?

Discussion:

Visual inspection of the median clearly shows there are no differences between all sign types, including between digital and static signage.

Median Fixation Duration per Sign Type*



*Based on fixation data adjusted for 'sign priority'

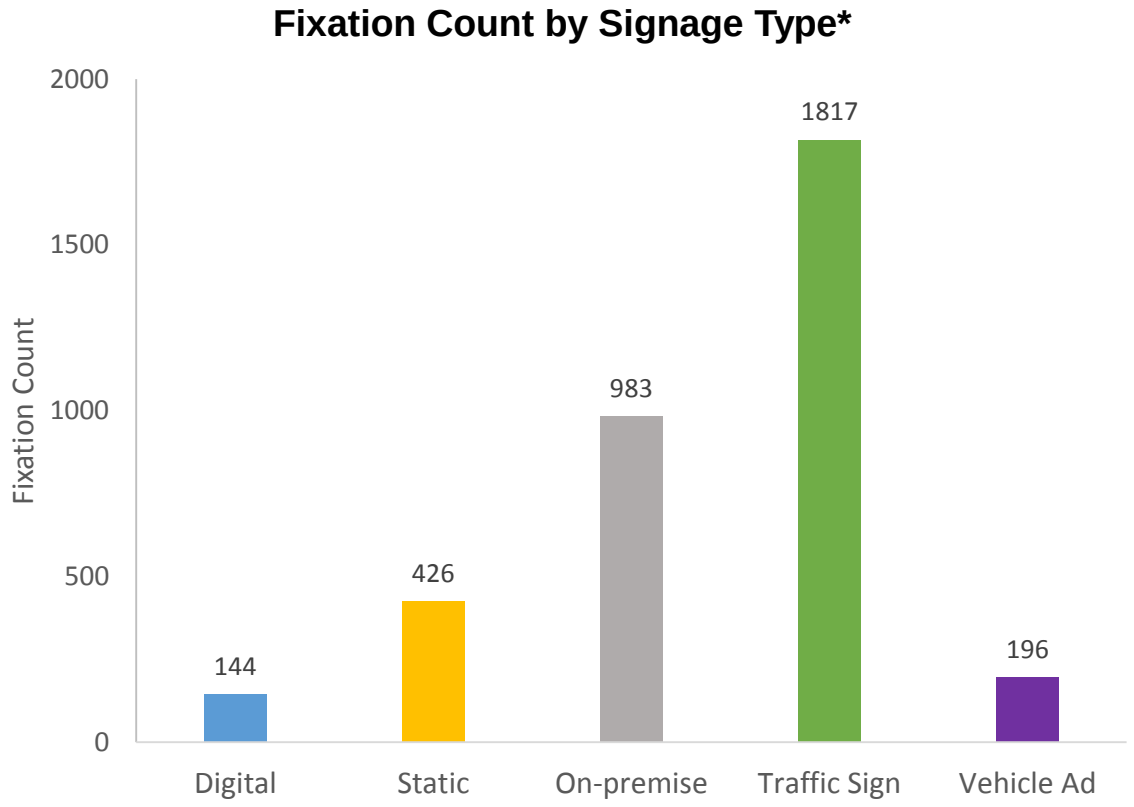
Fixation Count Analysis by Sign Type

What sign type attracts the most fixations?

Discussion:

This graph shows the breakdown of all fixation counts across sign types.

It can be seen that there are far greater hits on traffic and on-premise signage when compared to 3rd party signage.



*Based on fixation data adjusted for 'sign priority'

Fixation Count Analysis by Sign Type

Does digital attract more fixations than static?

Discussion:

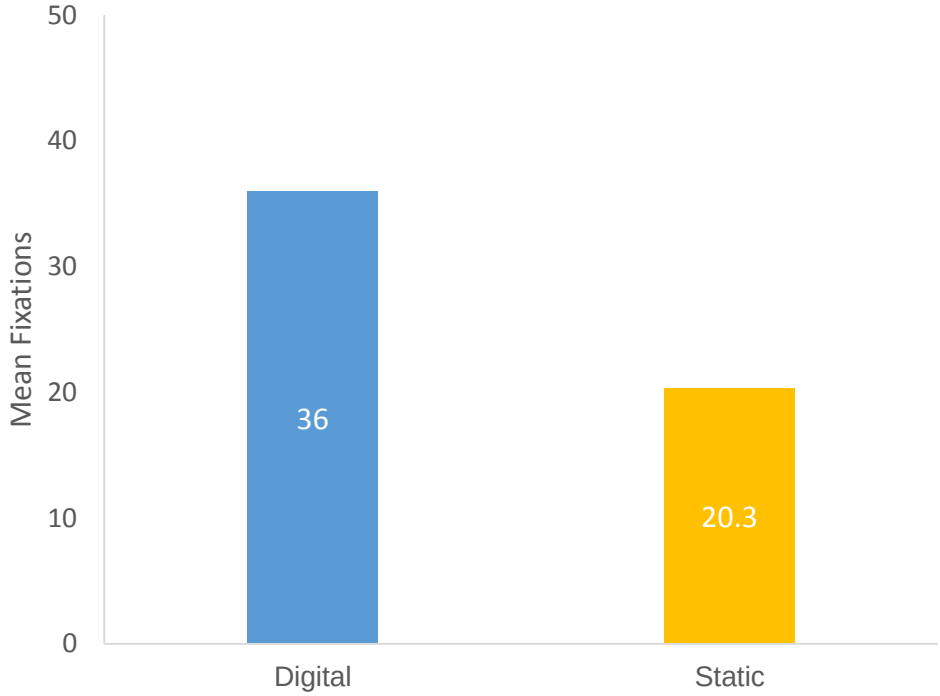
Whilst the absolute fixation count on static is greater than digital, there were five times more static signs compared to digital signs. Therefore, fixation counts were adjusted for the frequency of sign type.

The average fixation per sign type:

- Mean fixations per digital sign: 144/4 = 36.0
- Mean fixations per static sign: 426/21 = 20.3

