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Transport for NSW
M1 North Smart Motorway

Urban Design Concept and Landscape Character and Visual Impact Assessment
P16-084
10.09.2020
M1NSM-DC-UD-RPT-0001[7]

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1. Introduction

1.1 Background

The M1/A4 Motorway Corridor is a key piece of Sydney road transport infrastructure. It is located adjacent to and within the global city of Sydney, the North Sydney and Sydney CBDs and heritage conservation areas including the Sydney Opera House World Heritage Zone and Sydney Harbour Bridge State and National heritage listing curtilage.

The corridor experiences a high level of congestion on the motorway and adjoining major arterial roads and local roads. Congestion results in a breakdown in traffic flow and generally less safe and poor driving conditions with 'start-stop' driving, accidents and delays contributing to poor travel reliability.

To address the increasing congestion in Sydney, Transport for NSW established a stand-alone program office called Easing Sydney's Congestion (ESC). Following ESC's strategic review, the New South Wales and Australian governments agreed to the development of the M1NSM project. This project will introduce intelligent technology, known as a Smart Motorway. This includes adoption of a suite of technologies and infrastructure upgrades, to improve the management of the motorway and arterial road traffic flows, congestion and incidents.

The project is referred to as the M1NSM throughout the remainder of this document. It will deliver significant benefits to motor users and the broader road network by providing safer journeys, more reliable and consistent travel times, and improved incident response management.

1.2 The study area

Refer Figure 1: Sydney Region Overview and Figure 2: M1 North Smart Motorway Route.

The M1NSM project works extend 8kms along the M1/A4 corridor from Milsons Point in North Sydney to the western approach to Anzac Bridge at the intersection of Victoria Road, Rozelle. This project does not include the Sydney Harbour Tunnel in the scope of works.

The M1NSM route is located within the Federal Electorates of North Sydney, Sydney and Grayndler; the State Electorates of North Shore, Sydney and Balmain. The project extends through the three Local Government Areas (LGAs) of North Sydney, City of Sydney and the Inner West.

For the purposes of the contextual analysis and the landscape character assessment the study area has been limited to 200m either side of the motorway. A significant portion of the study corridor and associated access ramps are on elevated structures, particularly adjacent to the Sydney CBD. The route also incorporates the National and State heritage significant infrastructure elements of the Sydney Harbour Bridge and Anzac Bridge and the World Heritage Opera House viewshed.

Entry ramps to the study corridor along the route include connections to the Cross City Tunnel, the city CBD and Pyrmont.

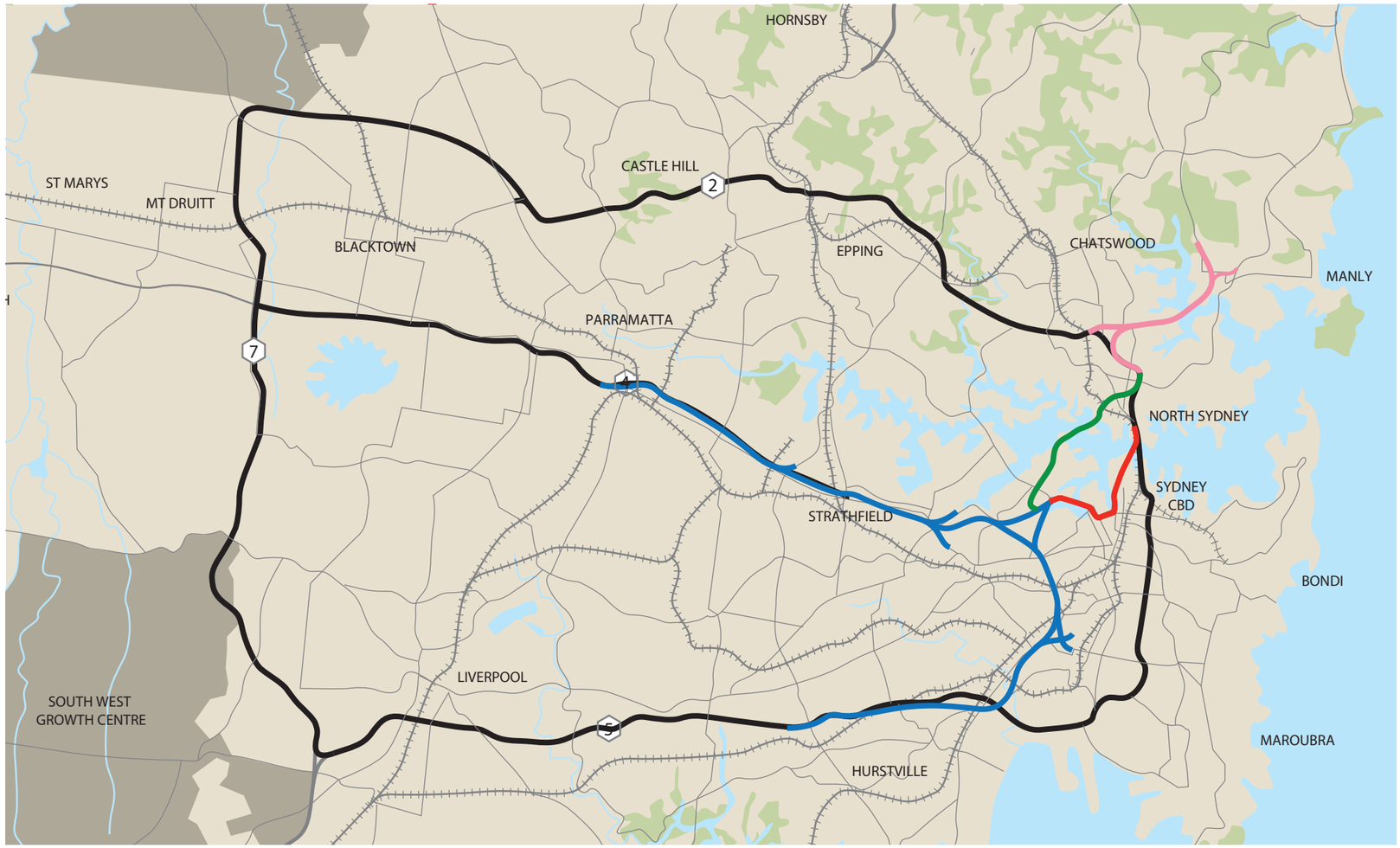


Figure 1: Sydney Region Overview

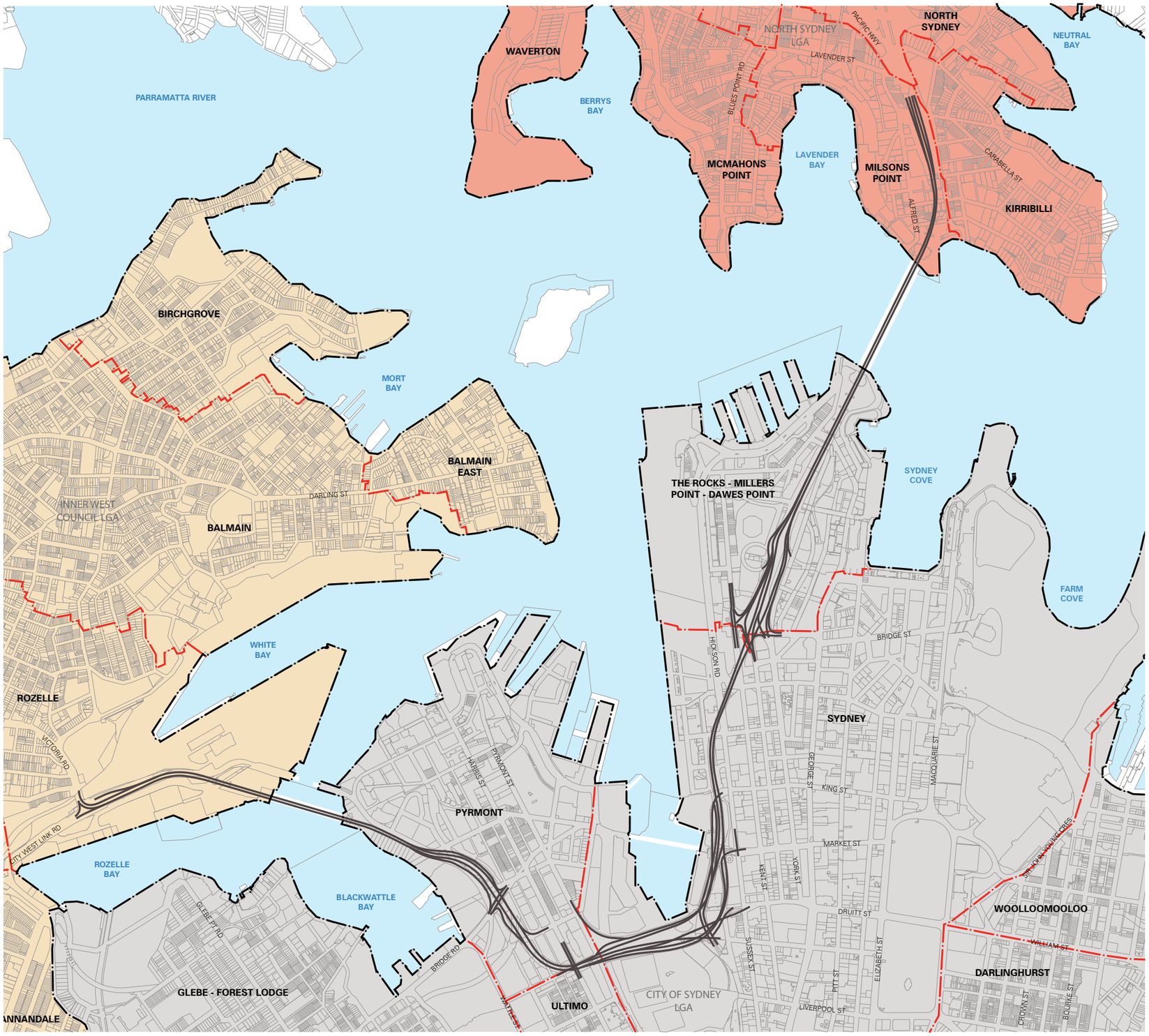


Figure 2: M1 North Smart Motorway Route

1.3 Purpose of this report

This report has been prepared for Transport for NSW (TfNSW) by DesignInc as part of the M1NSM Concept Design and Review of Environmental Factors (REF) process. The report outlines an urban design response to the challenge of retrofitting potentially quite visible traffic management infrastructure along a major city road corridor which traverses multiple, distinct city precincts.

1.4 Key reference documents

Roads and Maritime has produced a comprehensive list of design guideline documents aimed at achieving good urban design outcomes. This report has been undertaken with reference to the following published documents:

- *Beyond the Pavement* (TfNSW, 2020)
- Bridge Aesthetics Design Guidelines (Roads and Maritime, 2019)
- Noise Wall Design Guideline (Roads and Maritime, 2016)
- Shotcrete Design Guidelines (Roads and Maritime, 2016)
- Landscape Design Guideline (Roads and Maritime, 2018)
- Guidelines for Landscape Character and Visual Impact Assessment (Roads and Maritime, 2018).

1.5 Overview of the project

Transport for NSW proposes to introduce intelligent technology, known as a smart motorway system, to the M1 corridor between Milsons Point and the western approach to Anzac Bridge at Rozelle (the proposal and the proposal corridor). The suite of integrated 'smart' technologies and infrastructure upgrades will improve the management of the motorway and arterial road traffic flows, congestion and incidents. Smart technologies include vehicle detection, CCTV and cableways, dynamic speed and lane use management and electronic message signs along the motorway and on approach roads.

These systems, also referred to as Intelligent Transport Systems (ITS), integrate with the overall Managed Motorway System (MMS) to monitor traffic conditions, manage congestion and respond to incidents in real-time. Key features of the proposal would include:

- New gantries at 17 locations
- Integrated Speed and Lane Use Sign (ISLUS) on 16 new gantries and on the King Street overpass (northbound), and the King Street footbridge (southbound)
- Dynamic directional signs collocated on the eight of the new ISLUS gantries, on two existing Sydney Harbour bridge gantries, on the King Street footbridge and on a new gantry near the Clarence Street / Grosvenor Street entry / exit ramp
- New Variable Speed Limit Signs (VSLS) (11 in total) to provide speed limit information for vehicles entering the M1 corridor
- Retention of existing lane control signs and replacement of existing VSLS with new VSLS on existing Sydney Harbour Bridge gantries
- Wayfinding infrastructure including directional signs, lane allocation signs, advance exit signs and exit direction signs that allow strategic placement of key messages and repeater messages to optimise lane selection and lane changes
- Smart motorway hazard and vehicle detection system covering the full elevated motorway and sections without a shoulder/emergency lane.
- On and off ramp vehicle detection.
- Closed circuit television camera infrastructure (CCTV) to achieve full coverage across the corridor
- Minor changes to lane alignments, asphalt resurfacing and line marking changes along the Western Distributor
- Cables, pits, conduits and cabinets to support intelligent transport systems (ITS).

1.6 Overall project objectives

The overall objective of the M1NSM project is to:

- Increase network resilience
- Improve travel time and reliability
- Improve traffic safety
- Enhance the road user experience
- Optimise transport asset utilisation and investment.

1.7 Study objectives

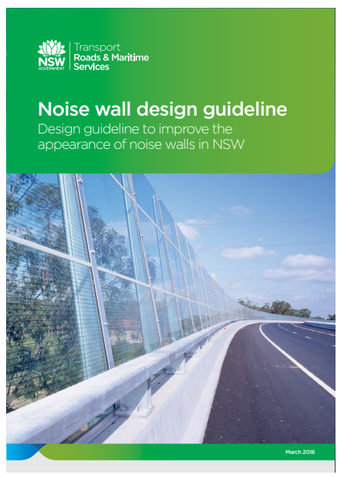
From the Roads and Maritime urban design scoping document (PS281), the objectives of the urban design for the project are:

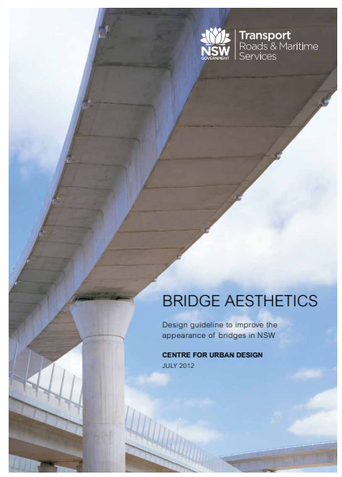
(i) To develop and present an integrated engineering and urban design outcome that:

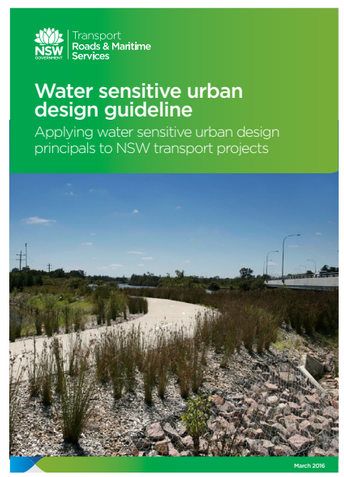
a. Fits sensitively into the built, natural and community environments through which it passes, is well designed and contributes to the character and functioning of the area.

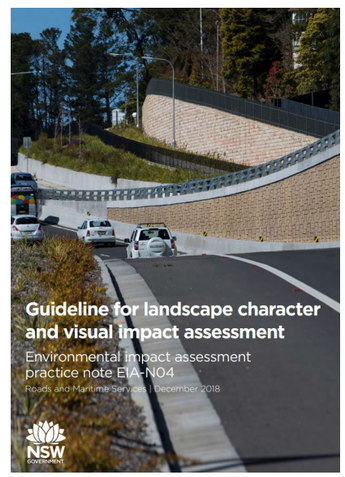
b. Contributes to the accessibility and connectivity of people within regions and communities.

c. Contributes to the overall quality of the public domain for the community and all road users.









1.8 Study methodology

The study follows an iterative process where key issues, constraints and mitigations relating to the landscape character and visual assessment of the alignment are integrated into the engineering and urban and landscape concept design. The study comprises the following key components:

- Contextual Analysis
- Landscape Character Assessment
- Visual Impact Assessment
- Proposed Urban Design Strategy
- Urban and Landscape Concept Design
- Mitigation Recommendations.

The methodology used in this Landscape Character and Visual Impact Assessment is based on the Roads and Maritime *Guidelines for landscape character and visual impact assessment*. The methodology in the guidelines has been modified to suit the characteristics and requirements of this particular project. Inputs to the design concept have been attached as an Appendix.

1.8.1 Contextual analysis

A contextual analysis of the built, natural and community character, structure and functioning of the study area is provided. This summary identifies issues and opportunities that have arisen from this analysis.

1.8.2 Landscape character assessment

This task involved photographing, mapping, understanding and describing the different landscape character zones in the study area, and determining and describing the capacity of these different zones to visually absorb the proposed upgrade. A landscape character zone is an area of distinct and consistent character and the impact of the proposed upgrade works within it may differ from the impact in another zone. Landscape character zones are mapped and described in Section 3.0.

Two primary factors are used to determine the impacts on any landscape character zone:

- Sensitivity of the character zone.
- Magnitude of the proposal in that zone.

The **sensitivity** of a landscape character zone is used in both Landscape Character Zone Impact Assessment and in the subsequent Visual Impact Assessment.

The Roads and Maritime *Guidelines for landscape character and visual impact assessment* (2013) defines sensitivity as: "*The sensitivity of a landscape character zone or view and its capacity to absorb change. Combined with magnitude, sensitivity provides a measure of impact.*" (Roads and Maritime, EIA-N04, p.6).

It further states: "*Sensitivity refers to how sensitive the character of the setting is to the proposed change. For example a pristine natural environment will be more sensitive to change than an industrial area.*" (Roads and Maritime, EIA-N04, p.9).

The capacity to absorb development is primarily dependent on landform, vegetation cover and existing structures. The more pristine the landscape, the greater the consequence of introducing new development and therefore the higher the sensitivity rating of that zone. Areas that have been previously modified for viaducts and other large building development would be ranked lower than (for example) areas such as the Royal Botanic Garden, special character areas such as The Rocks Conservation Area or the Sydney Harbour Bridge or Anzac Bridge precincts. A character zone with a coherent character, for example the Royal Botanic Garden, would be more visually sensitive to any new development than a precinct whose topography and natural and/or built character has greater variety such as Darling Harbour or Cockle Bay. Urban areas that are used for commercial or industrial uses may be ranked lower than, for example, areas that are predominantly residential in nature.

The **magnitude** of a proposal in a landscape character zone depends firstly on the scope of that proposal. For this project, replacing existing road signage and gantries would typically have a lesser magnitude than a new gantry. The location of the proposal in relation to the character zone also influences magnitude. For example, a proposal which is located in the middle of a character zone would have greater magnitude than one which is located on the edge of a zone. Six categories are used in ranking the magnitude of a proposal, ranging from negligible to high.

The **Landscape Character Zone Impact** is determined using the matrix shown in Table 1. Rankings for sensitivity and magnitude are combined to generate the impact in the body of the table.

Sensitivity \ Magnitude	HIGH	MODERATE	LOW	NEGLIGIBLE
HIGH	HIGH IMPACT	MODERATE - HIGH	MODERATE	NEGLIGIBLE
MODERATE	MODERATE - HIGH	MODERATE	LOW - MODERATE	NEGLIGIBLE
LOW	MODERATE	LOW-MODERATE	LOW IMPACT	NEGLIGIBLE
NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

Table 1: Landscape Character and Visual Impact Grading Matrix, Roads and Maritime, (2013)

It is important to note that Landscape Character Zone Impact Assessment has to do with the way and extent to which a proposal alters the perceived nature, or sense of place, of a zone. Change to the character of a zone would be felt and understood even when a zone extends beyond the immediate study area.

1.8.3 Visual impact assessment

This task involved assessing the likely visual impact of the proposal from key viewpoints. The assessment was limited to gantry and smaller VMS structures that were determined to be the most visually significant design elements. The following tasks were completed:

- A desktop analysis to ascertain the visual catchment of the proposal within the study area, as well as identifying potential receptors of the visual impact - determined through topographic analysis and using Google Maps. This provides the basis for the establishment of the Visual Envelope Map (VEM), view corridors, and key viewpoints
- An on-site field inspection to confirm the visual catchment, gain an understanding of the proposal within the context of the study area and identify and confirm key viewpoints and the sensitivity of potential visual receptors. This included site photography some of which, was later used in the viewpoint analysis
- The sensitivity rating of each viewpoint is based on the sensitivity ranking of the landscape character zone in which it is located
- The magnitude is measured as the degree of change the particular view undergoes as a result of the proposed development. Relative to the existing condition, magnitude is ranked on a six point scale from negligible to high
- In a process similar to that used for landscape character zone impact assessment, the visual impact is assessed by combining the viewpoint sensitivity and the magnitude of the proposal as illustrated by the matrix in Table 1.

1.8.4 Proposed urban design strategy

This task involved development of an Urban Design Strategy that articulates a vision, principles and objectives that guided the development of the concept design and that addresses the identified landscape character and visual impacts. It comprises four main objectives based on the Roads and Maritime "*Beyond the Pavement*" guideline and the Project Urban Design Objectives with principles to achieve those objectives. Refer Section 5.0 Urban Design Strategy.

1.8.5 Urban and landscape concept design

Development of a Concept Design proposal that is described in plans, sections/elevations, precedent photographs and other drawings, as appropriate. The Concept Design describes the proposed gantry locations and the structural forms and fixing options. The signage configurations and requirements have largely guided the design. Refer Section 6.0 Concept Design.

1.8.6 Mitigation recommendations

Recommendations are made for mitigation measures that might be further adopted during the detailed design to reduce, minimise or eliminate unwanted impacts. This is provided in Section 7.0 Recommended Mitigation Measures.

2. Contextual analysis

This section documents the study area's key built, natural, and cultural factors that may influence the design of the Project. The purpose of this background information is to understand the individual aspects that make up the landscape character of the study area and to identify the potential sensitivities associated with each character zone.

2.1 Land use

Refer Figure 3: Land use.

The land uses alongside the M1NSM route are typical of a highly urbanised global city centre. The edges of the corridor comprise a mix of commercial, residential and mixed-use buildings, often tall towers or large cultural buildings.

The western section of the corridor in Rozelle and Pyrmont traverses a mixture of land uses, which are predominantly industrial. It is important to note that a large area of land in Rozelle and Balmain forms part of the Sydney Regional Environmental Plan (SREP) No. 26 – City West, now called The Bays Precinct and is being managed by UrbanGrowth NSW.

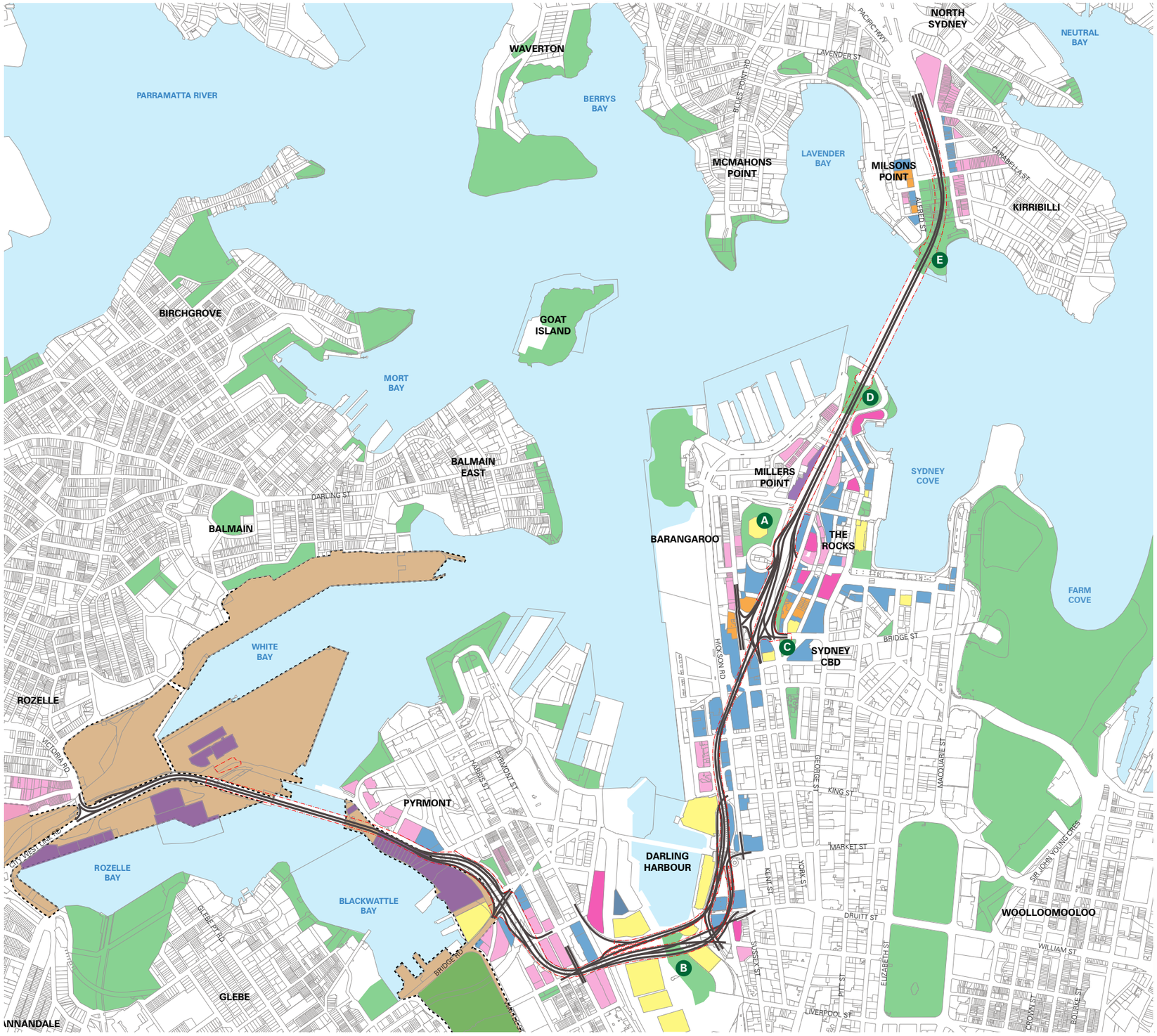
UrbanGrowth NSW's work on The Bays Precinct sits within the context of a wider NSW Government policy agenda for Sydney and the state of NSW set out in *A Plan for Growing Sydney* (NSW Government, Planning and Environment, 2014). The Bays Precinct is 95 hectares of largely government-owned land. It comprises 5.5kms of harbourfront, and 94 hectares of waterways in Sydney Harbour. *The Transformation Plan: The Bays Precinct*, Sydney (UrbanGrowth NSW, 2015) establishes a strategy for how the precinct can create:

"..a bustling hub of enterprise, activity and beautiful spaces over the next 20 to 30 years to be enjoyed by Sydneysiders and the global community alike. The Bays Precinct aims to build on its heritage, support its local communities, provide safe, beautiful and exciting places and spaces, optimise maritime uses and develop social capital to support the growth of Sydney as an internationally competitive and globally relevant city."

There are a number of unique and notable land uses near Darling Harbour, such as the International Convention Centre, Sydney Aquarium and Sydney Wildlife World directly adjacent and visible from the motorway corridor.

Urban public spaces occur along the length of the corridor in the form of city plazas, major pedestrianised thoroughfares or green open space. Significant green open spaces occur at:

- Observatory Hill Park
- Tumbalong Park at Darling Harbour
- Lang Park in York Street, Sydney
- Dawes Point Park and Hickson Reserve at the southern abutment of the Sydney Harbour Bridge
- Milsons Point and Bradfield Park at the northern abutment of the Sydney Harbour Bridge.



- M1 NORTH SMART MOTORWAY
- STUDY AREA
- GREEN OPEN SPACE / PARKS
- COMMERCIAL
- RESIDENTIAL
- MIXED USE
- CULTURAL
- INDUSTRIAL
- HOTEL
- SREP 26 CITY WEST AREAS (THE BAYS PRECINCT)

SIGNIFICANT GREEN OPEN SPACES ADJACENT TO THE PROJECT:

- A OBSERVATORY HILL PARK
- B TUMBALONG PARK
- C LANG PARK
- D DAWES POINT PARK AND HICKSON RESERVE
- E MILSONS POINT AND BRADFIELD PARK

Figure 3: Land use

2.2 Existing road formation

Refer Figure 4: Existing Road Configurations.

The M1NSM route is a complex combination of bridge and viaduct structures. Very little of the road corridor is on grade with minimal road shoulders and landscape verges found in traditional roadscape projects. The dense city urban fabric, and the incremental development of the motorway infrastructure, has restricted the road footprint and resulted in elevated structures. The motorway corridor traverses culturally and economically valuable tracts of land. Viaduct structures allow ground level uses and existing connections, both traffic and pedestrian, to be retained.

The following structures occur, noted from west to north on the A4 route:

A. City West Link on ramp to the Anzac Bridge is an underpass beneath the Victoria Road Intersection.
B. Retained earth structure facing Rozelle Bay and Glebe Island/White Bay forms the corridor edge in the approach to the Anzac Bridge.
C. The Anzac Bridge cable-stay structure.
D. Viaduct through Pyrmont and Ultimo.
E. Ramp connections with Bridge Road which are retained earth structures.
F. Viaduct over Darling Harbour.
G. On and off-ramps in Darling Harbour are multi-layered bridge structures.
H. Viaducts on the eastern edge of Darling Harbour with on and off-ramps which are retained earth structures.
I. Multi-layered viaduct through the CBD.
J. On and off-ramps around the CBD are viaducts, multi-level bridge structures or retained earth structures.
K. Observatory Hill spiral road cutting.
L. The Sydney Harbour Bridge approach spans on viaduct structures, sometimes enclosed and in use as commercial spaces.
M. The Sydney Harbour Bridge steel arch structure.

There is a long history, legacy, and layers of road development in this corridor; including the attachment of additional elements, such as signs and walkways, to the elevated viaducts along the motorway corridor. There are two successful languages of attachments visible amongst the existing examples:

1. The connections are concealed with coloured cladding material and expressed as art additions to the public realm. They are made more visible and intrude visually into the public space, celebrated as a positive contribution.
2. The connections are carefully refined. The structural components and fixings create elegant architectural compositions.

In other cases, the additional structures are attached in ill-considered ways and do not enhance either the structure or the public domain. Refer to the adjacent photos.

Signs, lightpoles and other road furniture create and additional layer of physical form. In most cases it forms an ephemeral layer of fine scaled urban clutter.

Examples of successful elements added to existing structures.

Examples of poorly done elements added to existing structures.

STUDY AREA

GREEN OPEN SPACE / PARKS

VIADUCT

RAMP

BRIDGE

TUNNEL

NOISE WALLS

STRUCTURES:

A CITY WEST LINK ON RAMP TO THE ANZAC BRIDGE

B RETAINED EARTH STRUCTURE CORRIDOR EDGE

C THE ANZAC BRIDGE CABLE-STAY STRUCTURE

D VIADUCT THROUGH PYRMONT AND ULTIMO

E RAMP CONNECTIONS

F VIADUCT OVER DARLING HARBOUR

G ON AND OFF-RAMPS IN DARLING HARBOUR

H VIADUCTS

I MULTI-LAYERED VIADUCT

J ON AND OFF-RAMPS AROUND THE CBD

K OBSERVATORY HILL SPIRAL ROAD CUTTING

L THE SYDNEY HARBOUR BRIDGE APPROACH

M SYDNEY HARBOUR BRIDGE STEEL ARCH STRUCTURE

0 1000m

Figure 4: Existing Road Configurations

2.3 Non-Aboriginal heritage

Refer Figure 5: Non-Aboriginal Heritage.

The major heritage item to be considered on this project is the Sydney Harbour Bridge which is listed on the NSW State Heritage Register and the National Heritage List.

The diagram shows the NSW State Heritage Register curtilage for the Sydney Harbour Bridge which is identical to that of the National Heritage Listing curtilage, except that the State Heritage Register curtilage also includes the northern approaches between Lavender Street and Arthur Street in Milsons Point. Both curtilages include land that is in the ownership of the NSW Government, the Sydney Harbour Foreshore Authority, the City of Sydney, North Sydney Council and Railcorp.

The Sydney Harbour Bridge, Circular Quay, and the Royal Botanic Garden are also located within the World Heritage listed Sydney Opera House buffer zone. The Sydney Opera House buffer zone centres on the nearby waters of Sydney Harbour. It includes places around Sydney Harbour within a radius of 2.5km that have been identified as offering critical views to and from the Sydney Opera House that contribute to its World Heritage significance. The buffer zone includes the Sydney Harbour Bridge in its entirety and most of its approach spans.

These are the statutory curtilages which need to be considered with any proposal as part of the M1 Smart Motorway. However, there are other considerations for views from further afield both to and from the Sydney Harbour Bridge and for other landmark structures such as the Anzac Bridge.

The Anzac Bridge has NSW State significance because of its technical qualities: it is a world standard bridge in scale, aesthetics and design features. The renaming of the bridge as Anzac Bridge in 1998 provided the structure with a link to the Anzac legend, a part of Australian heritage and folklore deeply rooted in the Australian psyche. The two Anzac soldier statues, by artist Alan Somervillle, are located at the western bridge abutment on either side of the road. The four metre bronze statue of an Australian World War 1 Digger was placed on the western end monument in 2000 and later, a similar statue of a New Zealand World War 1 soldier was placed on the south western approach in 2008. They are of significant cultural value and any new road structures, such as signage, should be located outside their visual curtilage.

Glebe Island Bridge across Johnstons Bay sits lower and parallel to Anzac Bridge. It is also listed on the State Heritage Register. The Glebe Island Bridge is of state significance as it demonstrates one of the earliest examples of an electric-powered swing bridge in Australia.

There are several conservation areas along the route. They include:

- The Rocks Conservation Area
- Millers Point Conservation Area
- Pyrmont Heritage Conservation Area
- Ultimo Heritage Conservation Area

Other smaller individual heritage listed buildings occur along the entire length of the M1 North corridor and have been mapped in the diagram. Other significant heritage items adjacent to and visible from the route are:

- Luna Park
- Milsons Point Railway Station

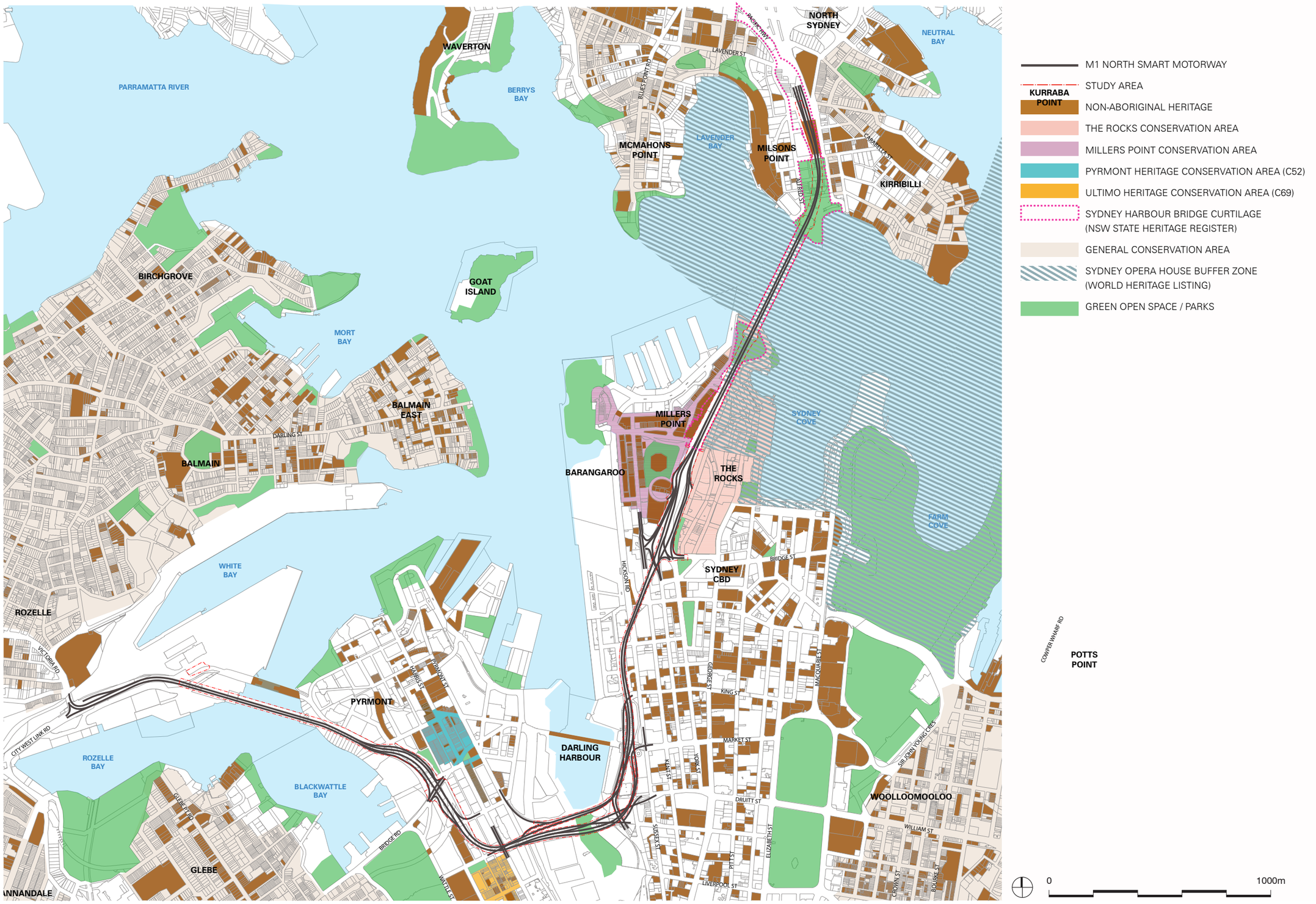


Figure 5: Non-Aboriginal Heritage

2.4 Landmarks & significant views

Refer Figure 6: Landmarks and Significant Views.

There are a number of additional significant views for the motorway user that the site visits have revealed. They include:

1. Views of the Anzac memorial statues on approach from the west to Anzac Bridge
2+3. The views of Anzac Bridge itself on approach from the east and west
4. Views of Darling Harbour travelling east after passing through Pyrmont
5+6. Views along the length of the motorway through the CBD on approach to the Sydney Harbour Bridge from both directions.

The major iconic landmarks include the Sydney Harbour Bridge and the Anzac Bridge however there are other landmarks that are area specific or useful for orientation and wayfinding for users of the motorway. They are captured on Figure 6: Landmarks and Significant Views and in order, travelling from the west, are:

A. The White Bay Power Station
B. The curved pedestrian bridge over the motorway at the Victoria Road interchange
C. The Anzac memorial statues on either side of the motorway
D. The Glebe Island silos
E. White Bay Cruise Terminal
F. Glebe Island Bridge
G. The Anzac Bridge
H. The Sydney Fish Markets
I. The Harbour Mill building to the west of the corridor in Pyrmont consists of a contemporary 10-storey residential structure which was built within the retained heritage façade and grain elevator room of the former Edwin Davey and Sons Flour Mill site. It is in an exposed location and highly visible from the M1 motorway.
J. International Convention Centre
K. National Maritime Museum
L. Pyrmont Bridge often noticeable for the banners waving in the wind
M. Darling Harbour is characteristic as an area where distant views become available from both directions because it is free of tall towers
N. Sydney Aquarium and Sydney Wildlife World
O. Observatory Hill
P. The Rocks
Q. Sydney Harbour Bridge and Sydney Harbour
R. North Sydney Swimming Pool
S. Luna Park
T. Sydney Opera House
U. Royal Botanic Garden.


01

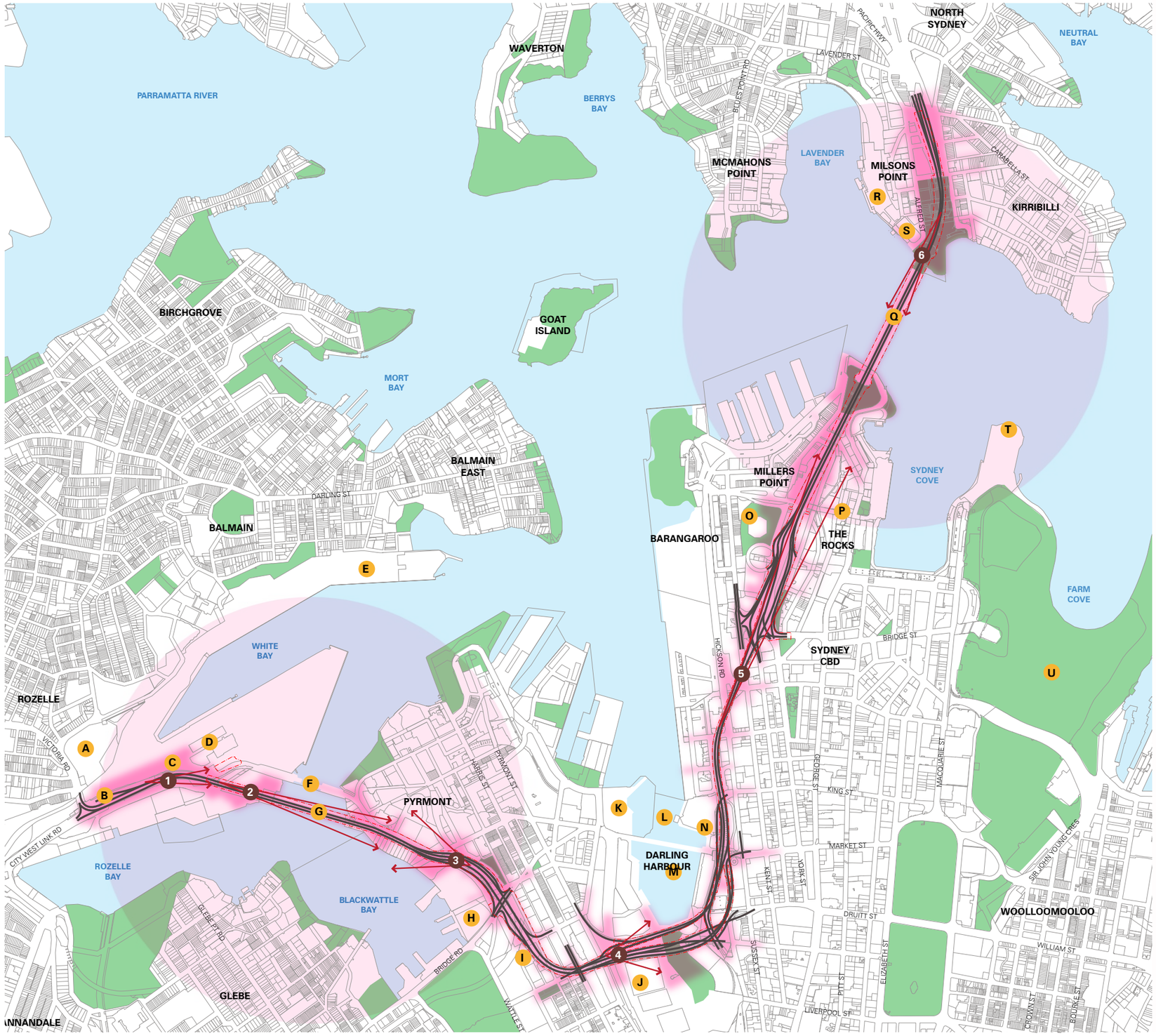

02


03


04

05


06



M1 NORTH SMART MOTORWAY

STUDY AREA

KURRABA POINT — GREEN OPEN SPACE / PARKS

VISUAL ENVELOPE

1 — SIGNIFICANT VIEWS

LANDMARKS:

- A WHITE BAY POWER STATION
- B FOOTBRIDGE
- C ANZAC MEMORIAL STATUES
- D GLEBE ISLAND SILOS
- E WHITE BAY CRUISE TERMINAL
- F GLEBE ISLAND BRIDGE
- G ANZAC BRIDGE
- H SYDNEY FISH MARKET
- I THE HARBOUR MILL BUILDING
- J INTERNATIONAL CONVENTION CENTRE
- K NATIONAL MARITIME MUSEUM
- L PYRMONT BRIDGE
- M DARLING HARBOUR
- N SYDNEY AQUARIUM & SYDNEY WILDLIFE WORLD
- O OBSERVATORY HILL
- P THE ROCKS
- Q SYDNEY HARBOUR BRIDGE
- R LUNA PARK
- S NORTH SYDNEY SWIMMING POOL
- T SYDNEY OPERA HOUSE
- U ROYAL BOTANIC GARDEN

0 — 1000m

Figure 6: Landmarks and Significant Views

2.5 City of Sydney special character zones & protected public views

Refer Figure 7: City of Sydney Special Character Zones and Protected Public Views.

There are a number of key views from within central Sydney, from parks and other well-used public places. These views often include important buildings or urban landscapes unique to central Sydney. Some significant vistas are silhouettes generated by the existing built form. These views have been identified as valuable by the City of Sydney Council in their Sydney Development Control Plan 2012, *Central Sydney Planning Strategy*, Draft Amendment 2016, pages 97-99. They include:

- View protection planes and Sydney Harbour views
- Protected views from public places
- Special character areas.

The objective of the development controls are to allow new development to make a positive contribution to the characteristics and composition of designated public views which should be preserved and have priority over private views. It is interesting to note that urban public domain structures such as street signs, light posts and other street furniture seldom detract from significant urban views or compositions. The City of Sydney plan also instructs that:

"The location of public domain structures such as trees and banners are to be considered ephemeral and should not be used as parameters to permit obstruction or encroachment into a protected public view."

Several of the public views to the water along city streets that need to be protected occur across the M1NSM route. They include views to the west from the CBD along:

- Margaret Street (Photo 01)
- Erskine Street (Photo 02)
- King Street (Photo 03)
- Market Street (Photo 04)

Views to and from Observatory Hill are perhaps some of Sydney's most historically significant and allow the public and visitors to Sydney to interpret and understand the evolution of Sydney as city. Therefore, Observatory Hill should retain its vast open aspect and distant views, a feature that informed its successive historic uses.