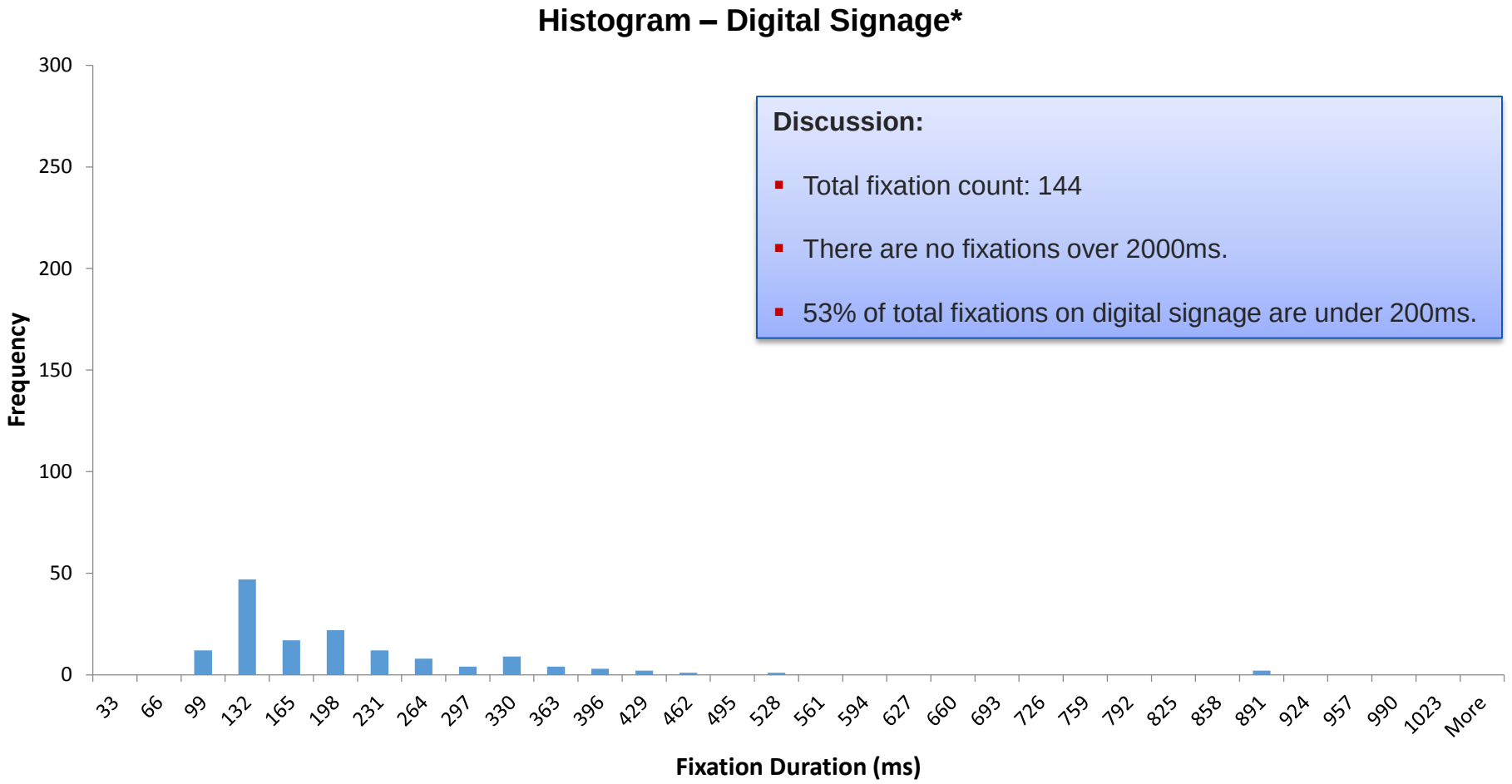
This analysis suggests that digital signs attract more fixations than static signs.

Mean Fixations per Digital and Static Sign*



*Based on fixation data adjusted for 'sign priority'

Distribution of Fixations on Digital Signage



Discussion:

- Total fixation count: 144
- There are no fixations over 2000ms.
- 53% of total fixations on digital signage are under 200ms.

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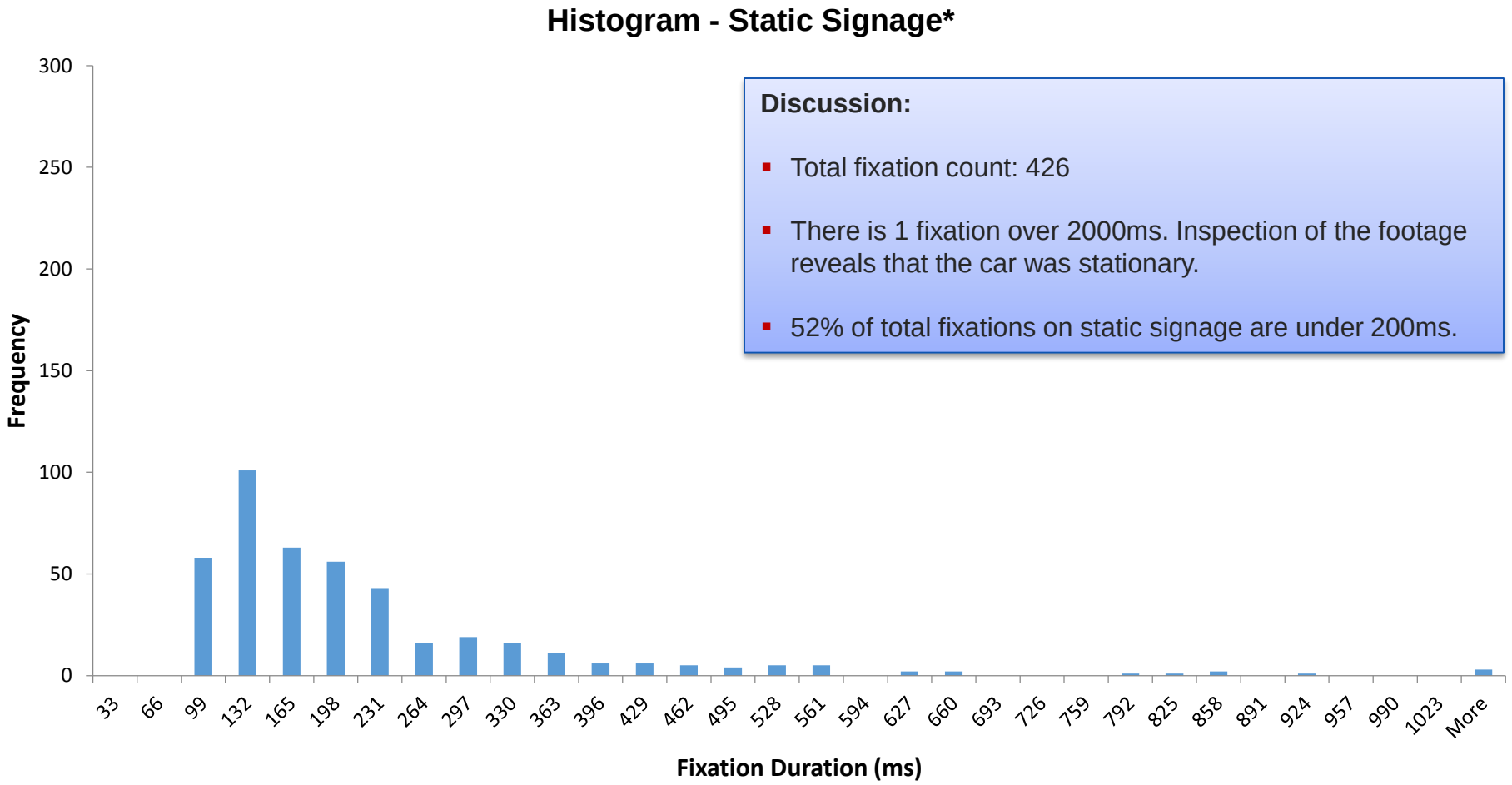
*Based on fixation data adjusted for 'sign priority'

Distribution of Fixations on Static Signage



Discussion:

- Total fixation count: 426
- There is 1 fixation over 2000ms. Inspection of the footage reveals that the car was stationary.
- 52% of total fixations on static signage are under 200ms.