The Council has determined Special Character Areas based on the following criteria:

"Special Character Areas nominated within Central Sydney are considered to be of significance and important to the identity and quality of Central Sydney and include some or all of the following characteristics:

- *A character unmatched elsewhere in Central Sydney;*
- *A concentration of heritage items and streetscapes;*
- *A highly distinctive element in the public domain;*
- *A focus of public life with high cultural significance; and*
- *A widely acknowledged public identity."*

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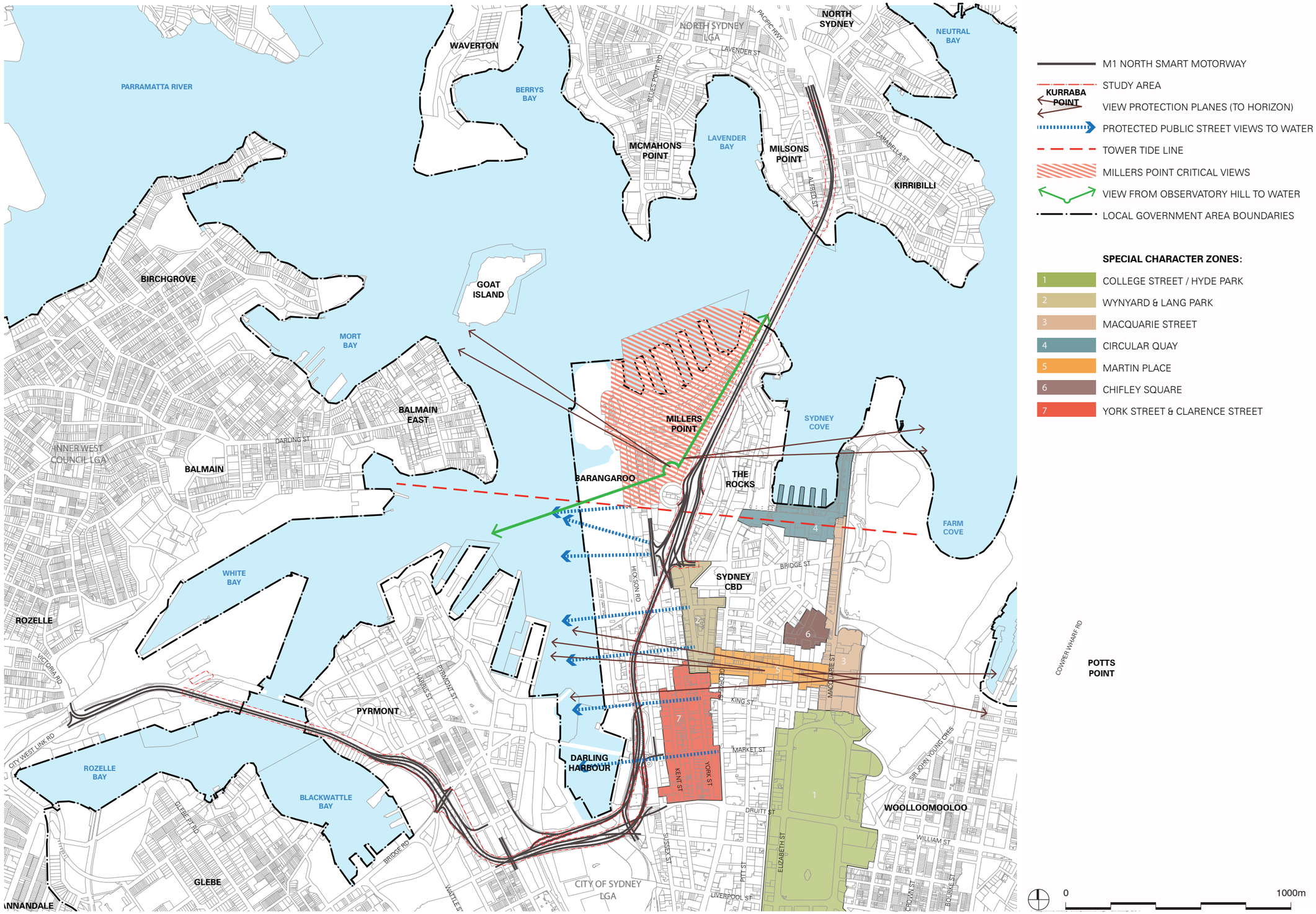

- M1 NORTH SMART MOTORWAY
- STUDY AREA
- VIEW PROTECTION PLANES (TO HORIZON)
- PROTECTED PUBLIC STREET VIEWS TO WATER
- TOWER TIDE LINE
- MILLERS POINT CRITICAL VIEWS
- VIEW FROM OBSERVATORY HILL TO WATER
- LOCAL GOVERNMENT AREA BOUNDARIES

SPECIAL CHARACTER ZONES:

1. COLLEGE STREET / HYDE PARK
2. WYNYARD & LANG PARK
3. MACQUARIE STREET
4. CIRCULAR QUAY
5. MARTIN PLACE
6. CHIFLEY SQUARE
7. YORK STREET & CLARENCE STREET

0 1000m

Figure 7: City of Sydney Special Character Zones and Protected Public Views

2.6 Pedestrian & cycle links

Refer Figure 8: Pedestrian and Cycle Links.

Pedestrian and cycleway links weave throughout the study area. The study area traverses a highly populated and pedestrianised urban environment where connection options are vital. Pedestrians are able to cross over and under the M1NSM route at a number of points such as:

- Victoria Road Interchange
- Darling Harbour Novotel Carpark across Harris Street
- Beneath both abutments of Anzac Bridge
- Pyrmont Bridge Road
- Darling Harbour Foreshore Area
- Bulwarra Road, Pyrmont.

Some crossing points occur in close proximity to each other connecting the city CBD to Darling Harbour, including:

- King Street
- Market Street
- Cockle Bay Wharf
- Druitt Street.

There is limited pedestrian/ cycle access provided alongside the motorway corridor. The only locations these do occur are at Darling Harbour, alongside the King Street off-ramp, on Anzac Bridge, and on the Sydney Harbour Bridge leading to the Cahill Expressway at Circular Quay.

Shared path on northern side of City West Link Road.

Shared path bridge crossing City West Link Rd..

Eastern approach to Anzac Bridge.

Shared path approach to Anzac Bridge from Pyrmont.

Shared path access to/from Anzac Bridge at Pyrmont.

Pedestrian bridge across Harbour Street at Darling Harbour.

Shared path on northern side of Western Distributor at Darling Harbour, looking west.

Pedestrian path on the eastern side of the Sydney Harbour Bridge viewed from the northern approach.

Pedestrian path on the eastern side of the Sydney Harbour Bridge at the southern pylon.

Pedestrian bridge crossing King Street.

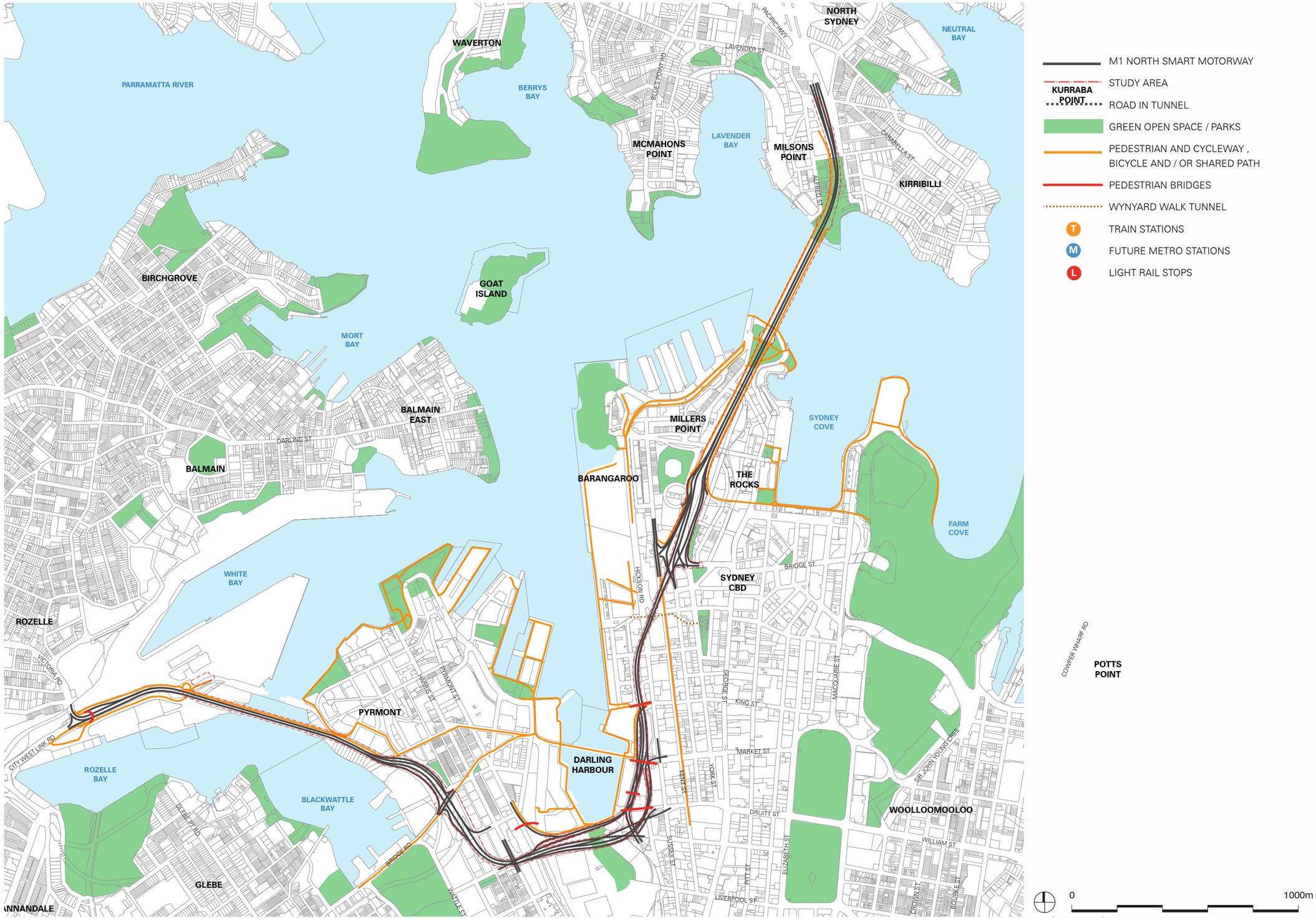

Figure 8: Pedestrian and Cycle Links

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3. Landscape character zone impact assessment

An analysis of the landscape character of the M1NSM route was carried out to provide a baseline against which to assess the significance of the likely changes resulting from the proposal.

This section identifies landscape character zones along the length of the study area and provides a description of the attributes that make up each landscape character zone (LCZ). These are mapped in Figure 9.

Landscape character zones are areas that are relatively consistent in terms of their landform, vegetation and land uses. TfNSW's 'Guideline for Landscape Character and Visual Impact Assessment' (Roads and Maritime practice note E1A-N04, 2018) provides the following definition of landscape character:

"The combined quality of built, natural and cultural aspects that make up an area and provide its unique sense of place."

For the purpose of this report, these zones generally reflect the motorway's surrounding land use and character, even though the land use may differ between the two sides of the motorway corridor. The following text, tables and photographs describe each landscape character zone and its sensitivity to change.

Nine landscape character zones (LCZ) have been identified along the M1 motorway corridor as depicted in Figure 9. The landscape character zones are as follows:

LCZ 1 – The Bays Precinct

LCZ 2 – Anzac Bridge

LCZ 3 – Blackwattle Bay, Pyrmont and Ultimo

LCZ 4 – Darling Harbour

LCZ 5 – Cockle Bay Wharf and the CBD Canyon

LCZ 6 – The CBD (Western Edge)

LCZ 7 – Millers Point and The Rocks

LCZ 8 – The Sydney Harbour Bridge

LCZ 9 – Milsons Point and Kirribilli.

This section also assesses the sensitivity for each LCZ. Sensitivity refers to how sensitive the character of the setting is to the proposed change. An assessment has been made as to the quality of the landscape, its cultural and historical importance to the community, scenic quality, and overall composition of the place and its inhabitants. The following assumptions have been used as the basis for this assessment:

- Residential land uses have a higher sensitivity
- Places with high social, tourism, recreational, and/or historical significance have a higher sensitivity
- Places identified by others as having significance, eg Protected public views, view planes and special character areas have a higher sensitivity.

Figure 9: Landscape Character Analysis - Overview of entire route

3.1 Landscape character zones

LCZ 1 – The Bays Precinct

Refer Figure 12: Landscape Character Zone 1: The Bays Precinct.

This character zone begins at the Victoria Road intersection and extends to the abutment of Anzac Bridge. The interchange is elevated slightly above the area between the corridor and the water's edge of Rozelle Bay as it heads uphill to Victoria Road to the west. The distinctively curved footbridge bridge forms part of the interchange, provides pedestrian and cycle connection across the busy road and is a recognisable wayfinding landmark.

On the north side of the motorway, the tall concrete Glebe Island Grain Silos provide a prominent visual landmark. White Bay Power Station also provides a highly visible landmark for motorists with its large bulk and tall brick chimneys. White Bay Cruise Terminal is also located in this area.

On the south side of the motorway, LCZ 1 is characterised by large bulky marina facilities, boat storage buildings, offices and other industrial waterfront facilities including associated at grade carparks. The corridor is relatively vegetated in appearance on the approach to Anzac Bridge with some median planting and Casuarina trees either side of the road providing filtered views to the surrounding area. Rozelle Bay is approximately 100m to the south of the corridor, and is visible from certain points along this length of road.

As the motorway rises and bends towards Anzac Bridge, motorists and pedestrians are presented with two war memorial statues to either side of the road. There are significant stands of Cabbage Tree Palms associated with the statue settings and they mark an end to the roadside vegetation of this section of road. Beyond the statues, the land falls away to either side and drivers are on the bridge structure itself with views of the water and city in the distance.

The area is classified under Sydney Regional Environmental Plan (SREP) No. 26 – City West, now called The Bays Precinct and is being managed by UrbanGrowth NSW. There will be significant changes to this character zone as it is further developed in the future.

Sensitivity	**Low**
Large bulky industrial facilities and vast open carpark areas on either side of an existing 6-9 lane motorway. Low visual coherence, with a significant variability of built form and landscape.	
Magnitude	**Negligible**
No additional signage or gantries are proposed as part of the project scope.	
Landscape Character Impact	**Negligible**

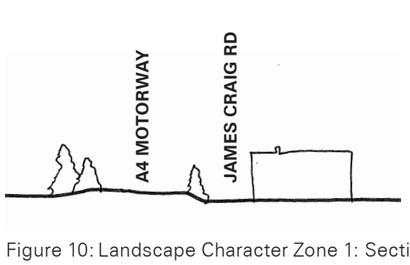

Figure 10: Landscape Character Zone 1: Section A - A

Figure 11: Landscape Character Zone 1: Section B - B

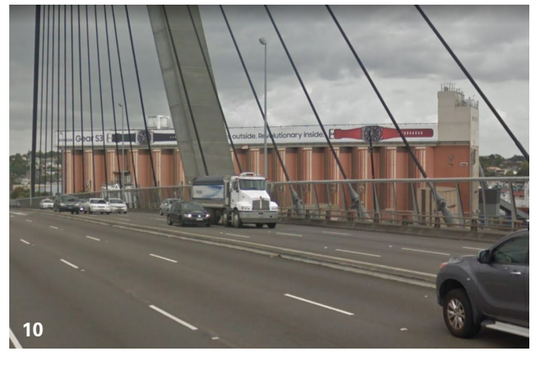

Figure 12: Landscape Character Zone 1: The Bays Precinct

LCZ 2 – Anzac Bridge

Refer Figure 13: Landscape Character Zone 2: Anzac Bridge.

LCZ 2 incorporates the abutments and main spans of Anzac Bridge. The iconic bridge makes an enduring contribution to Sydney's skyline and landscape. It provides pedestrians and motorists with a memorable, unique experience, whether perceived from vantage points across the harbour, or from on the bridge structure itself.

Approaching from the west, the bridge experience for motorists begins immediately beyond the war memorial gateway. The concrete cable-stay towers loom overhead, forming geometric frame for the views of the cityscape to the east.

Excluding a standard concrete crash barrier separating vehicle lanes from the shared path, road furniture and other road elements are limited on the bridge, resulting in a clean visual experience for the users. A shared bicycle and pedestrian path is located along the northern edge of the bridge.

Wire mesh throw screens extend the length of the bridge, affording motorists and pedestrians elevated, sweeping views across the Johnstons Bay toward the north shore, and south across Blackwattle Bay towards the Glebe waterfront. Filtered views through the wire mesh are provided of the present White Bay port facilities with its open dock storage, the old Glebe Island Bridge and residential apartment towers at Pyrmont.

The Glebe Island Bridge, across Johnstons Bay, is an item of state significance. It was designed by Percy Allan, a highly-regarded Australian bridge designer of the late 19th and early 20th century and demonstrates one of the earliest examples of an electric-powered swing bridge in Australia.

This landscape zone is considered a highly sensitive urban environment, and the experience of Anzac Bridge for motorists, pedestrians and cyclists is significant and worthy of protection.

Sensitivity	**High**
Anzac Bridge is an iconic landmark bridge set in a water landscape. Road furniture, signage and other road elements on the bridge are limited, resulting in an uncluttered visual experience. High visual coherence with iconic views to and from the bridge.	
Magnitude	**Moderate**
Large signage gantry to be added to each pylon structure. A new horizontal element (in a view predominantly comprising vertical elements) will provide a moderate degree of change.	
Landscape Character Impact	**Moderate-High**


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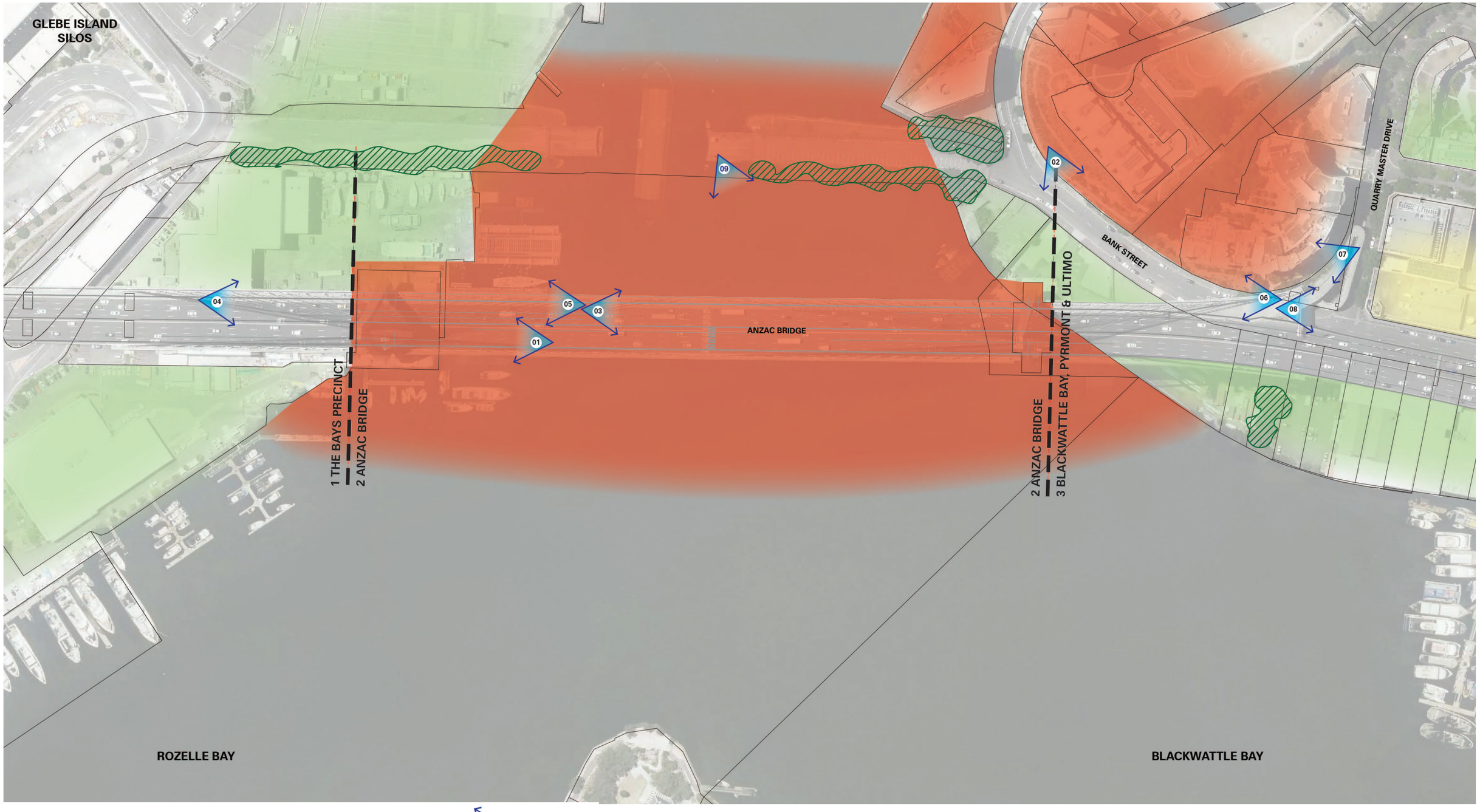

Figure 13: Landscape Character Zone 2: Anzac Bridge

LCZ 3 – Blackwattle Bay, Pyrmont & Ultimo

Refer Figure 17: Landscape Character Zone 3 Sheet 1: Blackwattle Bay, Pyrmont and Ultimo, Figure 18: Landscape Character Zone 3 Sheet 2: Blackwattle Bay, Pyrmont and Ultimo.

Beyond the east end of the Anzac Bridge, the motorway continues as an elevated viaduct winding into the inner city. It involves typical road infrastructure including a continuous concrete crash barrier, overhead street lighting and both static and digital signage. Pedestrian and cycle pathways occur beneath the viaduct only.

The north and south regions of the motorway in this section have two distinct characters.

The area to the north is dominated by high density residential and commercial development of approximately 6 storeys. The motorway viaduct runs alongside a wall of built form for approximately 200m, impeding views for the motorist toward the city. The view opens briefly at the Miller St intersection in Pyrmont, where high-rise residential development to the north is momentarily exposed.

In LCZ 3, precast concrete noise walls are present for stretches on both side of the corridor to protect residential housing from the road noise. Completed in the 1990's, the Glebe Island Arterial Streetscape project by TfNSW (then NSW RTA) saw precast concrete noise walls amongst other elements, designed by the architect Richard Goodwin, inserted into the urban motorway corridor.

The inclusion of such a permanent vision for a new "road architecture" was a first for the NSW Roads and Traffic Authority and Richard Goodwin has said about this project:

"I developed the sculptural component as a way of engaging the architecture of the freeway via prosthetic shapes attached to the forest of columns. The combination of aluminium wings, stone finished turrets and growing frames create a "pin-ball" machine of prosthetic devices which mediate between the pedestrian and the car to facilitate an increase in the permeability of the space."

The area to the south of the road corridor is a band of low-rise industrial facilities form the waterfront. The existing Sydney Fish Market is located in this zone, with its sprawling warehouse facility and vast open car park. Views over the market building and carpark toward Blackwattle Bay and beyond, define the motorist experience along this length of road.

On both sides of the corridor, the canopy tops of trees from adjacent land and cross streets begin to be visible at the elevated level of the road.

Continuing along the viaduct, a unique patterned concrete noise wall buffers the residential subdivision to the north of the motorway. The open vistas to the south are interrupted by multi storey residential development, which encloses the road corridor on either side of the motorway.

The viaduct sweeps to the east through the multi storey residential and commercial development, before the Sydney CBD appears ahead. The buildings and another curved patterned concrete noise wall on the southern shoulder of the road effectively form a gateway to Darling Harbour, the next landscape character zone.

Sensitivity	**Moderate**
The motorway is an elevated viaduct winding through waterfront industrial, commercial, residential and heritage landscapes, with typical road infrastructure such as overhead signage, street lighting and noise walls.	
Magnitude	**Moderate**
New gantries in this zone to replace existing signage. Moderate degree of change as the signage is larger than the existing and potentially more visible due to the illuminated component.	
Landscape Character Impact	**Moderate**

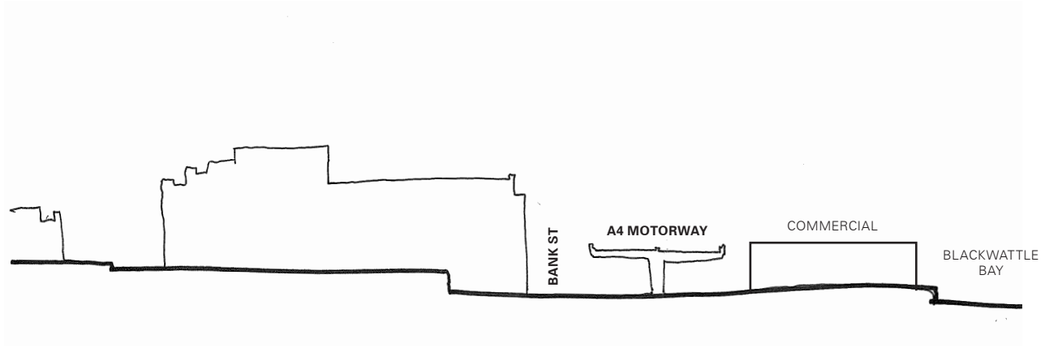

Figure 14: Landscape Character Zone 3: Section C - C

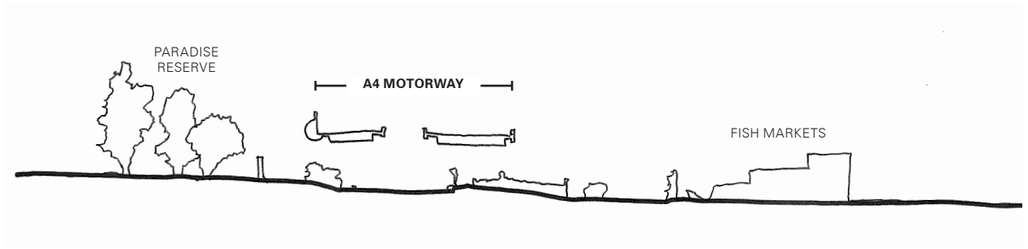

Figure 15: Landscape Character Zone 3: Section D - D

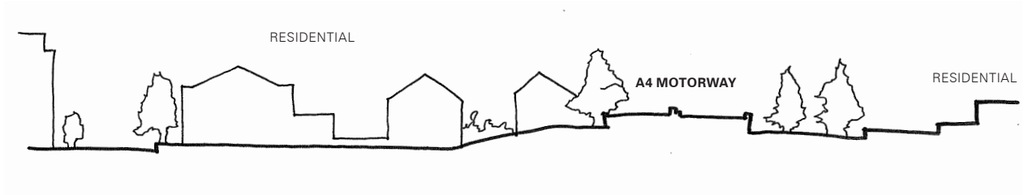

Figure 16: Landscape Character Zone 3: Section E - E


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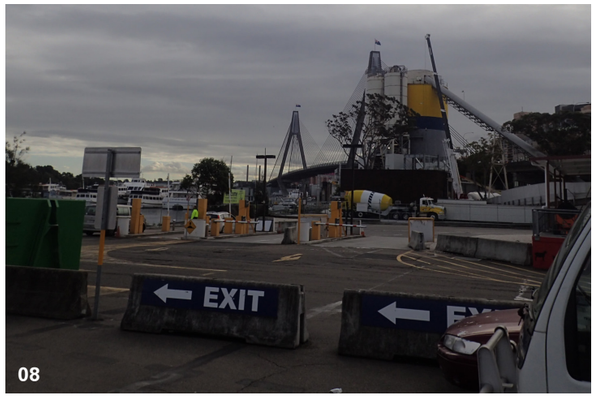

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Figure 17: Landscape Character Zone 3 Sheet 1: Blackwattle Bay, Pyrmont and Ultimo

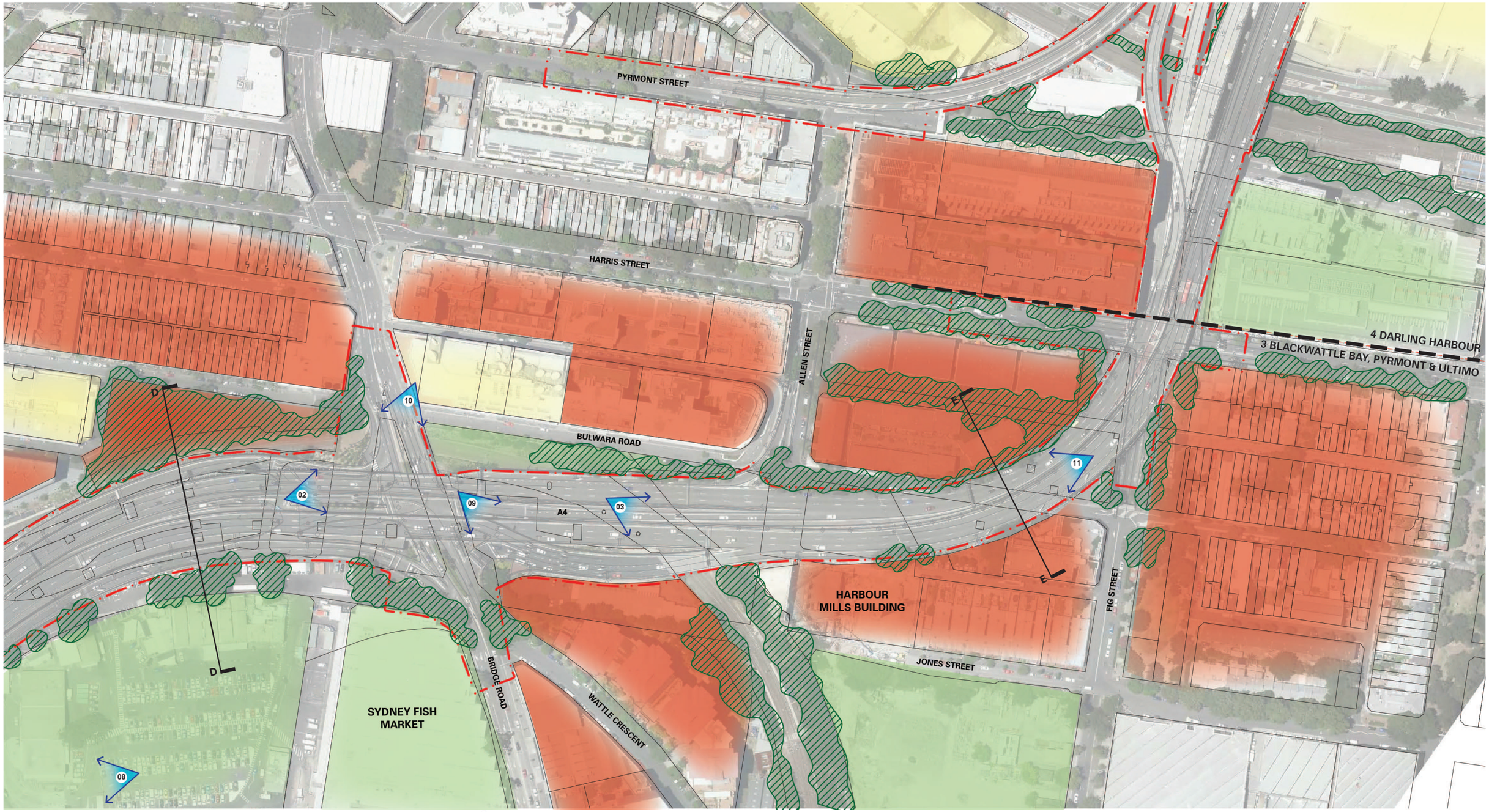

Figure 18: Landscape Character Zone 3 Sheet 2: Blackwattle Bay, Pyrmont and Ultimo

LCZ 4 – Darling Harbour

Refer Figure 21: Landscape Character Zone 4: Darling Harbour.

In LCZ 4, The A4 motorway connects the Pyrmont peninsula with the CBD as a series of adjacent elevated viaducts that bisect Darling Harbour. At times, there are five viaducts side by side with additional road layers beneath. To the east, the viaduct divides the recently completed International Convention Centre. The buildings are close to the edge of the motorway, framing views for the motorist and pedestrian of the city skyline beyond when driving east.

This length of motorway is currently void of visual obstructions, providing significant, unobscured views across Darling Harbour to the north and east toward the centre of the city. There is one section of low grass plantings on the elevated structure directly located between the two parts of the International Convention Centre. Despite being quite discrete, this planting does add a touch of vegetation to the road user experience.

The Darling Harbour precinct offers motorists, pedestrians and cyclists with a unique experience. It is broadly considered a highly sensitive zone, due to its on-going role as one of the city's most important cultural destinations, drawing local and international tourists to it. It encompasses numerous culturally significant buildings, along with swathes of Sydney's most prominent public open space.

The tops of the iconic palm trees at Darling Harbour are visible from the elevated viaducts providing a green, vegetated landscape element and add to the sense of significance at this location. The plantings are identified by the City of Sydney as Scheduled Significant Trees, and include the following:

- Cabbage Palms *Livistona australis*
- Washington Palms *Washingtonia robusta*
- American Cotton Palms *Washingtonia filifera*
- Canary Island Date Palms *Phoenix canariensis*
- A single Port Jackson Fig *Ficus rubiginosa f. glabrescens.*

At ground level, vast areas of landscaped open space provide a connection between the numerous public facilities of the Darling Harbour precinct. The viaduct structure itself is highly exposed and any intervention is likely to be highly visible and may have a high visual impact on the public space.

At the eastern end of Darling Harbour, the canopy tops of trees from adjacent land and cross streets begin to be visible at the edges of the elevated level of the road.

Sensitivity	**High**
The motorway is series of adjacent elevated viaducts that bisect Darling Harbour, an area of high visual sensitivity with significant public spaces and views to the harbour with a new key city landmark of the International Convention Centre (ICC). It includes typical road infrastructure such as overhead signage and street lighting.	
Magnitude	**Moderate**
New and replacement signage gantry structures are larger signs than the existing and potentially more visible due to their illumination components.	
Landscape Character Impact	**Moderate-High**


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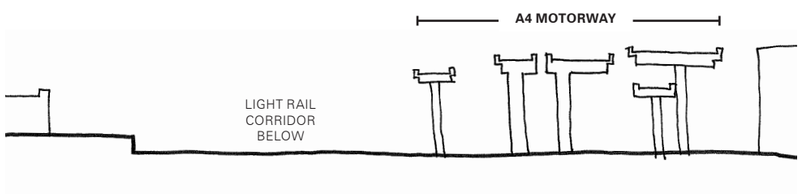

Figure 19: Landscape Character Zone 4: Section F - F

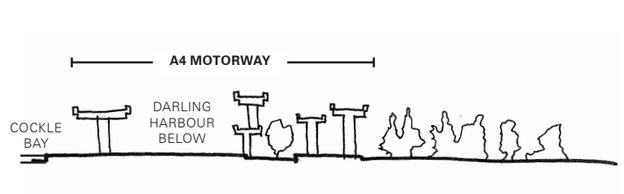

Figure 20: Landscape Character Zone 4: Section G - G

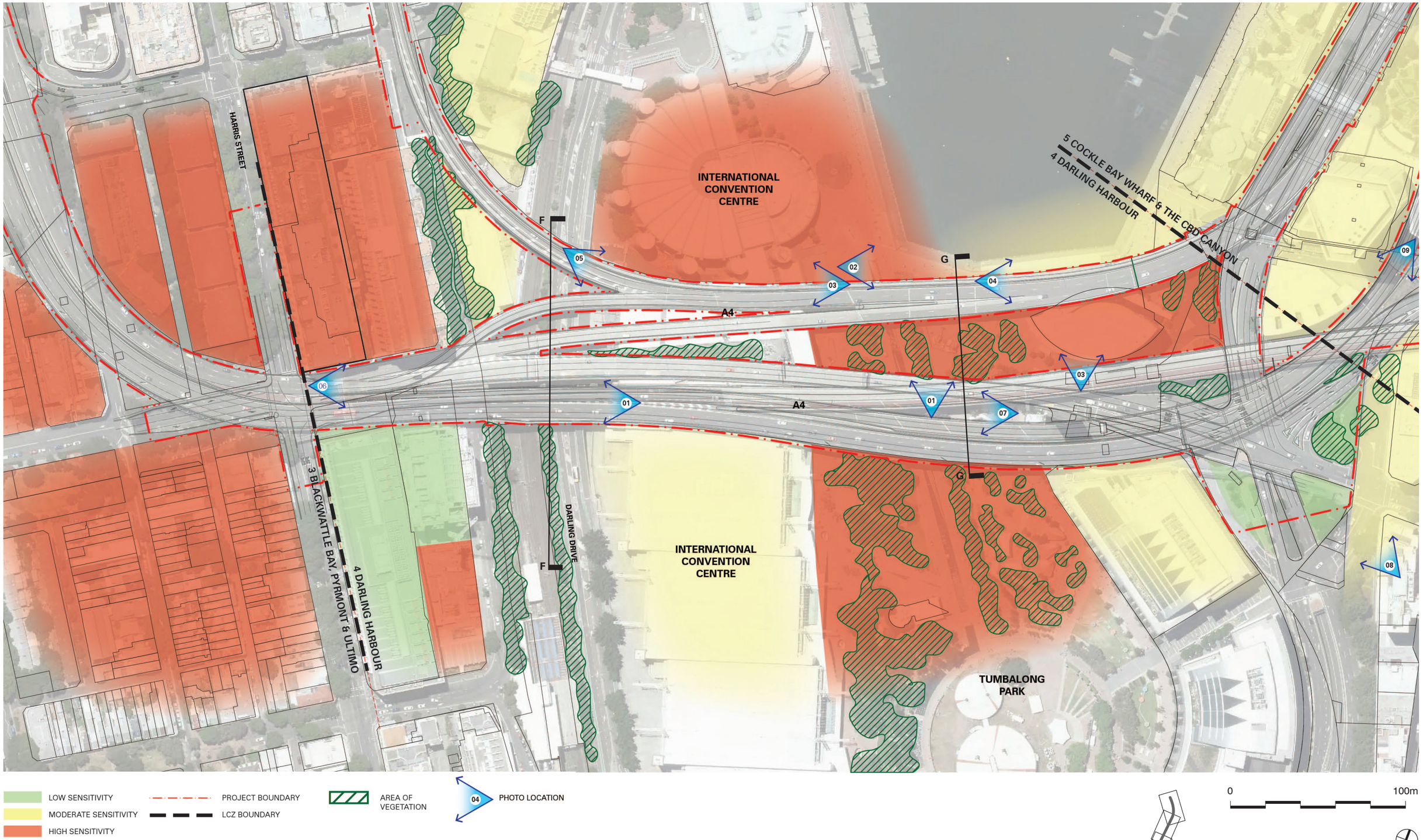

Figure 21: Landscape Character Zone 4: Darling Harbour

LCZ 5 – Cockle Bay Wharf & The CBD Canyon

Refer Figure 23: Landscape Character Zone 5: Cockle Bay Wharf and The CBD Canyon.

The motorway continues as an elevated viaduct, sweeping around Cockle Bay towards the north, and clinging to the western edge of the CBD. This zone is characterised by two distinct landscape zones to either side of the corridor. An open visual connection to the west across Darling Harbour and the heritage item of Pyrmont Bridge is maintained, while tall high-rise commercial buildings form a strong built edge to the east.

A continuous concrete crash barrier runs the length of the corridor viaduct, and roadside furniture remains sparse.

In this south west corner of the Sydney central business district, pedestrians connect to the city with the Darling Harbour precinct using public space beneath the viaduct. The underside of the viaduct is exposed and heavy structural elements are pronounced and seemingly exaggerated. Columns and headstocks are of varying shapes and sizes.

Further north along the motorway, a number of elevated pedestrian bridges cross the corridor, connecting the city with the Cockle Bay Wharf waterfront. The viaduct separates here and forms a series of layered tunnels and bridges that weave through the dense urban built form, leading motorists to various parts of the CBD.

An elevated length of the viaduct continues approximately two storeys above ground level, with the commercial buildings forming the eastern edge of the CBD creating a strong visual edge to the corridor and views being directed towards the Cockle Bay Wharf area. The corridor through this zone is highly visible to occupants of the adjoining commercial facilities, with lengths of facade positioned within metres of the viaduct edges. Just north of Market Street, the northbound traffic passes beneath the Hyatt Regency Hotel building which in itself is a memorable experience.

In this area, there are sparse tree plantings in the median on the lower level either side of the Darling Park pedestrian bridge. The canopy of these trees is visible to the traffic on the elevated viaduct. Another group of small trees occurs in the median either side of the Pyrmont Bridge pedestrian bridge at Market Street. A relatively dense vegetated edge to the east is visible from the upper level of the viaduct indicating the podium level landscaped garden of the Darling Park group of buildings.

Sensitivity	**Moderate**
City hotel precinct with viaduct carriageways located predominantly at lower level to buildings.	
Magnitude	**Low**
New signage gantry structures will either replace existing signage or are attached to existing buildings or overhead bridges.	
Landscape Character Impact	**Low-Moderate**


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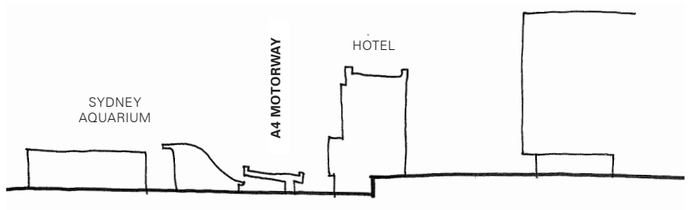

Figure 22: Landscape Character Zone 5: Section H - H

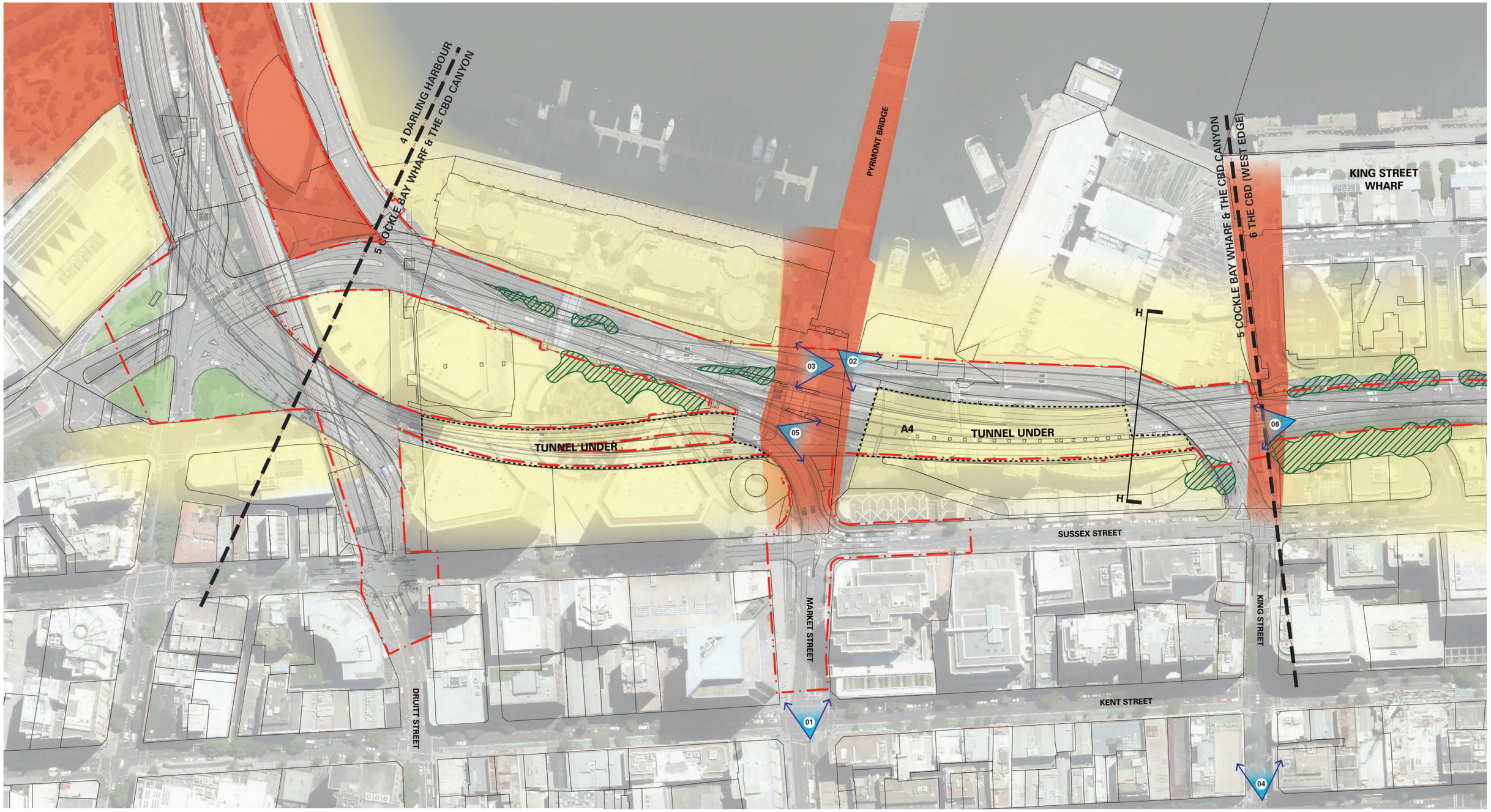

Figure 23: Landscape Character Zone 5: Cockle Bay Wharf and The CBD Canyon

LCZ 6 – The CBD (western edge)

Refer Figure 26: Landscape Character Zone 6: The CBD (Western Edge) - Sheet 1 and Figure 27: Landscape Character Zone 6: The CBD (Western Edge) - Sheet 2.

Extending from the alignment of King Street in the south to the Cahill Expressway to the north, LCZ 6 is characterized by the hard edge cityscape to the east, and by the extents of the newly developed area of Barangaroo to the west.

The Western Distributor is at ground level in the stretch between King Street and Erskine Street. This section is also heavily vegetated with large fig trees (Hill's Weeping Fig *Ficus microcarpa var. 'Hillii'*) to the east in the raised median between the A4 and Slip Street. Street trees and a planted road edge create a dense green screen to the buildings on Shelley Street to the west.

Travelling to the north, the road rises up onto elevated viaduct structure to cross the grid of city streets below. The viaduct passes through a unique 'canyon' of commercial high-rise buildings between Erskine Street and Clarence Street. This is a memorable experience for motorists in both directions with glimpses of King Street Wharf and Barangaroo as the motorway crosses perpendicular city streets.

Buildings in this section are predominately high-rise commercial, with a number of high-rise residential buildings adjoining the motorway further north toward Circular Quay. Roadside furniture is limited, with standard concrete crash barriers to either side of the viaduct, simple street lighting overhead and some signage structures. The glazed facades of adjacent buildings come within metres of the roadway, making this length of road highly visible to building occupants. There is no visible vegetation except for glimpses of street trees in the cross streets below.

Heading north, motorists are presented with clear views of the arched Sydney Harbour Bridge structure rising in the distance as the density of the city built form opens up around the Grosvenor Street access ramps. This unique vista is considered significant and the line of high-rise buildings forms a hard line running east to west. This built form edge is identified by the City of Sydney as the 'Tower Tide Line' (Refer Figure 7) and it continues along the edge of the Cahill Expressway through Circular Quay.

The road separates and widens north of Grosvenor Street, forming a vast junction with the Cahill Expressway and providing central city vehicle access to and from the A4 motorway. There is a very green edge formed by large mature trees along the western edge of the motorway and a highly visible sandstone cutting in front of the National Trust of Australia Building. The open and uninterrupted environment leading towards Observatory Hill and the Sydney Harbour Bridge is considered worthy of protection.