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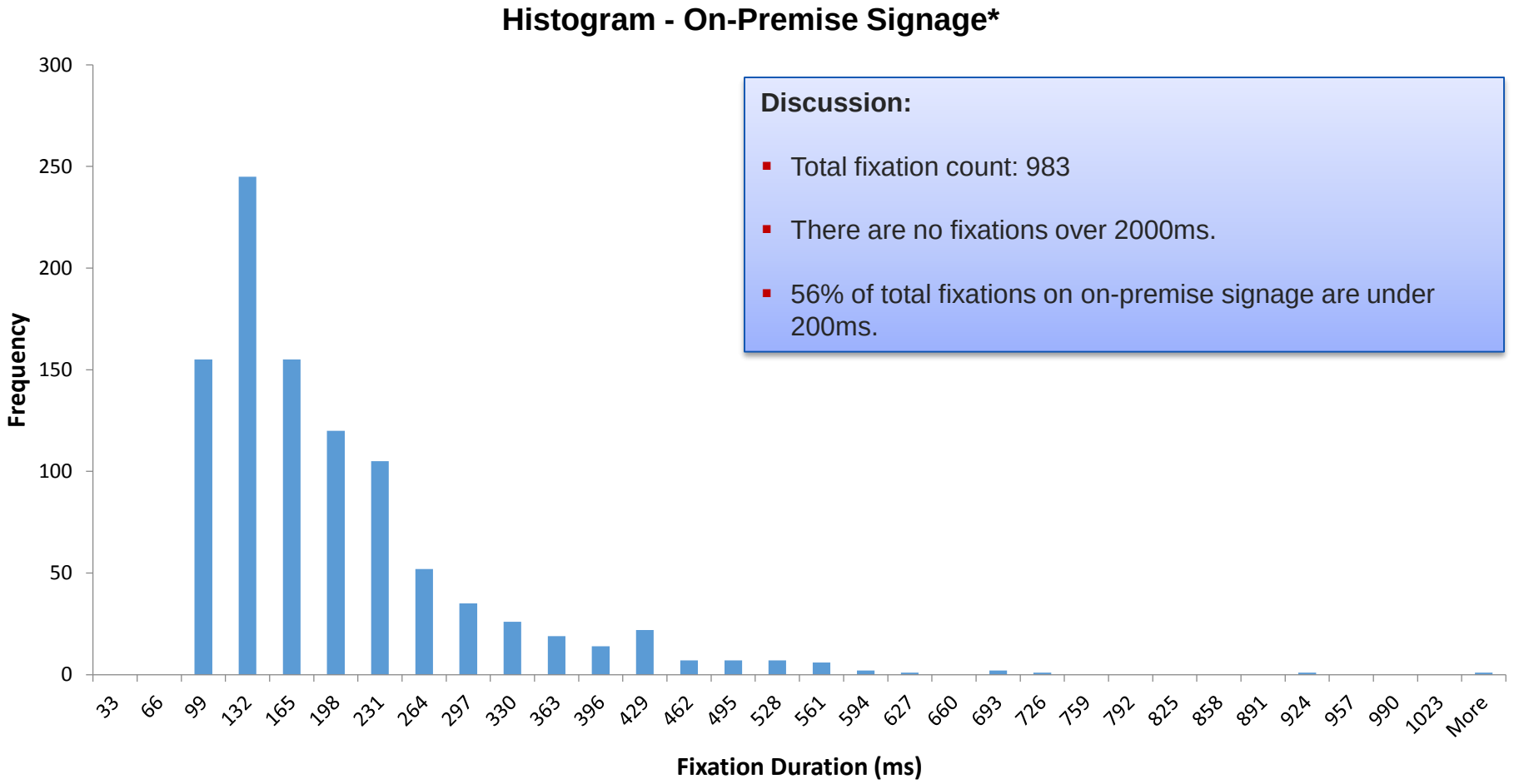
*Based on fixation data adjusted for 'sign priority'

Distribution of Fixations on On-Premise Signage



Discussion:

- Total fixation count: 983
- There are no fixations over 2000ms.
- 56% of total fixations on on-premise signage are under 200ms.

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*Based on fixation data adjusted for 'sign priority'

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Driver Performance

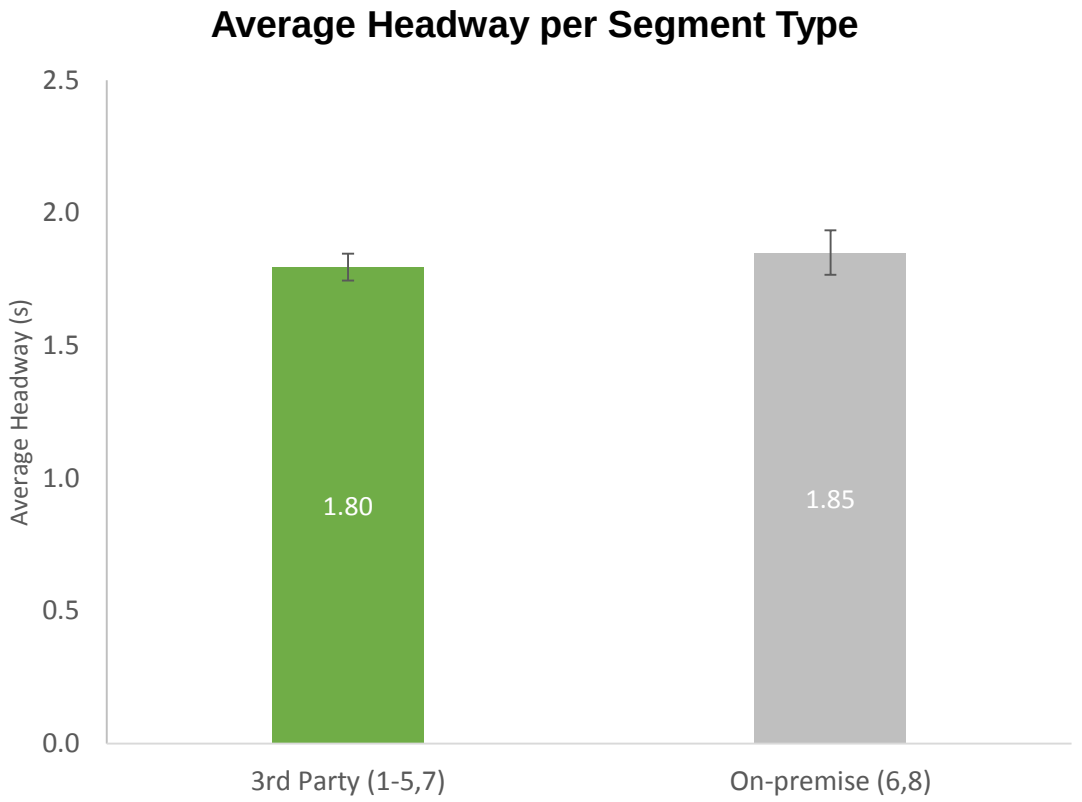
Average Headway Analysis by Segment Type

Does average headway differ significantly in the presence of 3rd party compared to on-premise signage?