Sensitivity	**Moderate**
This LCZ has moderate visual sensitivity as it is surrounded by commercial buildings only and has few existing gantry or signage structures.	
Magnitude	**Moderate**
New signage structures in this zone will be a moderate degree of change as there are no existing gantry structures and will be a new element in the setting.	
Landscape Character Impact	**Moderate**

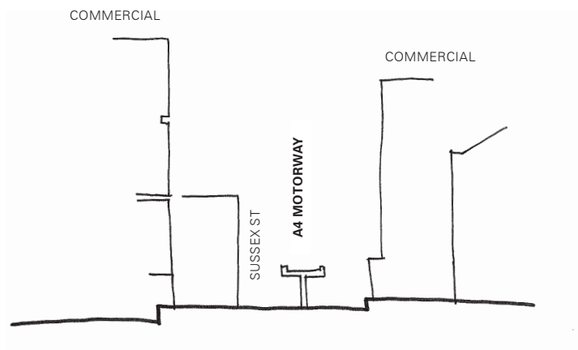

Figure 24: Landscape Character Zone 6: Section I - I

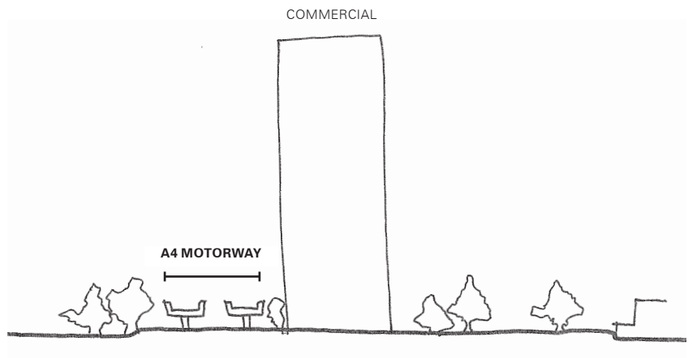

Figure 25: Landscape Character Zone 6: Section J - J


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Figure 26: Landscape Character Zone 6: The CBD (Western Edge) - Sheet 1

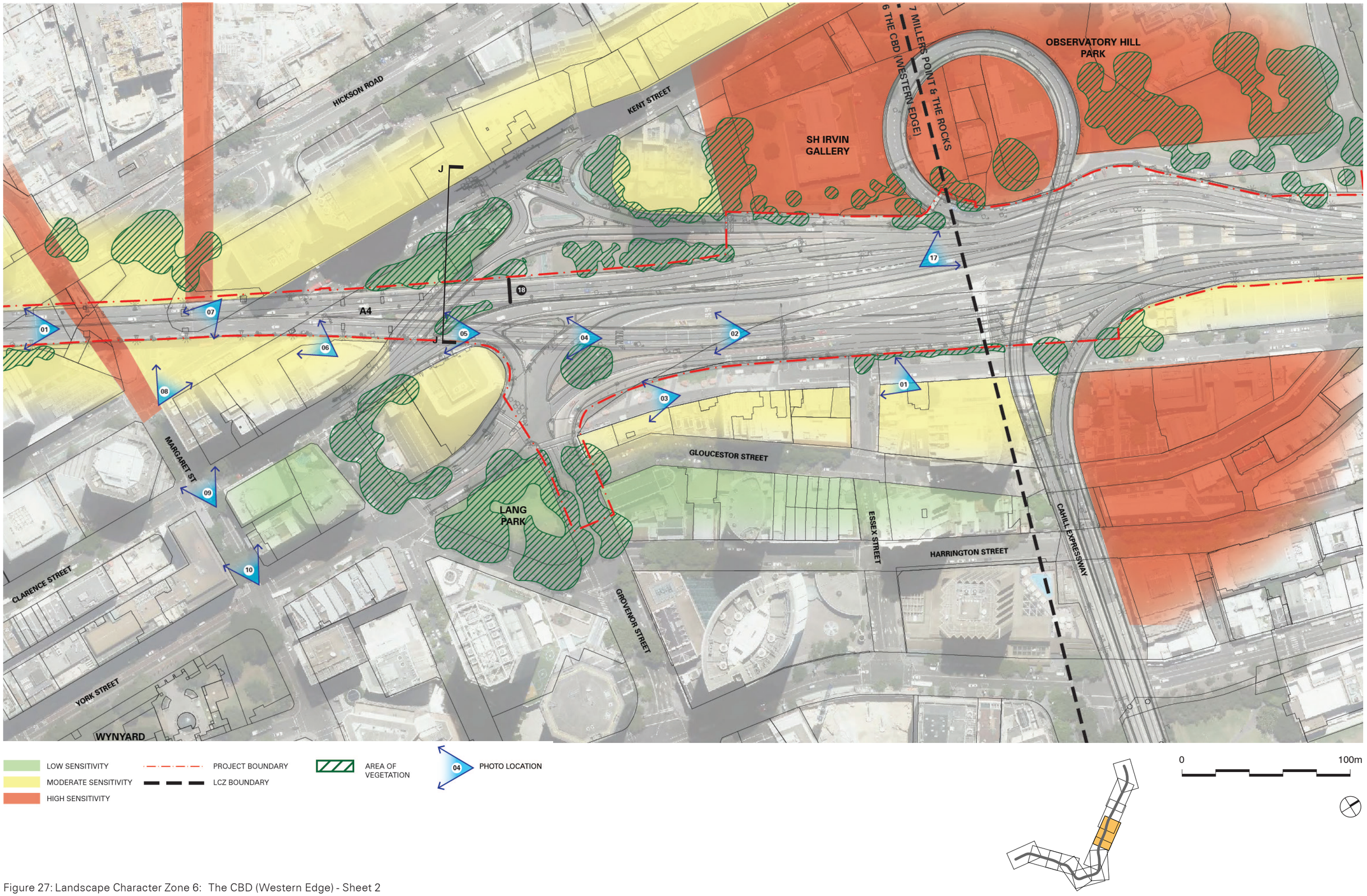

Figure 27: Landscape Character Zone 6: The CBD (Western Edge) - Sheet 2

LCZ 7 – Millers Point & The Rocks

Refer Figure 28: Landscape Character Zone 7: Millers Point and The Rocks.

Much of this LCZ is protected by heritage conservation areas such as The Rocks and Millers Point, as well as listed items. The Rocks precinct is defined by a unique history, representing the early development of Sydney as a city. Many of the buildings were constructed during the settlement/ colonial period, and provide a significant cultural and historic contribution to Sydney's urban landscape and are protected as part of a Heritage Conservation Zone. Streets throughout The Rocks area are narrow and winding, and built form is dense and buildings are generally small. The corridor looks over this area and the street tree canopies sometimes quite close to the edge of the motorway, are visible within the grid of streets and buildings.

The road corridor divides The Rocks from the Millers Point precinct. Millers Point, to the west of the Bradfield Highway (that also serves as the Sydney Harbour Bridge on ramp), is defined by its relatively small terraces, its historic finger wharf warehouse buildings and is protected as part of a Heritage Conservation Zone. The elongated finger wharf facilities extend north into the harbour and serve as cultural, residential and retail facilities.

The Argyle cut is a significant historic connection between The Rocks and Millers Point and is a rare example of early responses to the geographical difficulties presented to urban growth. The M1NSM route passes directly over this bridge cutting.

The western edge of the road corridor in this section is characterised by the topography of Observatory Hill and the by large mature fig trees in the grounds of Fort Street Public School and Observatory House.

Roads are relatively broad throughout Millers Point, and are typically lined with Plane trees. The orientation of numerous streets (north/ south) allows for dramatic views of the Sydney Harbour Bridge. Numerous pockets of landscaped public open space serve as a buffer between the bridge viaduct and the historic buildings beyond, including the parklands of Dawes Point and Hickson Road Reserve around the abutment of the Sydney Harbour Bridge.

Sensitivity	**High**
High visual sensitivity as it is the approach to the Sydney Harbour Bridge and adjacent the Rocks and Millers Point Conservation Areas.	
Magnitude	**Low**
Small degree of change as the new signage will be attached to the existing portal which has new recently installed LED signage.	
Landscape Character Impact	**Moderate**


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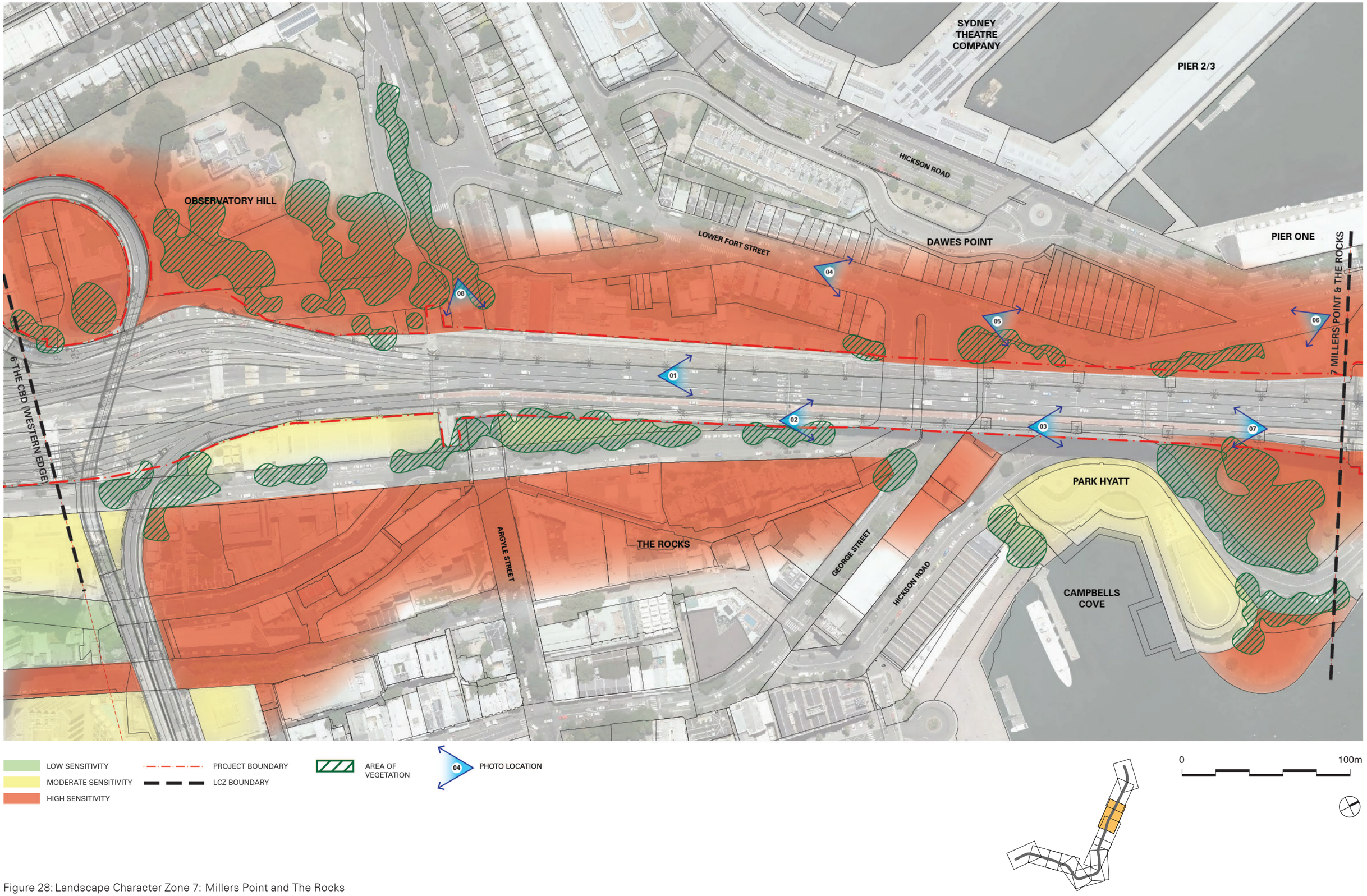

Figure 28: Landscape Character Zone 7: Millers Point and The Rocks

LCZ 8 – The Sydney Harbour Bridge

Refer Figure 29: Landscape Character Zone 8: The Sydney Harbour Bridge.

The Sydney Harbour Bridge is a unique experience for pedestrians, cyclists, train travellers and motorists. The bridge itself is of State Heritage significance with an identified curtilage area, and sits within the World Heritage buffer zone for the Sydney Opera House. The entire zone is protected by a strict layering of development controls, and views to, and from the bridge are of immense cultural and historic value.

The bridge itself spans approximately 2.4kms across Sydney Harbour, while the structure involves an intricate steel truss system that spans 500m. The bridge presents as an industrial structure with its weaving steel beams and visible bolts and rivets. It extends from Dawes Point to the south, to Milsons Point to the north, reaching a height of approximately 134m (from water level).

At each end of the steel arch, twin concrete pylons serve to frame the bridge curtilage. Clad in granite, they each reach a height of 89m above ground level. The effectively serve as a gateway onto the bridge, and bookend the bridge experience for the motorist, cyclist and pedestrian. There are green public spaces at ground level at either end of the bridge at Dawes Point and Milsons Point. There are significant tree plantings in both of these locations however they are not visible from road level.

The bridge is relatively visually busy with existing steel truss gantries, overhead street lighting, railway gantries and wiring, and digital directional signage. Arched wire mesh throw screens run the length of the bridge (for pedestrian and cyclist safety), providing an additional layer of detail.

Views of the harbour from the bridge are limited, but the CBD skyline rises to the south east and the high-rise buildings of North Sydney appears to the north.

Sensitivity	**High**
High visual sensitivity as it is the iconic Sydney Harbour Bridge with State Heritage Listing in a World Heritage Zone with views to and from the bridge structure.	
Magnitude	**Moderate**
Moderate degree of change additional LED signage are proposed as part of this project scope.	
Landscape Character Impact	**Moderate-High**


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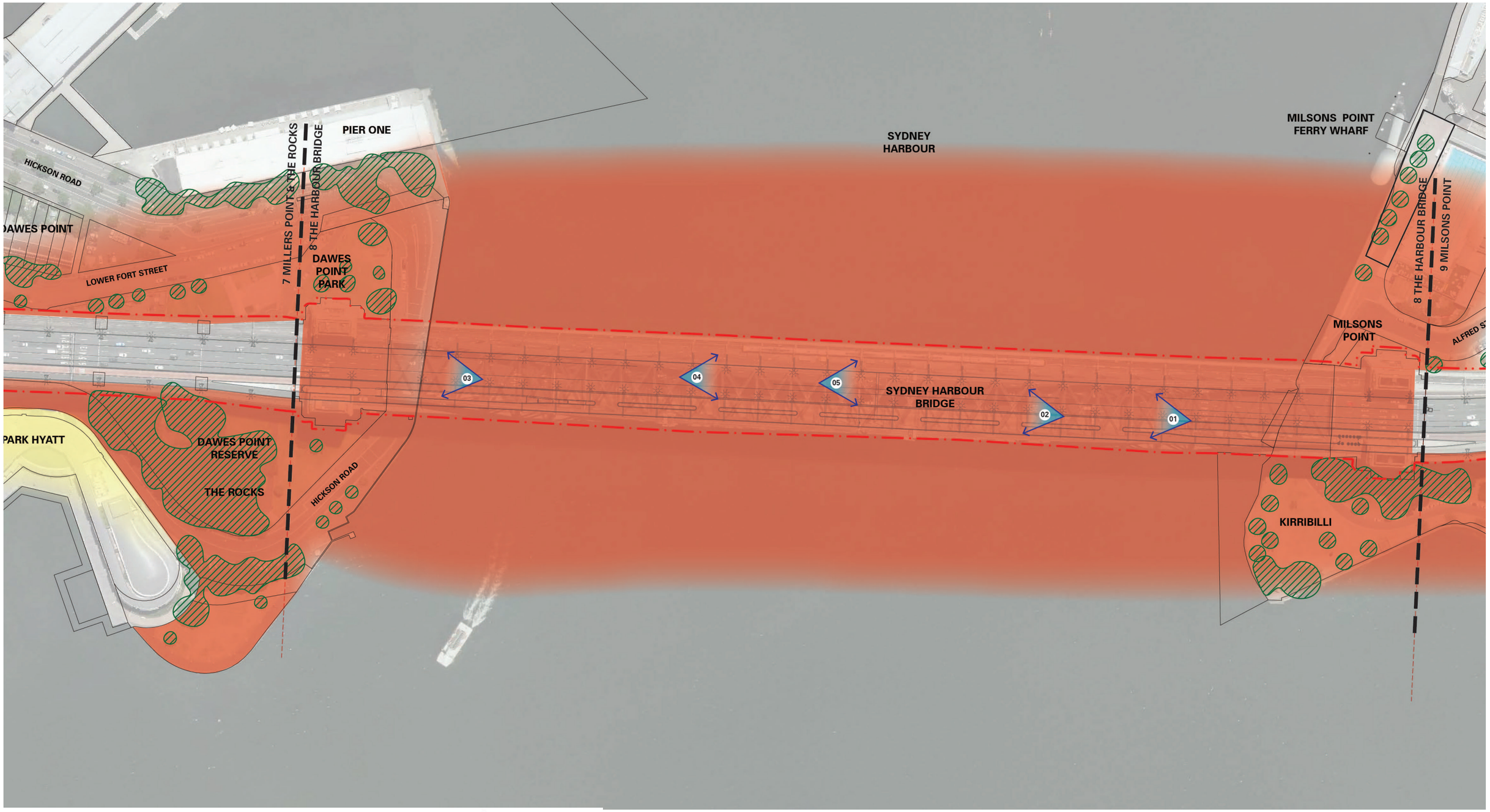

Figure 29: Landscape Character Zone 8: The Sydney Harbour Bridge

LCZ 9 – Milsons Point & Kirribilli

Refer Figure 31: Landscape Character Zone 9: Milsons Point and Kirribilli.

In LCZ 9, the north on-ramp of the Sydney Harbour Bridge separates Milsons Point to the west, from the smaller scale Kirribilli peninsula to the east.

The winding streets of Kirribilli are typically lined with single residential allotments, or two to six storey apartment buildings. Buildings are generally orientated to capitalise on views toward the Harbour and the city to the south. Running alongside the viaduct, Broughton Street provides a buffer of commercial and retail development to the residential buildings beyond and street trees are visible from the motorway.

Milsons Point is characterised by contemporary commercial and residential high-rise development, separated from the viaduct by a landscape zone with an approximate depth of 60m. This zone is heavily planted and contains many mature trees within a park-like setting. The viaduct is clearly visible from numerous locations along Milson Point's main thoroughfare, Alfred Street.

The motorway rises gradually toward the Sydney Harbour Bridge and street lighting and steel truss gantries are visible overhead. The railway line adjoins the motorway/ viaduct, providing additional infrastructure and clutter along this length of road. The motorway is separated from the rail corridor by steel mesh fencing, and a concrete and steel crash barrier separates vehicles from a pedestrian path along the roads eastern length. Views of the harbour from the viaduct are impeded by mesh pedestrian throw screens, but the high-rise structures of the CBD are clearly visible in the beyond to the north.

Sensitivity	**High**
High visual sensitivity as the zone includes the northern approach to the iconic Sydney Harbour Bridge, adjacent visually sensitive parks and open space around the bridge curtilage and the highly urban areas of North Sydney CBD.	
Magnitude	**Low**
Negligible degree of change as the new signage will be attached to the existing portal which has recently installed illuminated LED signage.	
Landscape Character Impact	**Moderate**

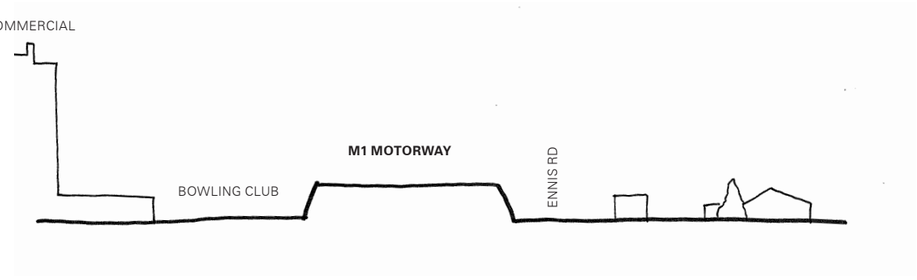

Figure 30: Landscape Character Zone 9: Section K - K

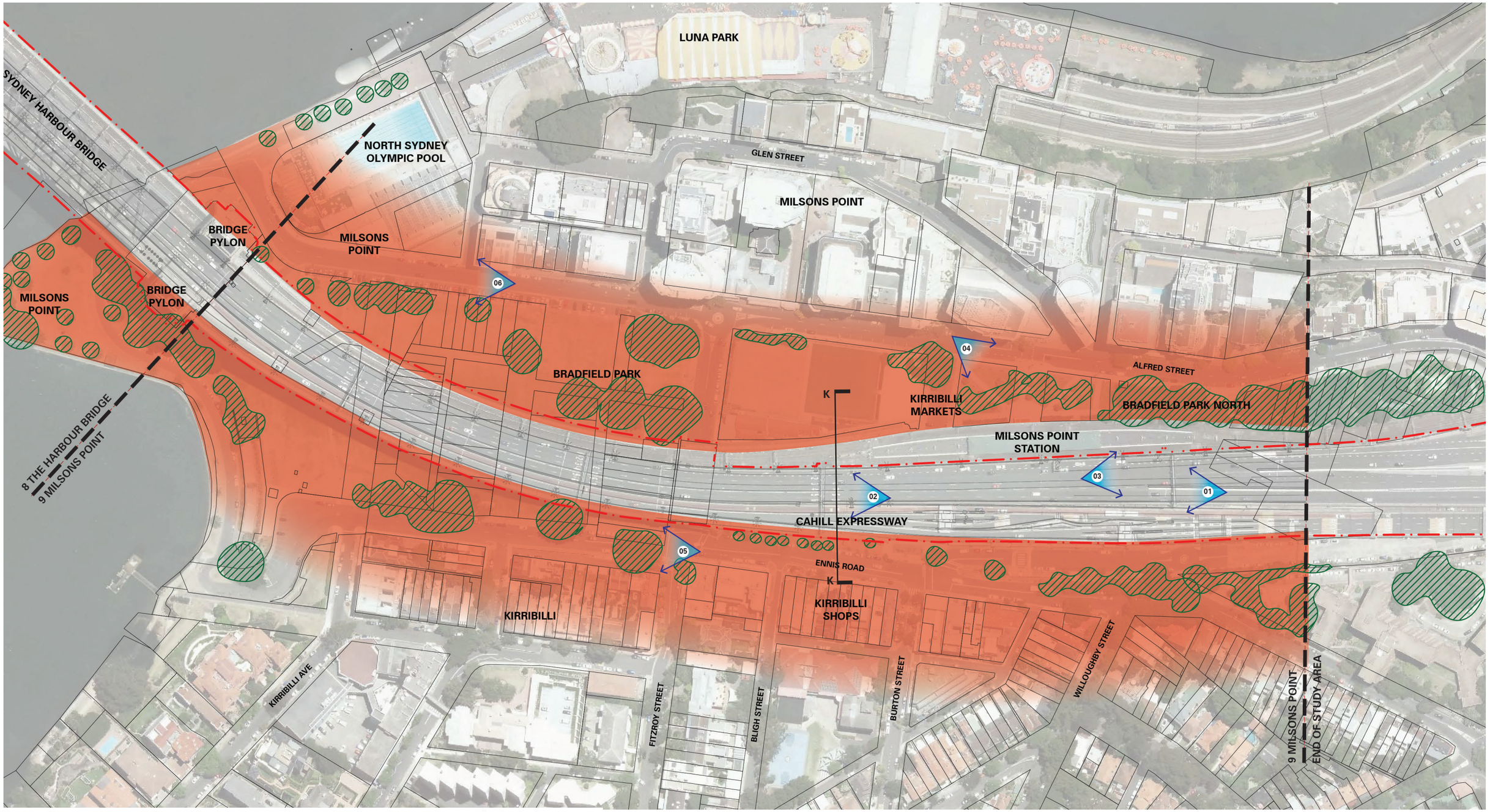

Figure 31: Landscape Character Zone 9: Milsons Point and Kirribilli

3.2 Summary of landscape character zone impacts

Refer Figure 32: Landscape Character Zone Impact.

The impact of the proposal on the landscape character zones varies from Negligible to Moderate-High.

The more visually sensitive landscapes such as the ones which have residential land uses, social, tourism, recreational, and/or historical significance, have higher sensitivity than the more commercial landscapes.

The magnitude of the proposal varies from Negligible to Moderate as there are locations where there will be no new elements, to more Moderate where new gantries or VMS are proposed.

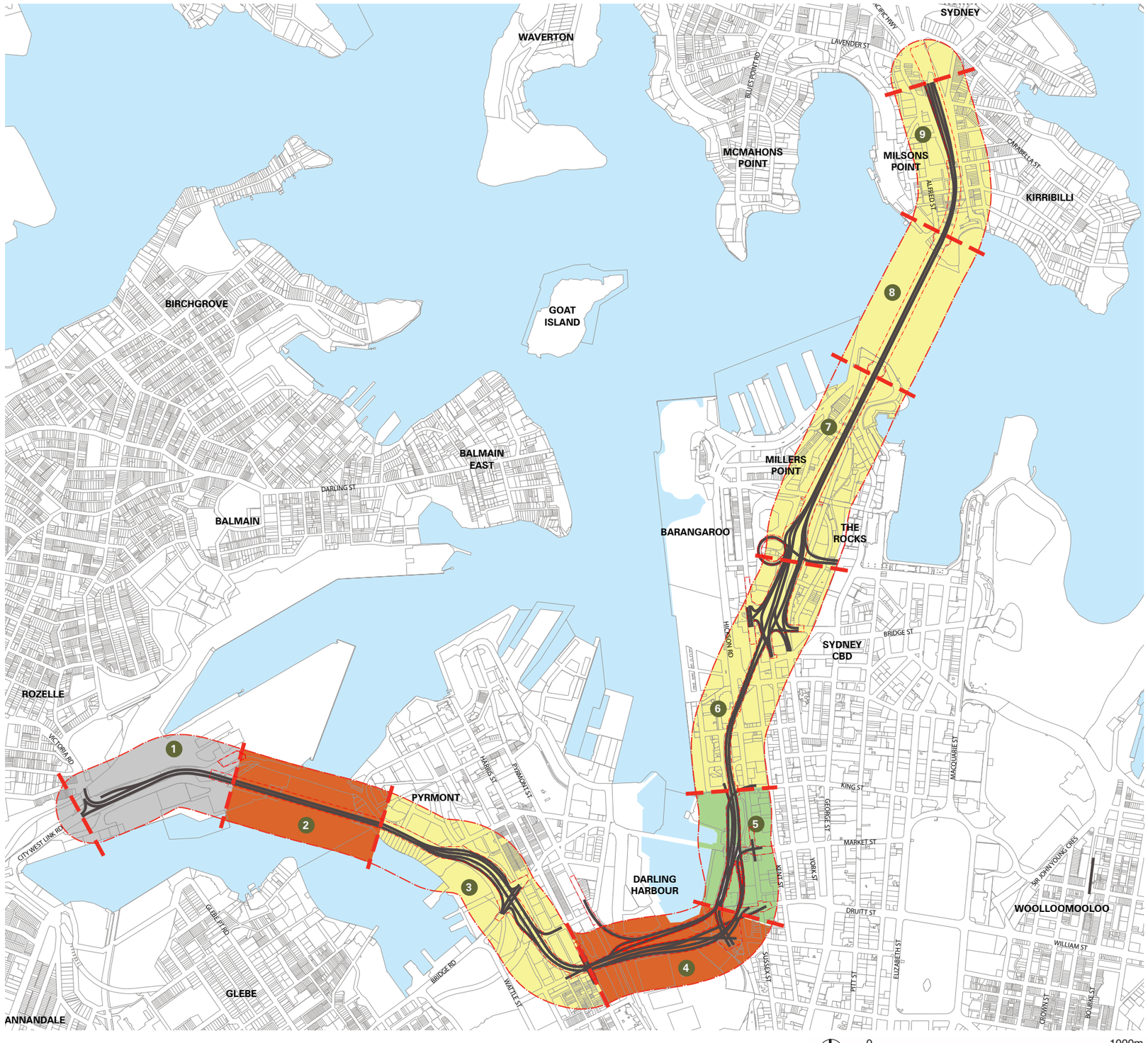

Figure 32: Landscape Character Zone Impact

4. Visual impact assessment

4.1 Visual envelope

Refer Figure 33: Visual Envelope Map.

The Visual Envelope Map defines the visual catchment of the proposal, in particular of the gantries on the motorway and the smaller variable message signs on streets leading up to the motorway. It generally describes the area surrounding the project works from which direct views are possible from any given location. Based on existing landforms, the visual catchment also takes into account vegetation, land uses and structures. Site investigations were undertaken to review the visual catchment and take into consideration the screening effect of buildings or vegetation. Key viewpoints from which potential visual impacts are to be assessed are located on the Visual Envelope Map. These locations were determined on a site visit and from further desktop analysis.

Figure 33: Visual Envelope Map

4.2 Visual impact assessment - gantries

Refer Figure 34: Visual Envelope showing Gantry Locations and Viewpoints.

Gantries with their signage, in particular where new freestanding structures, are the most visible element of the M1NSM concept design proposal.

The following assessment documents each viewpoint and assesses the visual impact assessment from that viewpoint for the gantries along the Motorway. The map opposite shows the location of the proposed gantries and the viewpoint locations. The overall visual impact rating has been determined by using the grading matrix in Table 1.

General Observations for other gantries:

- On SHB, for existing gantries under the archway, the design proposes consolidating and streamlining the older LUMS signage and replacing with the new ISLUS signs. This is an improved visual outcome reducing visual clutter.
- During the TfNSW review of the 80% concept design the need for an additional gantry has been identified on the Upper Fig Street entry ramp. This gantry will support directional signage only. It is proposed this will be a portal type gantry supported at a high level on brackets to the existing retaining wall. Its visual impact is considered low given its motorway setting, its low visibility from adjacent neighbours due to its trough location, and as it is static signage there is no illuminated component.
- The gantry for the Kent Street SHB on ramp has been removed resulting in an improved visual outcome.

Figure 34: Visual Envelope showing Gantry Locations and Viewpoints

4.2.1 Viewpoint 1 - Gantry 1

Refer Figure 35 and Figure 36.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
New spanning gantry mounted on Anzac Bridge western pylon. ISLUS over westbound and eastbound lanes, dynamic sign located over eastbound only (westbound dynamic signs are part of the WestConnex project).	New horizontal element spanning structure visible from surroundings particularly with additional enclosed signage that is not as transparent as rest of bridge structure.

Figure 35: Existing View of Gantry Location 1

Figure 36: Proposed view of Gantry Location 1

4.2.2 Viewpoint 2 - Gantry 2

Figure 37 and Figure 38.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
New spanning gantry on Anzac Bridge eastern pylon, ISLUS over westbound and eastbound lanes, dynamic sign located over eastbound lanes only (westbound dynamic signs are part of the WestConnex project).	New horizontal element spanning structure visible from surroundings particularly with additional signage that is not as transparent as rest of bridge structure.

Figure 37: Existing View of Gantry Location 2

Figure 38: Proposed view of Gantry Location 2

4.2.3 Viewpoint 1-2 - Gantry 1 & 2

Figure 39 and Figure 40.

Visual Sensitivity	**High**
Magnitude of visual effect	**Negligible**
Overall visual impact rating	**Negligible**
Element of proposal visible	**Comment**
New spanning gantries (1 and 2) on Anzac Bridge eastern and western pylons visible from Blackwattle Bay Park.	Whilst both are visible from this part of the park, from such a distance the visual impact is negligible.

Figure 39: Existing View of Anzac Bridge from Blackwattle Bay Park

Figure 40: Proposed view of Gantry Location 1 and 2 from Blackwattle Bay Park

4.2.4 Viewpoint 3a - Gantry 3

Refer Figure 41 to Figure 42.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low-Moderate**
Element of proposal visible	**Comment**
Portal gantry over eastbound lanes – attached to parapet - replaces an existing signage gantry with dynamic signage and ISLUS. Aligns with the start of the noise wall.	Moderate visual impact as it replaces existing signage and structure is a similar degree of change, but is more visible due to illuminated LED.

Figure 41: Existing View of Gantry Location 3

Figure 42: Proposed view of Gantry Location 3

4.2.5 Viewpoint 3b - Gantry 3

Refer Figure 43 to Figure 44.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low-Moderate**
Element of proposal visible	**Comment**
Portal gantry over eastbound lanes - attached to parapet - replaces an existing signage gantry with dynamic signage and ISLUS. Aligns with the start of the noise wall.	Moderate-low impact as it replaces existing signage, but is more visible due to illuminated LED

Figure 43: Existing View of Gantry Location 3

Figure 44: Proposed view of Gantry Location 3

4.2.6 Viewpoint 4a - Gantry 4

Refer Figure 45 to Figure 46.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
New portal gantry with ISLUS over westbound lanes – attached to parapet. New structure where none currently.	Scenic Anzac Bridge vista. New structure where none currently exists. Visible from many places including at viaduct/ road level and Bank St and scenic vista of Anzac Bridge. Blocks views westbound to Anzac Bridge vista although momentary in the road journey.

Figure 45: Existing View of Gantry Location 4

Figure 46: Proposed view of Gantry Location 4

4.2.7 Viewpoint 4b - Gantry 4

Refer Figure 47 to Figure 48.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
New portal gantry with ISLUS over westbound lanes. Parapet attachment and structure visible from Fish Markets.	Visible from many places including at viaduct/ road level and Bank Street although view is highly modified and commercial and carpark uses are less visually sensitive.

Figure 47: Existing View of Gantry Location 4 from Fish Markets

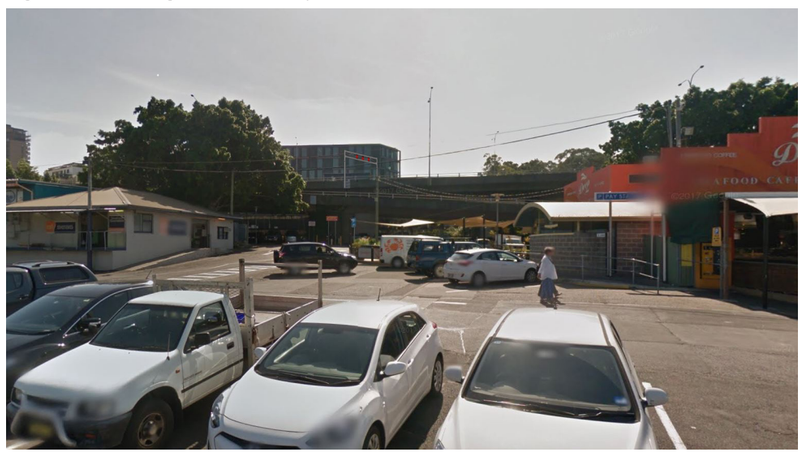

Figure 48: Proposed view of Gantry Location 4 from Fish Markets

4.2.8 Viewpoint 5 - Gantry 5

Refer Figure 49 to Figure 50.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
Cantilever gantry with ISLUS – located north of Allen St off ramp, on Bulwarra Road.	Located in a planted verge that provides screen planting to the motorway for residential on Bulwarra Road. New larger signage structure in a residential area with minimal road furniture/signage. Potential for light spill issue due to illuminated LED.

Figure 49: Existing View of Gantry Location 5

Figure 50: Proposed view of Gantry Location 5

4.2.9 Viewpoint 6 - Gantry 6

Refer Figure 51 and Figure 52.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate High**
Element of proposal visible	**Comment**
Cantilever gantry with ISLUS– located westbound near Pyrmont off ramp - post is taken to ground level between westbound viaduct and Pyrmont off ramp.	New larger signage structure where there is currently no gantry or signage.

Figure 51: Existing View of Gantry Location 6

Figure 52: Proposed view of Gantry Location 6

4.2.10 Viewpoint 7 - Gantry 7

Refer Figure 53 and Figure 54.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**High**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
Portal located on bridge beam/ headstock – located westbound over Pyrmont St with dynamic signage and ISLUS. Public walkway/ stairs directly underneath, portal will be visible from Pyrmont St and new residential apartments at No. 273.	Immediately adjacent is a less sensitive commercial building use. Residential sensitivity at Goldsborough Mort building. Moderate visual impact as, new large signage and gantry structure which is more visible.

Figure 53: Existing View of Gantry Location 7

Figure 54: Proposed view of Gantry Location 7

4.2.11 Viewpoint 8 - Gantry 8

Refer Figure 55 and Figure 56.

Visual Sensitivity	**Low**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low**
Element of proposal visible	**Comment**
Portal with ISLUS and dynamic signage attached to the bridge deck at the parapet, located over eastbound carriageway – replaces existing portal gantry signage	Low visual impact as replaces existing signage but potentially more visible due to illuminated LED component.

Figure 55: Existing View of Gantry Location 8

Figure 56: Proposed view of Gantry Location 8

4.2.12 Viewpoint 9 - Gantry 9

Refer Figure 57 and Figure 58.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
Western Distributor, Westbound, adjacent ICC, Portal with ISLUS attached to the bridge deck at the parapet.	Located in an area of high visual sensitivity with views to new key landmark of ICC. Gantry will obscure this view momentarily. Fixings will be visible from open space below viaduct carriageway.

Figure 57: Existing View of Gantry Location 9

Figure 58: Proposed view of Gantry Location 9

4.2.13 Viewpoint 10 - Gantry 10

Refer Figure 59 and Figure 60.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
Western Distributor eastbound approaching Darling Harbour. New portal with ISLUS and dynamic signage, attached to existing viaduct headstock.	Located in an area of moderate visual sensitivity with view to Cockle Bay and CBD. Fixings will be visible from open space below viaduct carriageway and shared path.

Figure 59: Existing View of Gantry Location 10

Figure 60: Proposed view of Gantry Location 10

4.2.14 Viewpoint 11 - Gantry 11

Refer Figure 61 and Figure 62.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Negligible**
Overall visual impact rating	**Negligible**
Element of proposal visible	**Comment**
Western Distributor, Westbound, South of Hyatt Regency Hotel Darling Harbour Tunnel – new portal with dynamic signage and ISLUS replaces existing portal and static signage.	Hotel precinct with moderate sensitivity. Replaces existing structure but with illuminated signage. Negligible visual impact as no direct building adjacencies and minor degree of change.

Figure 61: Existing View of Gantry Location 11

Figure 62: Proposed view of Gantry Location 11

4.2.15 Viewpoint 12 - Gantry 12

Refer Figure 63 and Figure 64.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low-Moderate**
Element of proposal visible	**Comment**
Western Distributor, Eastbound, adjacent to Cockle Bay – replaces existing portal gantry signage – portal structure with ISLUS and dynamic signage attached to bridge deck parapet.	Low-Moderate visual sensitivity from carriageway as replaces existing signage but potentially more visible due to illuminated LED component. Fixings will be visible from open space below viaduct carriageway.

Figure 63: Existing View of Gantry Location 12

Figure 64: Proposed view of Gantry Location 12

4.2.16 Viewpoint 13 - Gantry 13

Refer Figure 65 and Figure 66.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Negligible**
Overall visual impact rating	**Negligible**
Element of proposal visible	**Comment**
Western Distributor, Westbound, Adjacent to Market Street – cantilever structure with ISLUS and static signage. One lane converted to two lanes.	Hotel precinct with moderate sensitivity. Negligible visual impact as no direct building adjacencies and carriageway located at lower level to buildings.

Figure 65: Existing View of Gantry Location 13

Figure 66: Proposed view of Gantry Location 13

4.2.17 Viewpoint 14 - Gantry 14

Refer Figure 67 and Figure 68.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low-Moderate**
Element of proposal visible	**Comment**
Western Distributor, north/eastbound, near to Market Street – new freestanding cantilever structure with ISLUS. Post comes to ground level between carriageways.	Hotel precinct with moderate sensitivity. Hyatt Regency Hotel building spans over the motorway. Illuminated LED components and signage gantry will not be visible as the illuminated element faces away from hotel.

Figure 67: Existing View of Gantry Location 14

Figure 68: Proposed view of Gantry Location 14

4.2.18 Viewpoint 15 - Gantry 15

Refer Figure 69 and Figure 70.

Visual Sensitivity	**Low**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low**
Element of proposal visible	**Comment**
Western Distributor, north/eastbound, north of Hyatt Regency building – new LED signage connected to bridge.	Hyatt Regency adjacent. Located 5.5m below windows looking out over motorway with limited visibility. Low visual impact as carriageway at lower level to buildings and minimal degree of change.

Figure 69: Existing View of Gantry Location 15

Figure 70: Proposed view of Gantry Location 15

4.2.19 Viewpoint 16 - Gantry 16

Refer Figure 71 and Figure 72.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Low**
Overall visual impact rating	**Low-Moderate**
Element of proposal visible	**Comment**
Western Distributor westbound – new dynamic signage with ISLUS below. Mounted to face of existing pedestrian bridge.	Located within the "Protected Public Street Views to Water" although in parallel with the view so provides no additional obstruction and minimal degree of change to view.

Figure 71: Existing View of Gantry Location 16

Figure 72: Proposed view of Gantry Location 16

4.2.20 Viewpoint 17a - Gantry 17

Refer Figure 73 and Figure 74.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
East/northbound Western Distributor above Sussex Street. Portal structure with ISLUS spanning both directions.	Far enough away from Sydney Harbour Bridge to not impact that vista or block water views. New element in the streetscape setting, but surrounded by less visually sensitive commercial buildings.

Figure 73: Existing View of Gantry Location 17

Figure 74: Proposed view of Gantry Location 17

4.2.21 Viewpoint 17b - Gantry 17

Refer Figure 75 and Figure 76.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
East/northbound Western Distributor above Sussex Street. Portal structure with ISLUS spanning both directions.	Gantry connection to parapet will be visible from this view on Sussex Street. New element in the streetscape setting, but surrounded by commercial buildings only.

Figure 75: Existing View of Gantry Location 17 from Sussex Street

Figure 76: Proposed view of Gantry Location 17 from Sussex Street

4.2.22 Viewpoint 18 - Gantry 18

Refer Figure 77 and Figure 78.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
Eastbound western distributor adjacent to Kent Street – new portal structure with ISLUS signage.	Surrounded by commercial buildings but with a distant vista to Sydney Harbour Bridge. Connection to the parapet of the bridge will be visible from the pedestrian underpass below and Kent Street and in the distance from Grosvenor Street.

Figure 77: Existing View of Gantry Location 18

Figure 78: Proposed view of Gantry Location 18

4.2.23 Viewpoint 19 - Gantry 19

Refer Figure 79 and Figure 80.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
Westbound, western distributor, near Kent Street – near old gantry location – new portal structure with dynamic signage.	Surrounded by commercial buildings only. Replaces existing signage that has been removed in recent road works.

Figure 79: Existing View of Gantry Location 19

Figure 80: Proposed view of Gantry Location 19

4.2.24 Viewpoint 24 - Gantry 24

Refer Figure 81 and Figure 82.

Visual Sensitivity	**High**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate-High**
Element of proposal visible	**Comment**
Sydney Harbour Bridge southern approach - dynamic signage attached to existing portal gantry.	High sensitivity view of the Sydney Harbour Bridge vista. New signage blocks view of bridge abutment tower.

Figure 81: Existing View of Gantry Location 24

Figure 82: Proposed view of Gantry Location 24

4.2.25 Viewpoint 25 - Gantry 25

Refer Figure 83 and Figure 84.

Visual Sensitivity	**Moderate**
Magnitude of visual effect	**Moderate**
Overall visual impact rating	**Moderate**
Element of proposal visible	**Comment**
Sydney Harbour Bridge northern approach - Attach dynamic signage to existing portal gantry.	Moderate degree of change in area of moderate sensitivity.

Figure 83: Existing View of Gantry Location 25

Figure 84: Proposed view of Gantry Location 25

4.3 Construction and Operation Impacts

During construction temporary visual impacts may include visible construction activities such as demolition and excavation works, removal of vegetation, installation works involving cranes and hoists, construction compounds and finishing works such as concrete sawing, joint installation, line marking, kerb and gutter construction, installation of safety barriers, installation of street lighting and landscaping, installation of sign posting.

During operation the primary visual impact will be the illuminated signage on dynamic directional signage. Dynamic signage is generally located in the motorway corridor and as such is most visible to motorists. Refer to Section 4.2 for individual gantry visual impact assessment. All new gantries will be designed as inaccessible with no maintenance walkways provided. It is anticipated that any maintenance to the gantries, the signage or the ITS equipment will be carried out from a mobile access platform under a lane closure.

4.4 Summary of visual impact

The areas in which the gantries and signage are proposed to be located is a city environment. Its urban presentation is highly developed and modified and at the same time can also be a highly scenic environment with many heritage items and significant view corridors. Being a city environment, existing signs, light poles and other road furniture already provide a degree of small scale ephemeral urban clutter. The study area also has a history of attaching new ITS and signage to bridges, parapets or barriers. This is because space is constrained and road widths limited.

The proposed gantry structures themselves also vary in visual magnitude. Gantries in general will have a higher magnitude due to their larger scale of structure and illuminated signage.

In general, where new gantries replace existing signage gantries, visual impacts are lower. Where there are no existing gantries or signage the visual impact is higher. The visual impacts are highest in the areas where the adjoining land use is more visually sensitive such as areas with residential buildings or areas with heritage significance.

The tables below summarise the preceding viewpoint analysis, indicating the overall visual impact without mitigation.

Table 2: Gantry Visual Impact Summary Table

VIEWPOINT	VISUAL IMPACT
VP 1	MODERATE-HIGH
VP 2	MODERATE-HIGH
VP 1-2	NEGLIGIBLE
VP 3a	LOW-MODERATE
VP 3b	LOW-MODERATE
VP 4a	MODERATE-HIGH
VP 4b	MODERATE
VP 5	MODERATE-HIGH
VP 6	MODERATE-HIGH
VP 7	MODERATE-HIGH
VP 8	LOW
VP 9	MODERATE-HIGH
VP 10	MODERATE
VP 11	NEGLIGIBLE
VP 12	LOW-MODERATE
VP 13	NEGLIGIBLE
VP 14	LOW
VP 15	LOW
VP 16	LOW-MODERATE
VP 17a	MODERATE
VP 17b	MODERATE
VP 18	MODERATE-HIGH
VP 19	MODERATE
VP 20	REMOVED FROM SCOPE
VP 24	MODERATE-HIGH
VP 25	MODERATE

Table 3: Variable Message Signs Visual Impact Summary Table

VIEWPOINT	VISUAL IMPACT
VP 1	LOW-MODERATE
VP 2	MODERATE
VP 3	LOW
VP 4	MODERATE-HIGH
VP 5	MODERATE
VP 6	MODERATE-HIGH
VP 7	LOW
VP 8	LOW
VP 9	MODERATE-HIGH
VP 10	MODERATE
VP 11	LOW
VP 12	MODERATE
VP 13	MODERATE-HIGH
VP 14	LOW
VP 15	MODERATE-HIGH

5. Urban design strategy

5.1 Urban design objectives & principles

This section outlines a set of urban design objectives and principles to guide design development of the project and to ensure that the project is physically, visually, and operationally integrated with the surrounding environment. As the project will comprise primarily a suite of integrated 'smart' technologies (known as Intelligent Transport Systems, or ITS), the objectives and principles focus on these elements. Some examples of this technology, for example, are CCTV, dynamic speed and lane use management, electronic message signs. There would be no new or widened roads or ramps due to the restricted road corridor space available.

The objectives are consistent with the '*Beyond the Pavement*' (TfNSW, 2020) urban design principles and more specifically based on the objectives set out in the Project briefing document for Urban Design (PS281) which are:

To develop and present an integrated engineering and urban design outcome that:

- Fits sensitively into the built, natural and community environments through which it passes, is well designed and contributes to the character and functioning of the area
- Contributes to the accessibility and connectivity of people within regions and communities
- Contributes to the overall quality of the public domain for the community and all road users.

The study area has a history of attaching new ITS and signage to bridges, parapets or barriers. This is because space is constrained and road widths limited. The vision for the Project is therefore to carefully and sensitively locate new gantries, signage and ITS elements to minimise visual, heritage and community impacts. Design of gantries, signage and ITS elements should be refined, elegant and contextual and may vary in appearance to better integrate with their context.

Objective 1: Fit sensitively with the existing qualities, characteristics and community of the surrounding highly urban and visually sensitive environments.

The principles to achieve this are:

- Maintain the integrity of the existing urban character, particularly the physical and visual experience of the motorway and adjacent environments of Rozelle, Pyrmont, Darling Harbour, Sydney CBD, the Rocks, Circular Quay and Royal Botanic Garden
- Maintain and enhance key landmarks along the route such as Anzac Bridge and its Soldier memorials, the Sydney Opera House, Sydney Harbour Bridge, including significant views and vistas both across and along the corridor, by carefully considering the location of the new ITS elements
- Design other major project elements, such as retaining or noise walls if required, to fit into their setting and reduce their visual and physical obtrusiveness
- Consider the visual experience of pedestrians using major public thoroughfares beneath, along and over the motorway corridor.

Objective 2: Connectivity and Legibility

The principles to achieve this are:

- Consider opportunities to enhance the motorway experience
- Consider opportunities to improve the appearance and connectivity under the motorway viaduct spaces, to reconnect adjacent communities and cityscape
- Limit the amount of signage and ITS hardware as far as practical to minimise road-side clutter and retain key vistas.

Objective 3: To protect the heritage and cultural attributes of the motorway corridor within the globally recognised City of Sydney.

The principles to achieve this are:

- Minimise the visual impact upon adjacent communities and buildings positioned close to the motorway corridor and motorway structures
- Minimise the impact and promote a considered design response to the Sydney Harbour Bridge and Anzac Bridge landmarks
- Protect and enhance significant views from streets and other public places
- Respond sensitively to individual heritage items that occur adjacent to the road corridor
- Respond sensitively to the cultural precincts that occur adjacent to the road corridor
- To provide a considered design response for fixing of signage structures on existing bridge structures.

Objective 4: To develop a simple and unified palette of roadside ITS elements.

The principles to achieve this are:

- Design proposed ITS elements as part of a unified design palette to minimise visual clutter and provide a coordinated visual outcome with details that are contextually appropriate, attractive and easily maintained
- Design ITS structures to minimise bulk and massing
- Minimise and rationalise signage structures to the minimum technical requirements to minimise visual clutter
- Design all gantry, lighting and signage for the proposed project to be as unobtrusive as practicable, particularly for areas where the new ITS would introduce new illuminated visual elements
- Ensure ITS conduits and cables are concealed from view. Where conduits / cables are unable to be concealed either provide a screening system that will reduce the visual impact and clutter or paint an unobtrusive colour.
- Use robust, high quality and durable materials appropriate to the urban setting and avoid opportunities for vandalism
- Utilise visually recessive colours for posts and fixings such as Sydney Harbour Bridge Grey.

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6. Concept design

The Project aims to deliver a Smart Motorway upgrade along one of the busiest sections of the city road network in Sydney. The system requires signage gantries spanning the main motorway alignment at regular intervals (approximately 500-600 metre spacing) and smaller span gantries at interchange entry and exit ramps. The gantries will hold both directional, electronic and ISLUS (Integrated Speed and Lane Use Sign) signage for lane and traffic management.