Discussion:

This graph shows the average vehicle headway in seconds in the presence of different sign types. While vehicle headway appears to be shorter for 3rd party compared to on-premise signage, this is not a statistically significant result.

There is no evidence to suggest that driver performance is impacted in the presence of 3rd party compared to on-premise signage as measured by vehicle headway.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
3rd Party v On-premise	F(1,20)=.335, p=.569	Not Significant	Not Significant

Average Headway Analysis by Segment Type

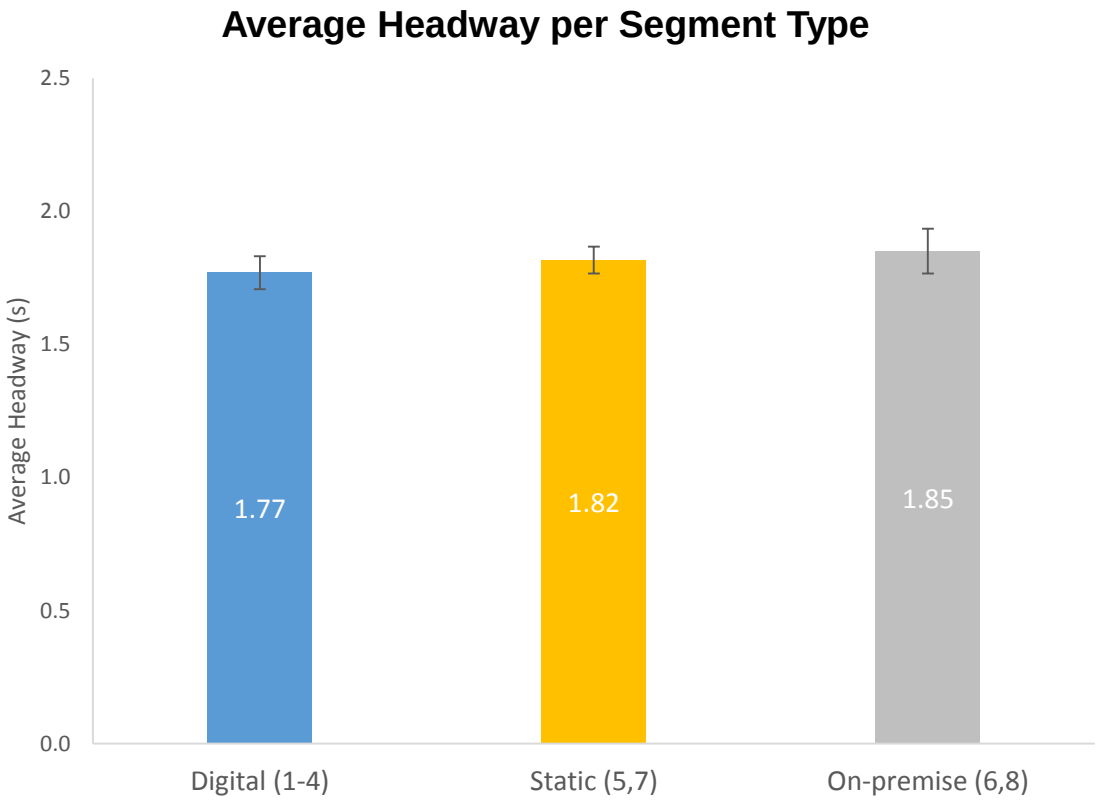
Does average headway differ significantly in the presence of digital and static signage compared to on-premise signage?

Discussion:

While this graph shows decreased average headway for digital compared to static signage, this difference is not significant.

Similarly, while vehicle headway appears to be shorter for both digital and static compared to on-premise, this is also not a statistically significant result.

Therefore, there is no evidence to suggest that the presence of digital or static signage impacts driver performance compared to on-premise signage as measured by vehicle headway.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
Digital v Static	F(1,20)=.636, p=.435	Not Significant	Not Significant
Digital v On-premise	F(1,20)=.544, p=.469	Not Significant	Not Significant
Static v On-premise	F(1,20)=.121, p=.732	Not Significant	Not Significant

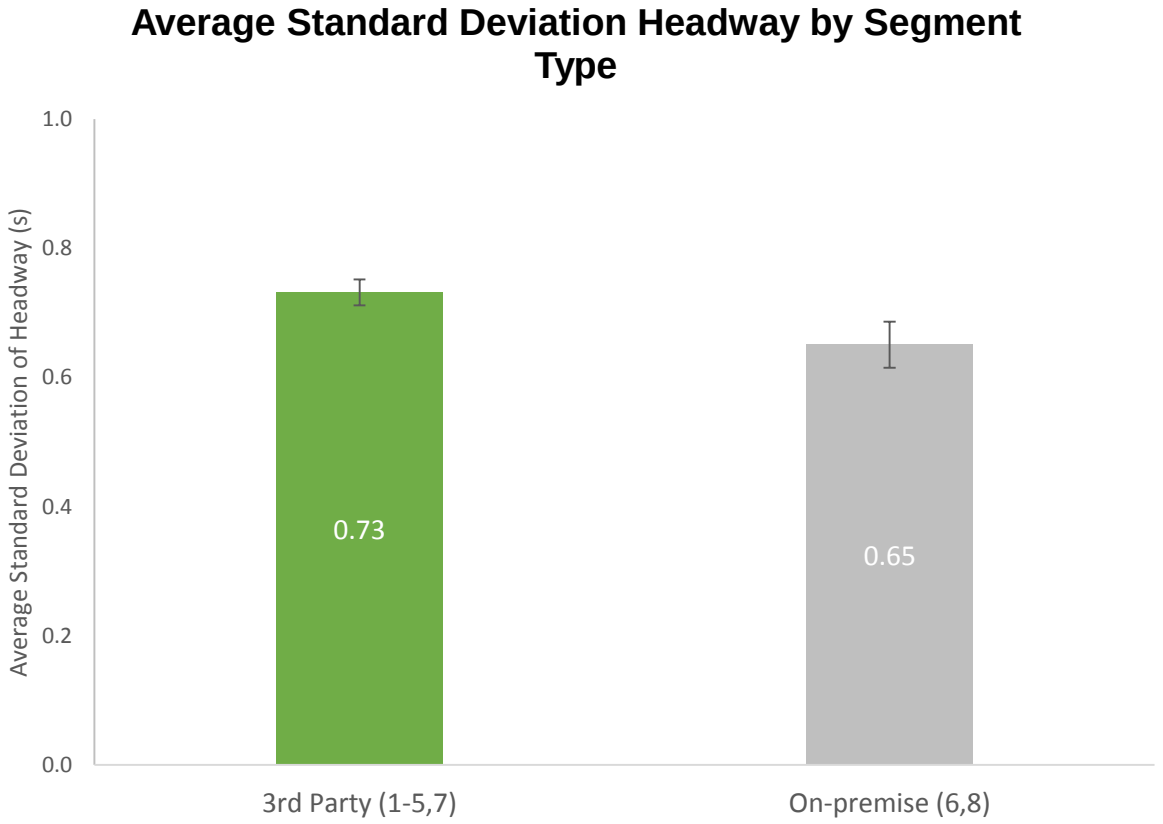
Headway Deviation Analysis by Segment Type

Does average standard deviation of headway differ significantly in the presence of 3rd party compared to on-premise signage?

Discussion:

This graph shows the average standard deviation of vehicle headway in seconds in the presence of different sign types.

Headway deviation is larger in the presence of 3rd party compared to on-premise signage. However, this difference was not statistically significant when using the Bonferroni correction.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
3rd Party v On-premise	F(1,26)=6.323,.p=.018	Not Significant	Significant

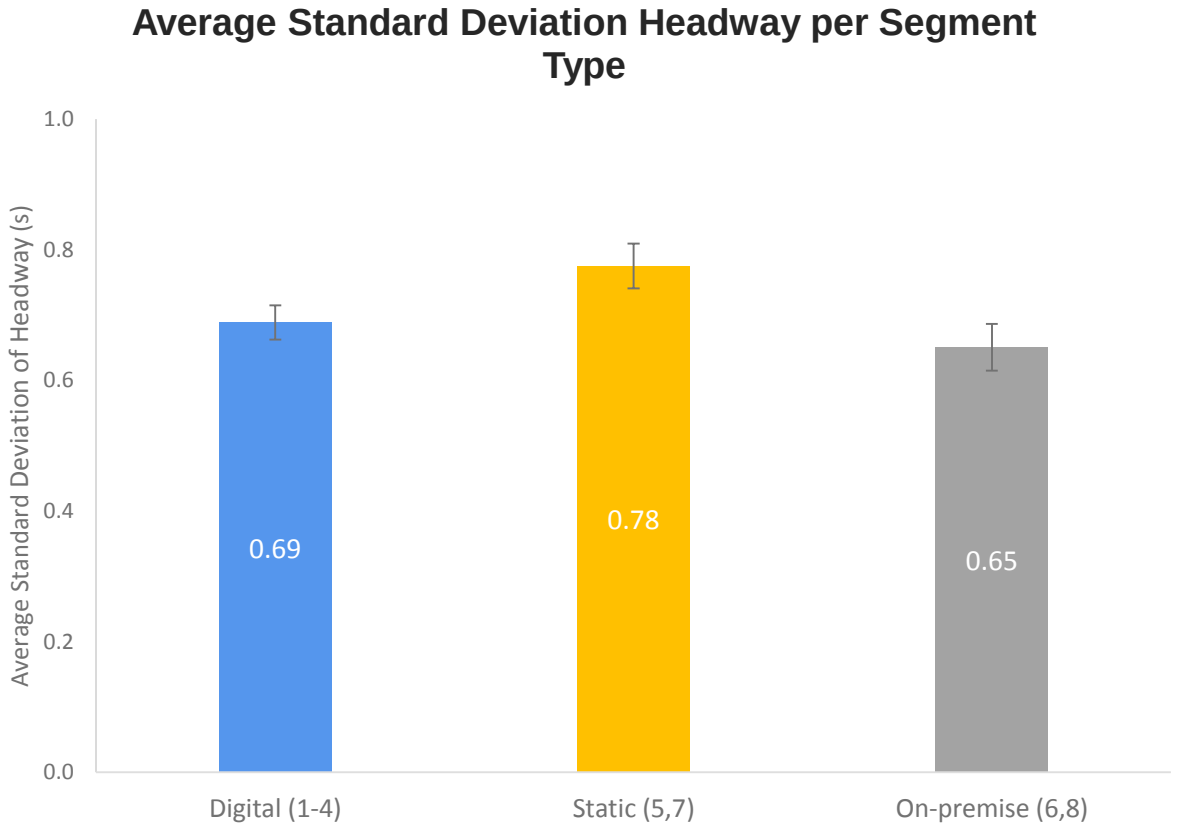
Headway Deviation Analysis by Segment Type

Does average standard deviation of headway differ significantly in the presence of digital and static signage compared on-premise signage?

Discussion:

While this graph shows decreased average standard deviation of headway for digital compared to static signage, this difference is not significant.

However, the results also show that average standard deviation of headway is greater in the presence of static compared to on-premise signage. This difference was statistically significant.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
Digital v Static	F(1,26)=3.651, p=.067	Not Significant	Not Significant
Digital v On-premise	F(1,26)=.715, p=.406	Not Significant	Not Significant
Static v On-premise	F(1,26)=12.776, p<.001	Significant	Significant

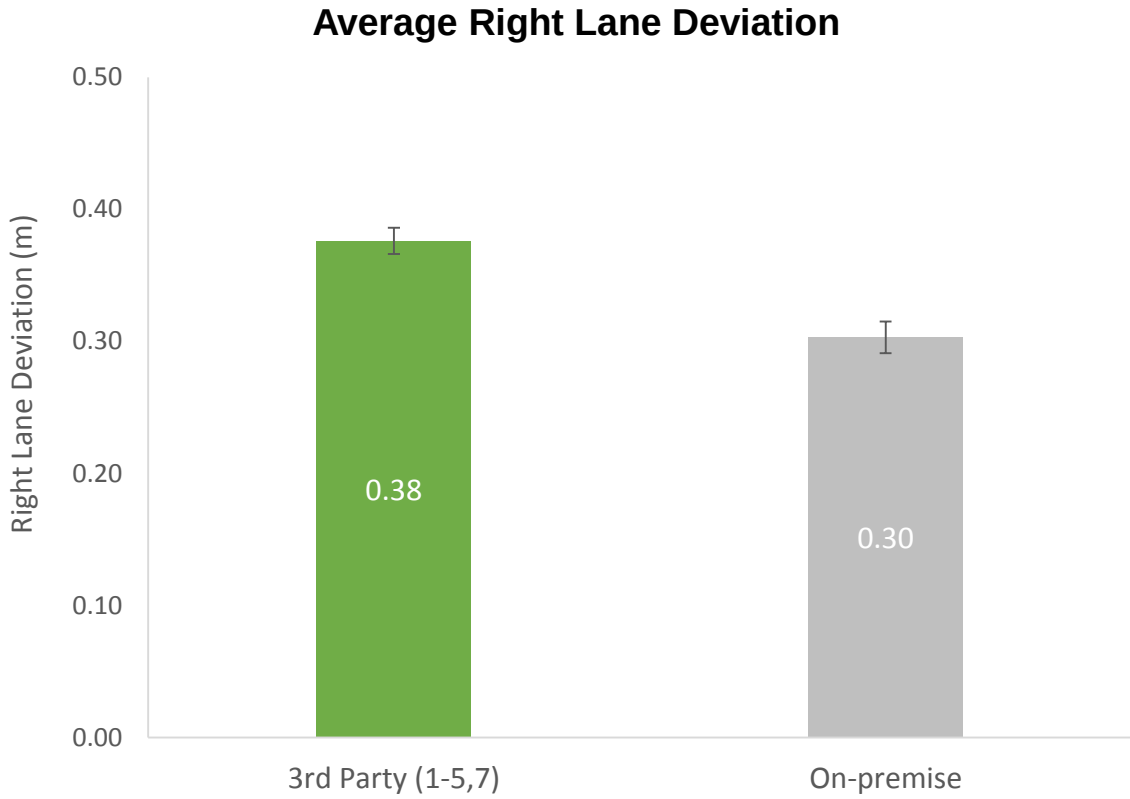
Lane Deviation Analysis by Segment Type

Does average lane deviation differ significantly in the presence of 3rd party compared to on-premise signage?