The M1NSM project design team has developed a simple, considered and coherent design for the gantry structure. The gantry will form a familiar, regularly spaced, repetitive roadside element working to reinforce, but not dominate, the linear identity of the M1 Motorway. Refer to Figure 88 for illustrations of the gantry design.

Recognising that the gantries are large structures in the urban landscape and may have negative visual impacts upon the M1 Motorway's neighbours, mitigation measures to minimise their impact have been considered during the concept design development. The mitigations included:

- Evaluating, rationalising and consolidating the locations of each gantry and considering its visual impact
- Developing a gantry system that integrates a range of components in a simple, neat and organised fashion
- Introducing clean, simple lines to the gantry members
- Minimising the bulk of the overhead section of the gantry whilst recognising safety and maintenance access requirements
- Using discreet and neutral colours to allow the gantries to become an integrated part of the existing Transport for NSW roadside suite of furniture.

6.1 Gantry locations

Refer Figure 85: Gantry Location Plan.

The proposed location of the gantry structures has been determined, in the first instance, by the technical and operational requirements of the motorway. This, along with the motorists needing to be informed in a timely way for wayfinding purposes, has dictated the type of signage required on each gantry. The contextual analysis and character zone sensitivity assessment captured in Section 2.0 of this report has been used to inform and influence the gantry positions. In particular, the sensitivity of the proposed locations along the M1 Motorway in relation to the City of Sydney Special Character Zones and Protected Public Views (Section 2.1), the Landmarks and Significant Views (Refer Section 2.4) and heritage item locations. As a result of this, several gantries proposed in the concept design process have either been deleted or relocated to reduce the visual impact.

For a structural description of the design, refer to Section 6.2 The gantry concept design.

A complete list of gantries and their types and location can be found in Table 4: Schedule of gantry types.

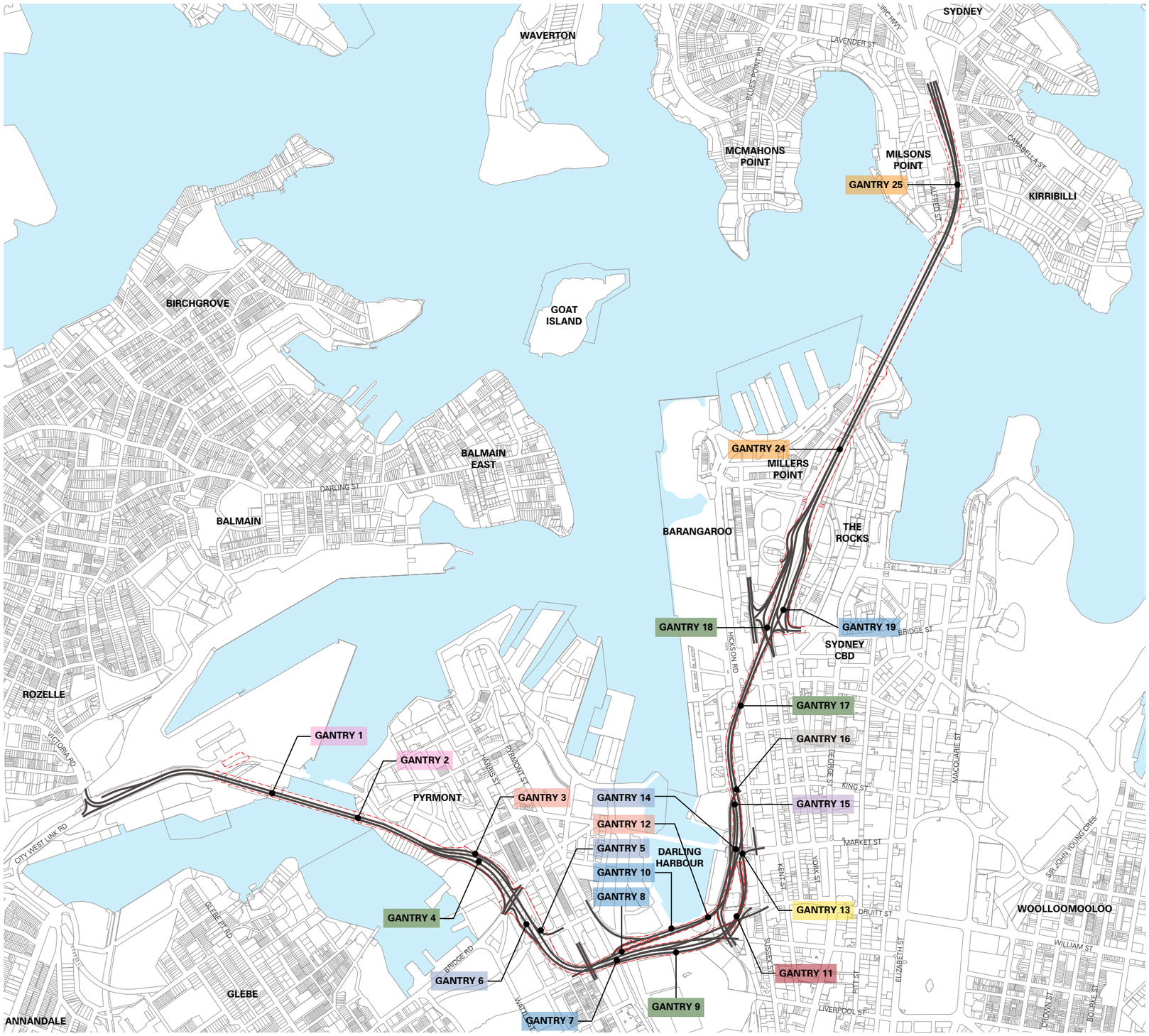


Figure 85: Gantry Location Plan

Table 4: Schedule of gantry types

GANTRY No	LOCATION	NUMBER OF:					SPAN	GANTRY STRUCTURE	GANTRY SUPPORT TYPE	GANTRY POST	GANTRY ARM CHORD	GANTRY ARM BRACE	FIXING ASSEMBLY
		Lanes	Gantry Type	ISLUS	Static Signage	Dynamic Signage							Left
1	Anzac Bridge western pylon	8	1	8	4	4	30000	Beam	Pylon	N/A	610 x 16 CHS	273.1 x 12.7 CHS	B1
2	Anzac Bridge eastern pylon	8	1	8	TBA	TBA	30000	Beam	Pylon	N/A	610 x 16 CHS	273.1 x 12.7 CHS	B1
3	WD CBD approach to Anzac Bridge (Pyrmont) eastbound	3	2	3	-	3	15000	Portal	Bridge Deck	508 x 16 CHS	406.4 x 12.7 CHS	273.1 x 12.7 CHS	F1
4	WD CBD approach to Anzac Bridge (Pyrmont) westbound	3	2a	3	-	-	18000	Portal	Bridge Deck	355.6 x 16 CHS	355.6 x 16 CHS	273.1 x 12.7 CHS	F1
5	Western Distributor, CBD near Allen Street, westbound	3	5a	3	1 ON POST	-	12000	Cantilever	New Foundation	700 x 16 CHS	610 x 12.7 CHS	273.1 x 12.7 CHS	BP1
6	Western Distributor, CBD near Allen Street, eastbound	3	5a	3	-	-	12000	Cantilever	New Foundation	700 x 16 CHS	508 x 16 CHS	273.1 x 12.7 CHS	N/A
7	Western Distributor, CBD - westbound over Pyrmont Street	5	3	4	4	-	21000	Portal	Headstock	508 x 16 CHS	508 x 16 CHS	273.1 x 12.7 CHS	BP2
8	Western Distributor, CBD - eastbound over Darling Drive	2	3	2	-	2	9000	Portal	Headstock	406.4 x 16 CHS	355.6 x 16 CHS	273.1 x 12.7 CHS	BP3
9	Western Distributor, CBD - Darling Harbour, westbound	4	2a	4	-	-	15000	Portal	Bridge Deck	355.6 x 16 CHS	355.6 x 16 CHS	273.1 x 12.7 CHS	F1
10	Western Distributor, CBD - Darling Harbour, eastbound	2	3	2	-	2	12000	Portal	Headstock	508 x 16 CHS	406.4 x 12.7 CHS	273.1 x 12.7 CHS	BP3
11	Western Distributor, westbound, south of Regis Darling Harbour Tunnel	3	4	3	-	3	11000	Portal	New Foundation	406.4 x 16 CHS	355.6 x 16 CHS	273.1 x 12.7 CHS	BP1
12	Western Distributor, westbound, adjacent to Cockle Bay	3	2	3	3	-	17000	Portal	Bridge Deck	508 x 16 CHS	508 x 16 CHS	273.1 x 12.7 CHS	F2
13	Western Distributor, westbound, adjacent to Market Street	2	5	2	2	-	6000	Cantilever	New Foundation	700 x 16 CHS	610 x 12.7 CHS	273.1 x 12.7 CHS	BP1
14	Western Distributor, CBD - Darling Harbour eastbound adjacent to Market Street	2	5a	2	-	-	8000	Cantilever	New Foundation	700 x 16 CHS	508 x 16 CHS	273.1 x 12.7 CHS	N/A
15	Connected to bridge carrying King Street ramp over Western Distributor. Over eastbound lanes only	3	6a	3	-	-	-	Bracket	Bridge Deck	N/A	N/A	N/A	N/A
16	Pedestrian footbridge over Western Distributor at King Street	3	6	3	-	-	-	Bracket	Bridge Deck	N/A	N/A	N/A	N/A
17	Western Distributor above Sussex Street	6	2a	6	-	-	26000	Portal	Bridge Deck	508 x 16 CHS	406.4 x 12.7 CHS	273.1 x 12.7 CHS	F2
18	Western Distributor eastbound adjacent to Kent Street	3	2a	3	-	3	14000	Portal	Bridge Deck	508 x 16 CHS	406.4 x 12.7 CHS	273.1 x 12.7 CHS	F2
19	Western Distributor westbound near Grosvenor Street	3	3	-	-	3	13000	Portal	Bridge Abutment	508 x 16 CHS	406.4 x 12.7 CHS	273.1 x 12.7 CHS	F3
24	Sydney Harbour Bridge (SHB Gantry 2) southern approach	8	7	-	-	2	27000	Bracket	Existing Portal Gantry	N/A	N/A	N/A	N/A
25	Sydney Harbour Bridge (SHB Gantry 8) northern approach	8	7	-	-	6	28500	Bracket	Existing Portal Gantry	N/A	N/A	N/A	N/A

6.2 The gantry concept design

The M1NSM gantries comprise three main structural elements that work like a Kit-of-Parts where components can be selected to suit the sign type, the span and the founding support situation. The three parts that comprise the gantry are:

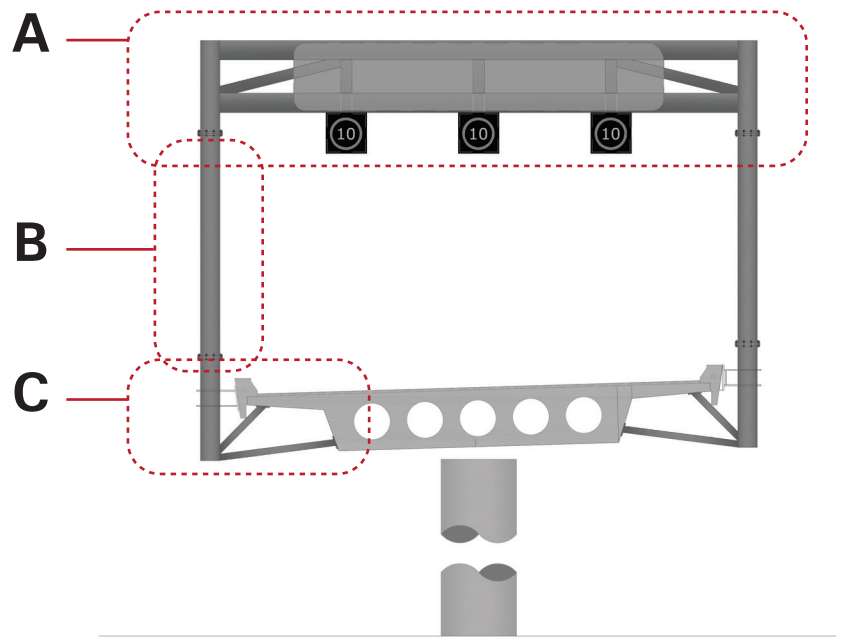
A. The beam – to suit the span and type/ combination of sign being supported.
B. The post – To form either a portal or cantilevered structure.
C. The fixing bracket – the connection to the founding support be it a bridge parapet, girder, headstock or to the ground below an elevated structure.

Refer Figure 86: Gantry Kit of Parts

The gantries require a range of span arrangements however a balance has been sought between consolidating locations and optimising the span for structural efficiencies. The description of the following pages provides an indication of the variety of combinations and configurations determined during the 80 per cent design process.

Minimisation of the visual impact of gantries have been carefully considered during the road design however, the exact locations are primarily determined by the technical and operational issues such as traffic speed, traffic lane complexity, sight distances, and location of interchanges. The design intends to:

– Introduce clean lines and reinforce the horizontality of the structure
– Consider posts that accommodate various attachment situations
– Capitalise on repetition in relation to production costs, minimise variations in design to accommodate various situations
– Consider safety and maintenance access
– Minimise visual clutter.



A The Beam
B The Post
C The Fixing Design

Figure 86: Gantry Kit of Parts

6.2.1 Gantry types

The gantries have been split into types for structural design purposes and based on location and the opportunities for foundation/support locations. There are three general structural types:

1. Beams
2. Portals
3. Cantilevers

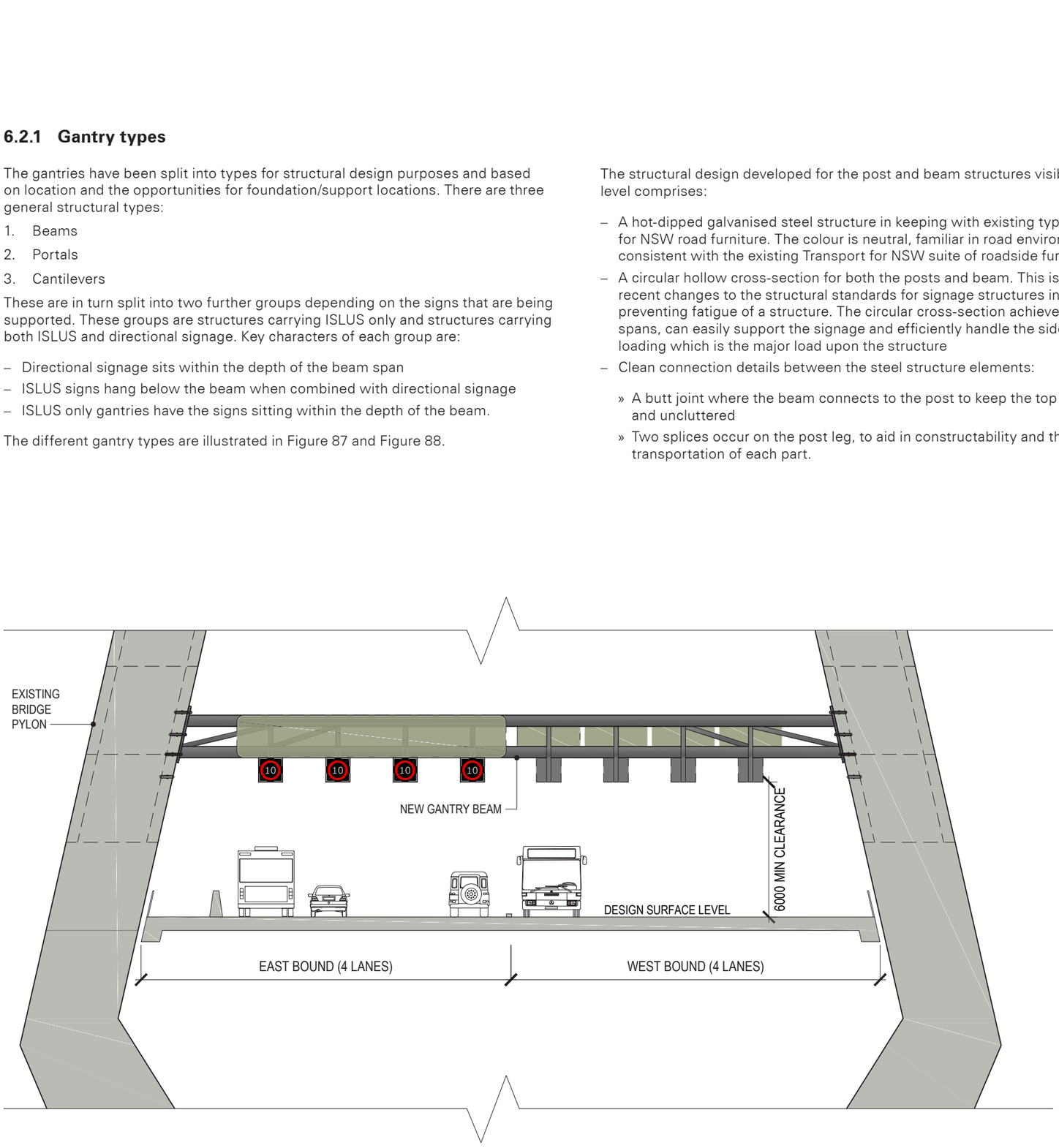
These are in turn split into two further groups depending on the signs that are being supported. These groups are structures carrying ISLUS only and structures carrying both ISLUS and directional signage. Key characters of each group are:

- Directional signage sits within the depth of the beam span
- ISLUS signs hang below the beam when combined with directional signage
- ISLUS only gantries have the signs sitting within the depth of the beam.

The different gantry types are illustrated in Figure 87 and Figure 88.

The structural design developed for the post and beam structures visible from road level comprises:

- A hot-dipped galvanised steel structure in keeping with existing typical Transport for NSW road furniture. The colour is neutral, familiar in road environments and consistent with the existing Transport for NSW suite of roadside furniture
- A circular hollow cross-section for both the posts and beam. This is driven by recent changes to the structural standards for signage structures in regards to preventing fatigue of a structure. The circular cross-section achieves the required spans, can easily support the signage and efficiently handle the sideways wind-loading which is the major load upon the structure
- Clean connection details between the steel structure elements:
  - » A butt joint where the beam connects to the post to keep the top corner simple and uncluttered
  - » Two splices occur on the post leg, to aid in constructability and the transportation of each part.



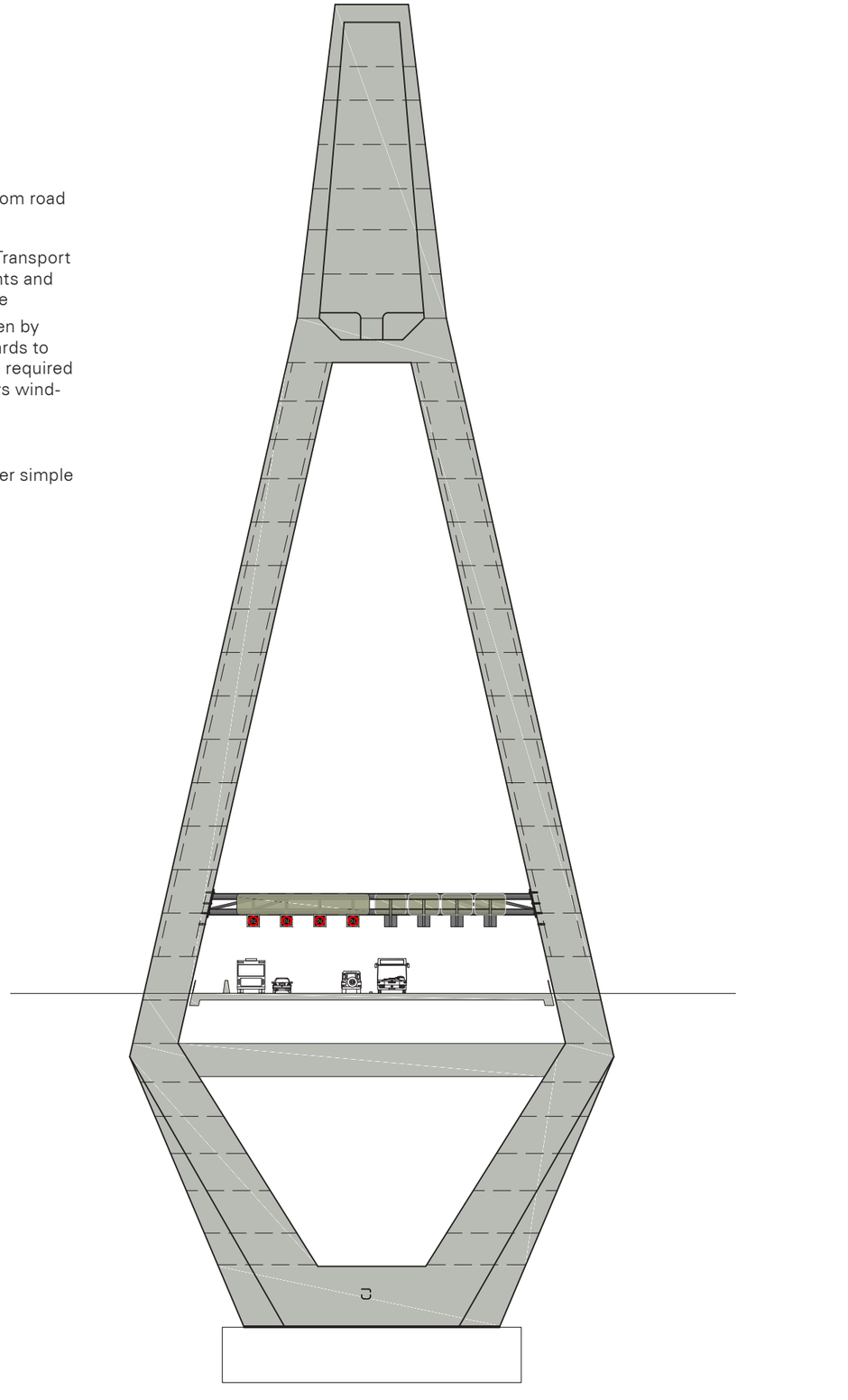
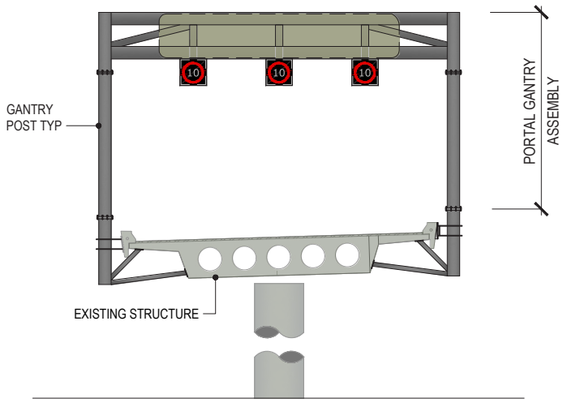
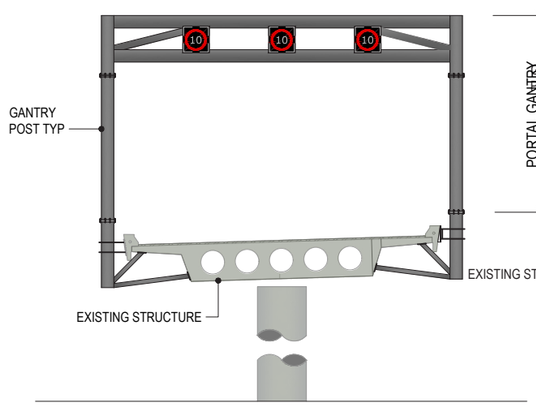


Figure 87: Gantry Type 1 for Anzac Bridge requires a beam only

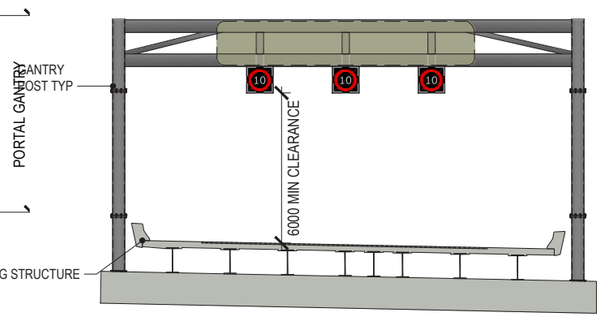


TYPE 2

Type 2 and 2a: Portal structure attached to bridge deck at parapet at Western Distributor (several locations)