Discussion:

This graph shows the average lane deviation in metres in the presence of different sign types.

Lane deviation was greater in the presence of 3rd party compared to on-premise signage. This result was statistically significant.



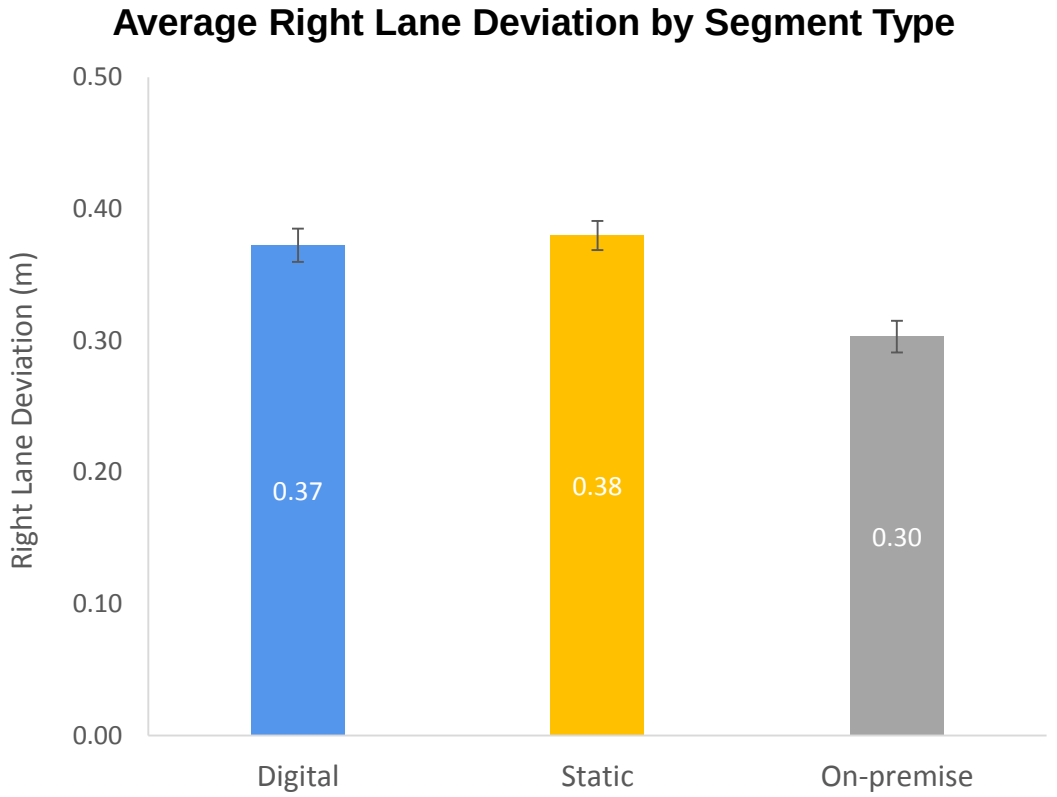
Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
3rd Party v On-premise	F(1,27)=23.846, p<.001	Significant	Significant

Lane Deviation Analysis by Segment Type

Does average lane deviation differ significantly in the presence of digital and static signage when compared to on-premise signage?

Discussion:

While there was no difference in average lane deviation in the presence of digital compared to static signage, lane deviation was greater in the presence of both digital and static signage when compared to on-premise signage.



Comparison	Statistics	Corrected (α=0.0125)	Uncorrected (α=0.05)
Digital v Static	F(1,27)=.333, p=.569	Not Significant	Not Significant
Digital v On-premise	F(1,27)=14.917, p<.001	Significant	Significant
Static v On-premise	F(1,27)=28.183, p<.001	Significant	Significant

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5. Qualitative Assessment of Effective Signage

Qualitative Assessment of Effective Signage

Evaluation of the most effective signs indicated four rules of thumb:

Left, high and centre

The most effective signs tend to be positioned left of the road, above street level and central from the driver's point of view.

Easy driving encourages viewing

Signs tend to be looked at more in road conditions that require less attentional demands on the driver.

For example, predictability of traffic conditions and greater perceived hazards may take up attentional resources that could otherwise be allocated to signs.

Leverage existing navigation signs

High performing signs were also found to be directly above navigation signs.

Signs placed in the vicinity of navigation signs take advantage of intentional fixations and parafoveal vision.

Drivers in traffic look for longer

Signs placed in proximity to traffic lights take advantage of stationary or slow moving traffic.

Note: ad placement must also take into account effective communication distance. That is, smaller street furniture would need to be placed closer to a traffic light than a static billboard in order for it to be effective.

7. References

References

- Crundall, D., Van Loon, E., & Underwood, G. (2006). Attraction and distraction of attention with roadside advertisements. *Accident Analysis & Prevention*,*38*(4), 671-677.

- Dunn, O. J. (1961). Multiple comparisons among means. Journal of the American Statistical Association, 56(293), 52-64.

- Hanowski, R. J., Olson, R. L., Hickman, J. S., & Dingus, T. A. (2006). *The 100-Car Naturalistic Driving Study: A Descriptive Analysis of Light Vehicle-Heavy Vehicle Interactions from the Light Vehicle Driver's Perspective, Data Analysis Results* (No. FMCSA-RRR-06-004).