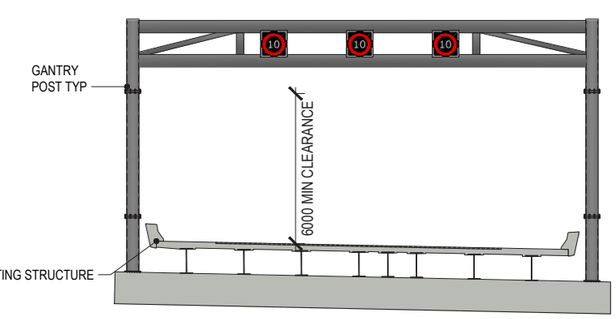


TYPE 2a

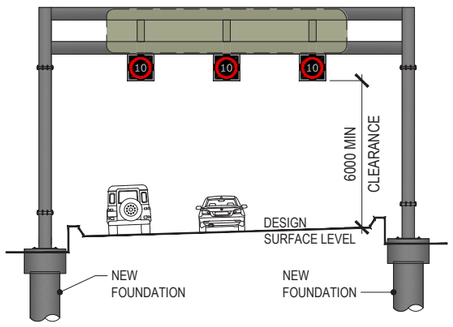


TYPE 3

Type 3 and 3a: Portal structural type located on headstock at Western Distributor over Pyrmont Street

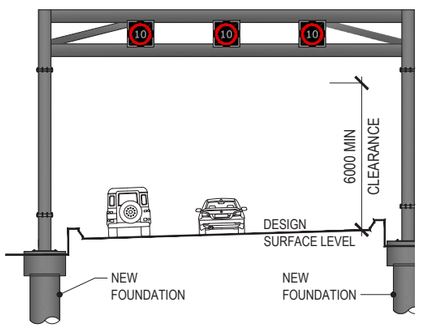


TYPE 3a - Note: not currently proposed

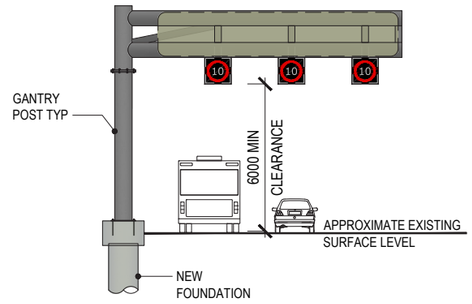


TYPE 4

Type 4: Portal structure type with new foundation at Darling Harbour Tunnel

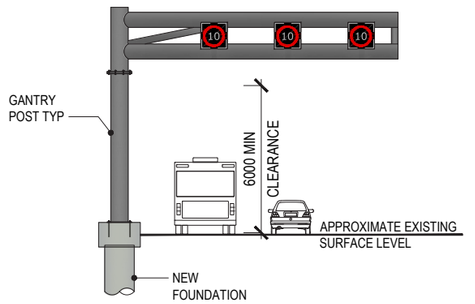


TYPE 4a - Note: not currently proposed

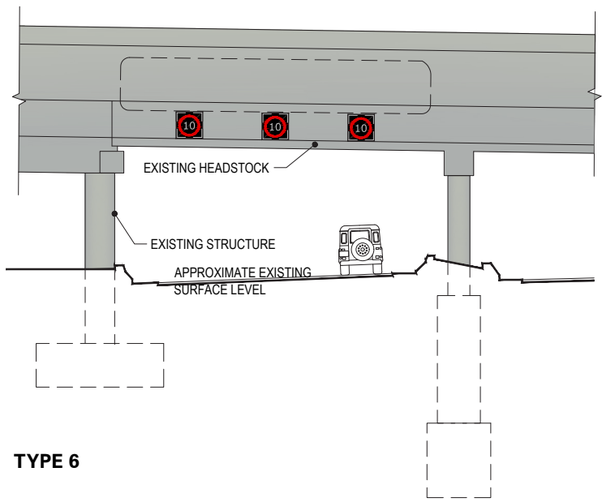


TYPE 5

Type 5 and 5a: Cantilever structure (several locations)

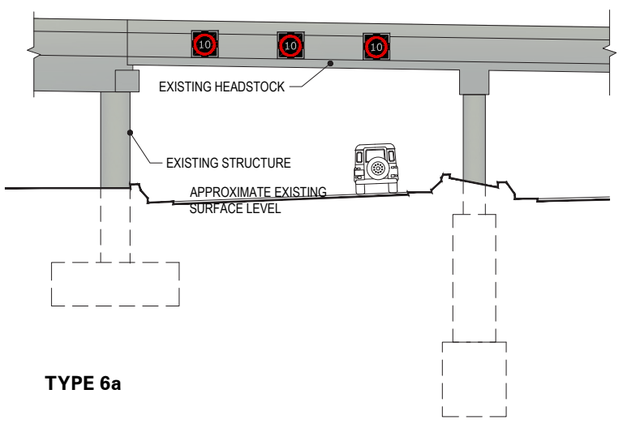


TYPE 5a

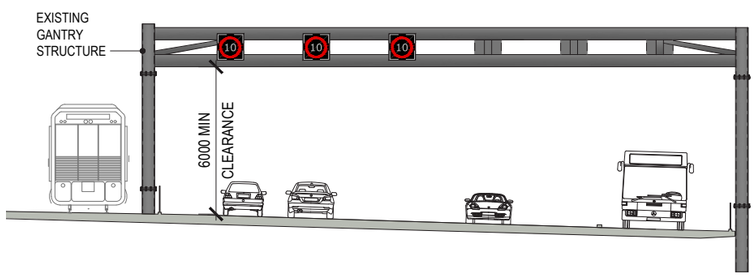


TYPE 6

Type 6 and 6a: Existing bridge structure



TYPE 6a



Type 7: Existing gantry structure along Sydney Harbour Bridge

0 10m

Figure 88: Gantry Types

6.2.2 Gantry connections

The gantries are supported on different types of brackets/fixings or concrete footings which connect the gantry to the supporting structure or foundation as appropriate. These bracket/fixing types are visually described in Figure 89 and Figure 90. The structural design developed for the gantry foundation/support structures comprises a hot-dipped galvanised steel structure in keeping with the post and beam elements.

The gantry support structure can be one of several options:

Types BP2 and BP3:

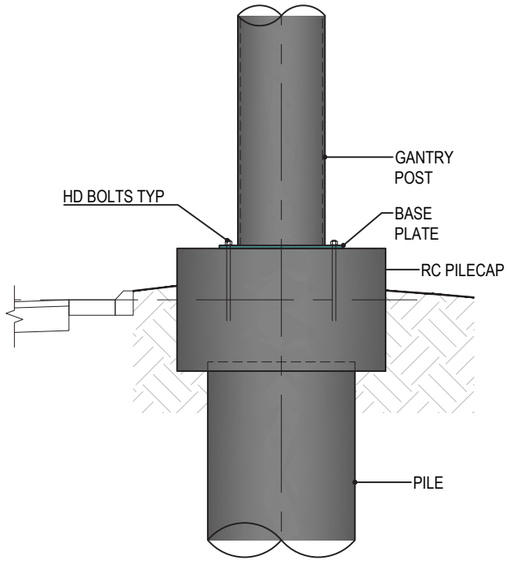
Gantry support on top of or on the end of existing bridge headstocks – preferred option if fixing to an existing structure as the headstocks have more reserve capacity than the superstructure elements of a bridge.

Types F1, F2, F3:

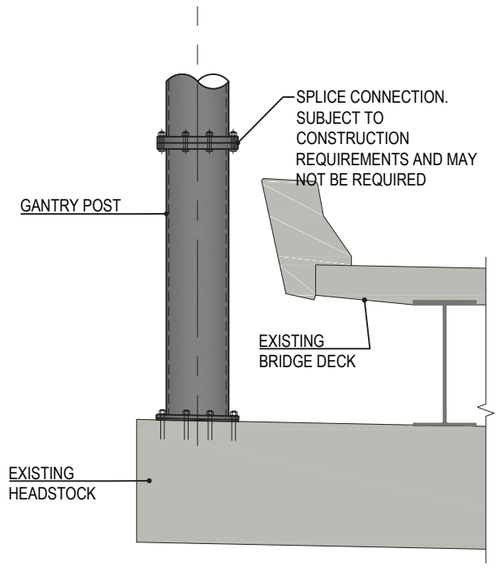
Gantry support on parapet barrier/side of deck or abutment – where location of the gantry does not align with pier locations of the existing structure or there are no headstocks. The gantry size and the number and size of attachments to the gantry will be determined by the structural capacity and the geometric constraints of the barrier and it is likely that some compromise in signage/ITS equipment will be required. A steel bracket system has been developed to connect the post to the superstructure. Refer to Figure 90.

Type BP1:

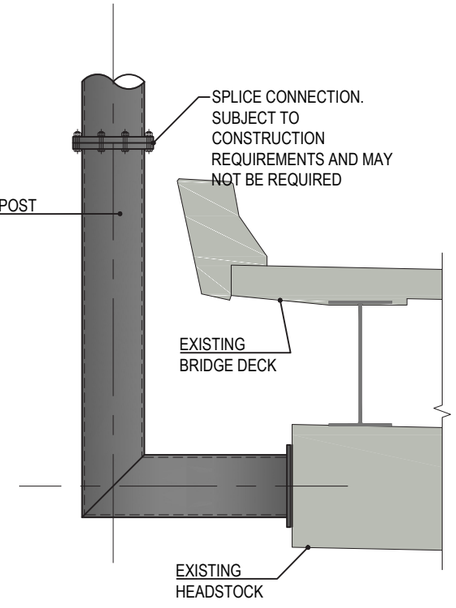
Gantry fixed on ground – where the height to ground is economical and the space allows. This option is advantageous in that it does not rely on the capacity of an existing structure.



TYPE BP1
GANTRY TO NEW FOUNDATION CONNECTION

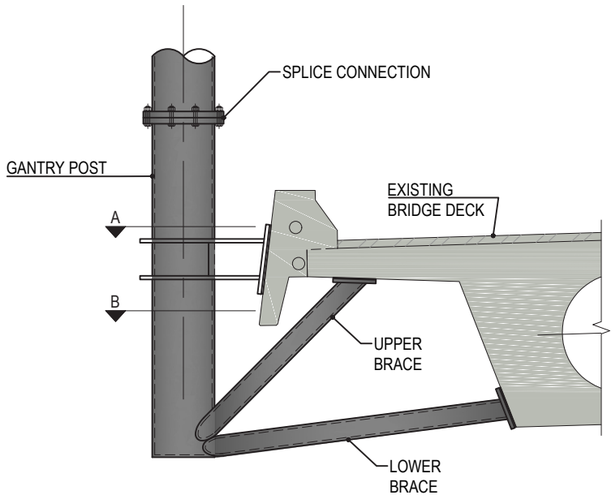


TYPE BP2
GANTRY TO EXISTING HEADSTOCK CONNECTION

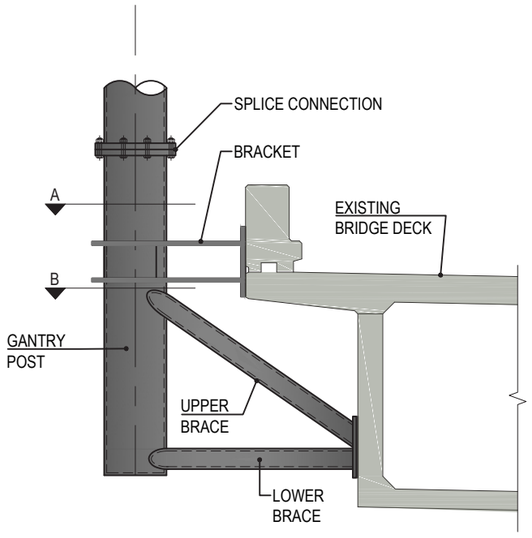


TYPE BP3
GANTRY TO EXISTING HEADSTOCK CONNECTION

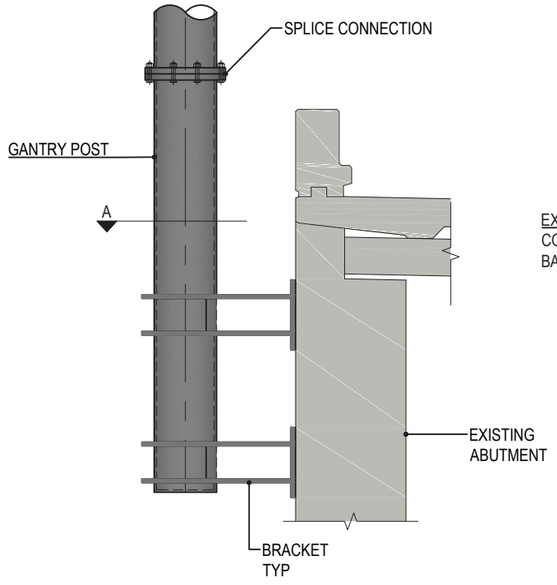
Figure 89: Gantry Support Options



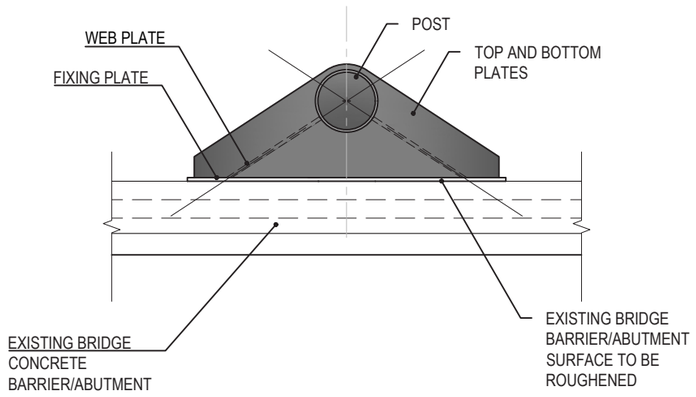
TYPE F1
GANTRY TO EXISTING BRIDGE DECK CONNECTION



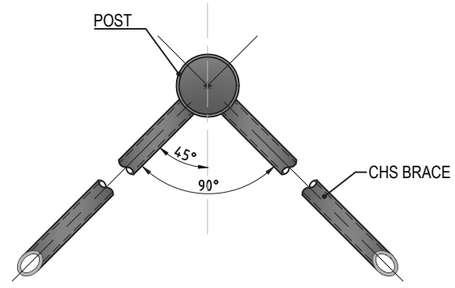
TYPE F2
GANTRY TO EXISTING BRIDGE DECK CONNECTION



TYPE F3
GANTRY TO EXISTING ABUTMENT CONNECTION



SECTION A



SECTION B

0 10m

Figure 90: Gantry Support Options

6.3 Static signage

There is some new static signage proposed as part of the M1NSM. Signage types include directional, lane control, and speed control signs. Most of the signage proposed are upgrading of existing signage.

Refer Road Furniture Signage Package PS2017-005287-DC-RF.

6.4 ITS equipment

ITS Equipment

Where possible new ITS equipment has been located on existing infrastructure such as light poles, smart poles, traffic signals, gantries and bridge structures. The following summary of typical ITS equipment locations is provided:

- RC1's and RC4's are mounted on traffic signal posts.
- RC2's located on ramps are mounted off existing barriers or other existing structures.
- RC3's are typically located on existing smart poles or in locations where existing light poles are being replaced with smart pole in same location.
- Detectors are small devices mounted on existing barriers or other existing structures.
- ISLUS is mounted to existing barriers or structure on ramps or adjacent retaining walls or rock cuttings.
- CCTV is attached to existing infrastructure such as overhead bridges, signalised intersection posts and gantries.

7. Recommended mitigation measures

The Visual Impact Assessment process brings to light a variety of mitigation measures that have further potential to locally mediate the effects of the M1NSM project in detailed design. Some measures will potentially eliminate any impact, others help to better integrate the gantries and signage into their surroundings and/or reduce their visual impact.

7.1 Mitigations incorporated in the concept design

Development of the concept design has attempted to mitigate the overall impact of the proposal, focussing on the major proposal components of the ITS structures and their design and location within the Blackwattle Bay, Pyrmont, Ultimo, Darling Harbour and the Sydney CBD settings. It is recognised that further opportunities will arise during detail design to refine the design to produce further enhanced urban design outcomes.

The sensitivity of landscape character zones along the M1 North Motorway influenced early, in the concept design process, the gantry locations. Some gantries have either been deleted or relocated elsewhere to avoid visual impact. In particular the following issues were investigated and mitigated from the 20% concept design:

- Anzac soldiers memorial location – a gantry was proposed in the vicinity of the war memorial but was identified early as a potential visual impact and relocated to the Anzac Bridge pylons.
- A gantry was proposed on the city end of Anzac Bridge that would have required a tall connection to ground level or a connection near where the steel bridge cables connect to the deck structure. Both were flagged as a potential high visual impact.
- New gantries on the Sydney Harbour Bridge were discouraged early in the design process in favour of utilising existing gantry structures.
- Opportunities to reduce visual clutter such as removing redundant signage or streamlining were encouraged.

7.2 Safeguards and Management Measures recommended to be incorporated into detail design

Subject to the environmental approval of the project being granted, it is recognised that further work will be required to develop the final urban design plan for the proposal.

The urban design objectives and principles outlined in Section 5, together with the urban design concept included in Section 6, will be used to guide the detailed design of key project elements.

Below is a summary of the urban design recommendations for key mitigation and management strategies for the detail design phase of the project.

7.2.1 General

- Ongoing integrated project development in the detail design phase will follow TfNSW integrated project development processes, and will include urban designers (selected from the TfNSW Registered Contractors Scheme) as part of the project team.
- TfNSW Urban Design Policy (Beyond the Pavement) and Urban Design Guidelines will be used to guide future design development of the project.
- The urban design objectives, principles and concept design strategy presented in the urban design report for the Environmental Assessment (REF, EIS) will form the basis for future design development and consultation with stakeholders.

7.2.2 Project Specific Recommendations

- Where dynamic illuminated signage is located adjacent more sensitive residential uses provide screening to minimise potential light spill at these locations:
  - » Gantry 5 – investigate potential additional screening for Bulwarra Road residential
- Ensure ITS cabinets associated located at ground level do not obstruct pedestrian and cyclists accessways
- Capitalise on opportunities to tidy up weed infested area with hard surface finishes where gantry construction occurs.

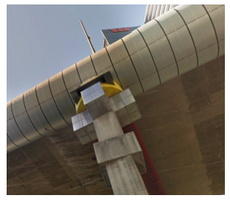
Gantry Design

General

- Further design development of gantries will be undertaken in accordance with TfNSW urban design policies and procedures, the design principles and objectives in Sections 5 and 6, and will consider long term maintenance, durability and operation
- Minimise the quantum of signage to be the minimum the project requires in order to minimise visual clutter and the overall bulk and massing of the gantries
- Provide minimal depth and width for structural post and beams for the gantry structure
- Conceal fixings to streamline appearance
- Utilise a visually recessive colour on posts and fixings so that the visual impact on the skyline is minimised, such as Sydney Harbour Bridge Grey.

Specific gantry locations

- Gantry 9: Investigate if this gantry can be moved further east away from the International Convention Centre as it has become a new Sydney landmark vista
- Gantry 17: The fixing connection to the bridge parapet for the gantry structure should be sympathetic with existing architectural bridge fixings ie provide an architecturally clad finish. Refer to photo below



Anzac Bridge gantries

- On the Anzac Bridge, the design of gantries will be sympathetic to the existing open, vertical and transparent bridge character. Strategies investigated will include:
  - » Ensuring the gantry appearance is as visually transparent as possible in elevation. For example, this may be achieved through several smaller width signs as has been used on the Sydney Harbour Bridge, rather than one large sign
  - » Utilise existing fixing points from the original design
  - » Investigate alternative semi-transparent materials such as a fine aperture mesh for the signs and any background to de-materialise the overall bulk and massing.

7.2.3 Mitigation during construction

Consider implementing the following mitigation measures during construction:

- Suitable barriers will be provided to screen the visibility of construction activities from adjacent areas where appropriate.
- Construction site compound areas will be returned to at least their pre-construction state, unless otherwise detailed in the project design, once construction activities are complete or will be progressively remediated throughout the construction program where possible.
- Existing footpaths, shared use paths or cycleways that would be affected by construction activities will be diverted, or suitable alternatives provided, for the duration of construction.
- Existing trees to be retained within construction facilities areas will be identified, protected and maintained for the duration of the construction works.
- Temporary lighting will be screened, diverted or minimised to avoid unnecessary light spill.
- Material used for temporary land reclamation will be removed once construction activities are complete.

7.3 Urban design opportunities to be further investigated in detail design

The following opportunities have been identified for further investigation in detailed design:

- Further investigate opportunities to reduce the number of gantries and signs.
- Ensure detailed design of the gantry structure considers the mitigation strategies noted in 7.2.2.

8. Conclusion

The urban design objectives and principles, developed for the M1NSM proposal, take into account the urban design and visual character of the study area, and reflect its relationship with the surrounding Sydney cityscape. The overall character of the M1NSM is retained due to the low to moderate magnitude of the Smart Motorway proposal. The urban design concept has been developed to achieve an integrated outcome that helps fit the project as sensitively as possible into its context and to minimise the impacts of the project on the character of the M1NSM and its surrounds, through the incorporation of a number of mitigation measures. The urban design and landscape concept will:

- Ensure retention of iconic harbour, heritage and city views through considered placement of gantry structures avoiding highly visually sensitive areas as far as possible
- Develop a gantry system that integrates a range of components in a refined, elegant, neat and considered way
- Incorporate materials and finishes for gantries that are generally visually recessive and contextually appropriate with the existing road furniture palettes
- Ensure ITS elements limit visual and roadside clutter.

Development of the proposed project during a future detail design phase should consider the key mitigation strategies outlined in this report to further integrate the works into the M1NSM and its surrounds.

Appendix A: Glossary

CBD

Central Business District

ESC

Easing Sydney's Congestion

ICC

International Convention Centre, Darling Harbour

ITS

Intelligent Transport System

ISLUS

Integrated Speed and Lane Use Signs. Refers to signs which display either the current enforceable speed limit, road conditions, or lane-based availability messages

Landscape

A tract of land. Taken to mean a prospect or piece of scenery or land. Landscape includes buildings, villages, towns, cities and infrastructure. The term is also used as shorthand for vegetation either planted, seeded or existing.

Landscape Character

The aggregate of built, natural and cultural aspects that make up an area and provide its unique sense of place. Landscape in this context is taken to include all aspects of a tract of land - the built, planted and natural topographical and ecological features.

LCZ - Landscape Character Zone

An area of the landscape with similar properties or strongly defined spatial qualities.

LED

Light Emitting Diode

LGA

Local Government Area

Magnitude

The scale, form and character of a development proposal. Combined with sensitivity, magnitude provides a measurement of impact.

M1NSM

M1 North Smart Motorway Project or Route

MMS

Managed Motorway System

REF

Review of Environmental Factors

Road Furniture

Items along a roadway including signage, crash barriers, street lights, etc.

Roads and Maritime / RMS

New South Wales Roads and Maritime Services

RTA

Road Transport Authority

Sensitivity

The sensitivity of a landscape character zone or view and its capacity to absorb change. Combined with magnitude, sensitivity provides a measurement of impact. Four factors determine sensitivity:

- The extent to which the landscape is pristine or modified
- Its coherence or variability
- The number of viewers and frequency of view
- The distance the viewers are from the proposed development.

TfNSW

Transport for New South Wales

Urban Design

Urban design in the Roads and Maritime Service is the process where proposals are designed so that they fit sensitivity with the built, natural and community environment, contribute to the functioning of the community and contribute to the quality of the public domain for the community and road users. Architects, engineers, environmental experts, landscape architects, planners and urban designers are all practitioners in the process of urban design. Urban designers are generally landscape architects and architects who have extended their expertise into the field of urban design.

VEM

Visual Envelope Map also referred to as 'viewshed', 'visual catchment' or 'zone of visual influence'. It is the area within which a proposal can be seen at eye level above ground.

Visual Impact

The impacts on the views from residences and key publicly accessible locations.

Appendix B: References

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