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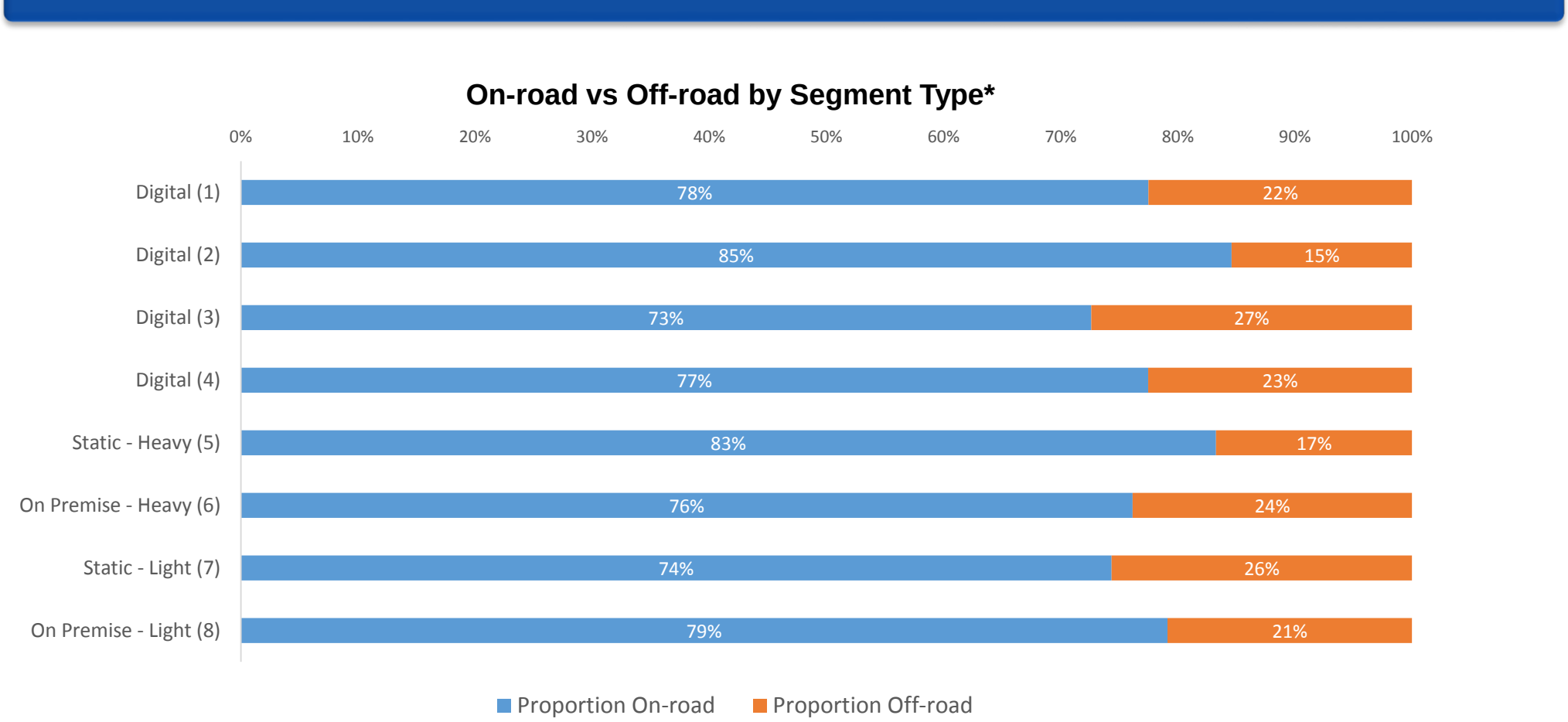
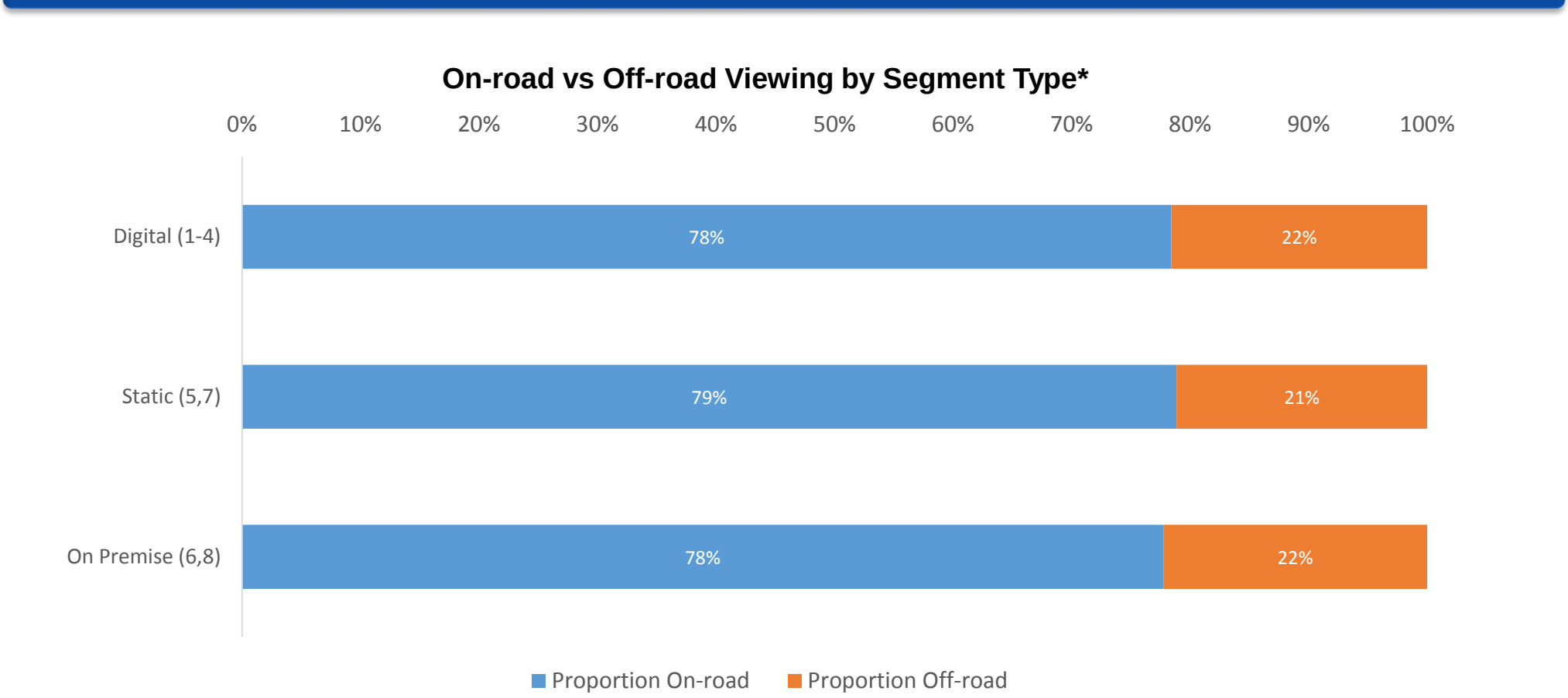
8. Appendix - Additional Results

On-Road vs Off-Road Viewing Across Segments



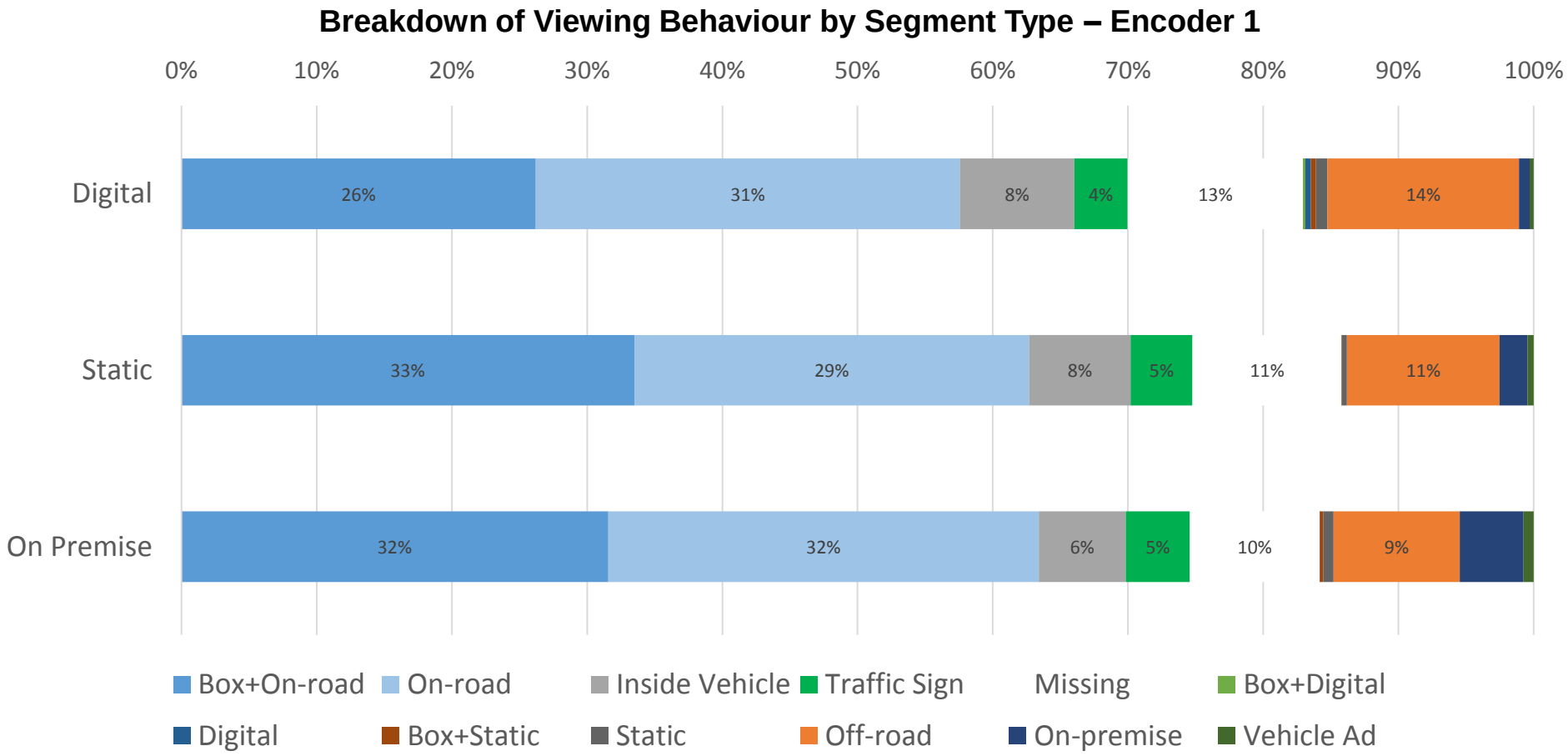
*The graph shows the dwell times aggregated across both encoders.

On-Road vs Off-Road Viewing by Segment Type

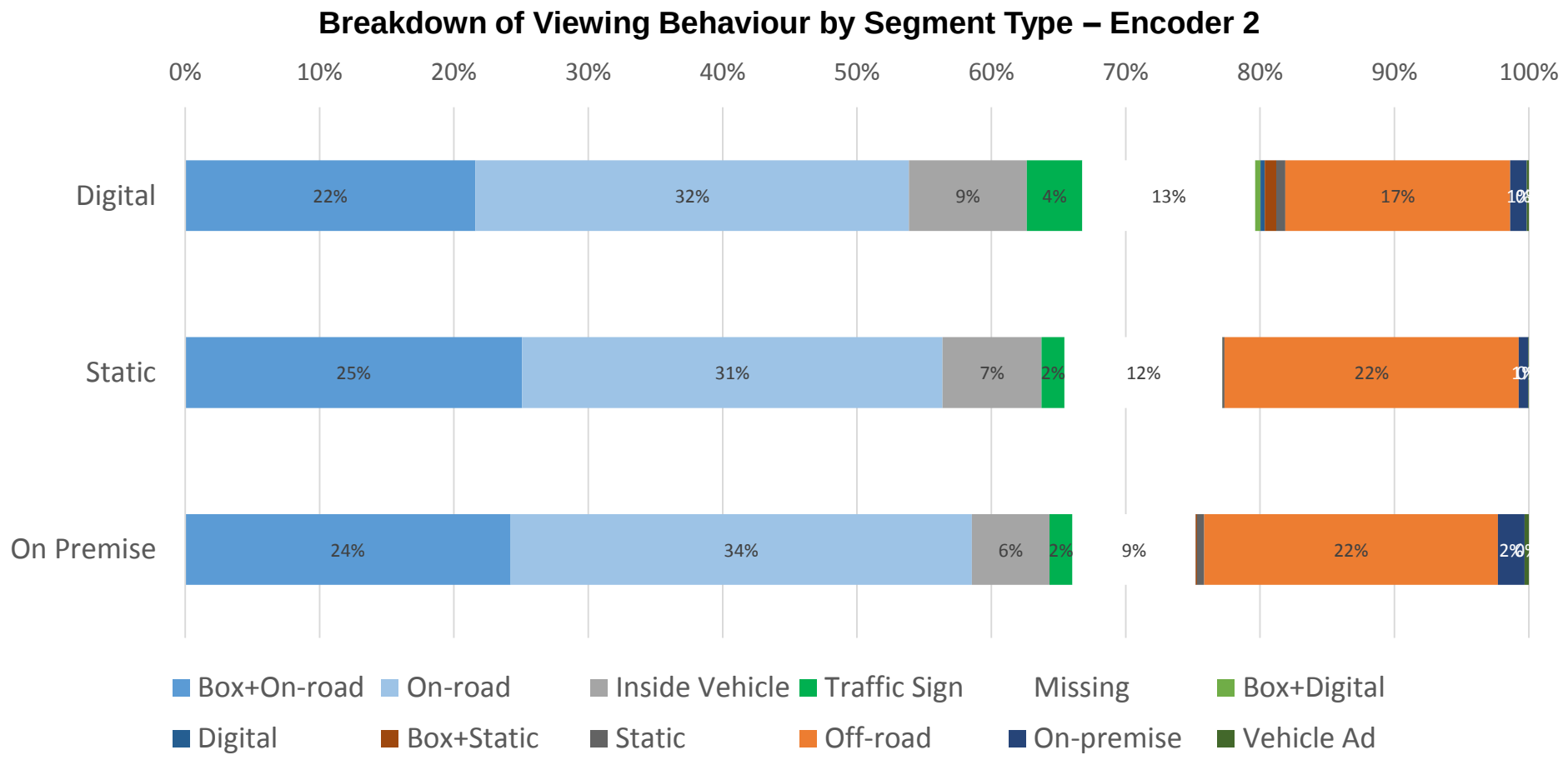


*The graph shows the dwell times aggregated across both encoders.

Breakdown of Viewing Behaviour by Segment Type



Breakdown of Viewing Behaviour by Segment Type



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"see through your customers' eyes"