Sydney Harbour Bridge: Replacement of Arch Maintenance Units

Statement of Heritage Impact

Report to Roads and Maritime Services

March 2018

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EXECUTIVE SUMMARY

Artefact has been engaged by Roads and Maritime Services (Roads and Maritime) to prepare a Statement of Heritage Impact (SoHI) for the proposed replacement of the Sydney Harbour Bridge (SHB) Arch Maintenance Units (AMUs) (the proposal).

The proposal would involve the replacement of the four existing AMUs (or cranes) on the arch with two new AMUs consisting of a movable gantry, each featuring two smaller Building Maintenance Units (BMUs). The new AMUs would travel on newly installed rails between the king posts and the crown – that is, from the southern and northern ends of the arch to its summit. The BMUs would be able to move laterally across each gantry, allowing full access to the centre of the SHB.

The proposal would require the hand rails currently used by SHB staff and BridgeClimb patrons to be removed. The walkway would be shifted toward the outer edge of the top chords and feature new hand rails and fibreglass stair treads. A number of rivets would need to be removed on the top chord to allow for the installation of the new AMU rails.

The existing AMUs, which were installed in 1997, have limited reach and manoeuvrability and do not provide access to the lateral bridge members. This has resulted in a limited capacity to carry out necessary maintenance works and inspections. The proposal would provide improved accessibility and safety for maintenance workers on the SHB arch and ensure that the steel bridge members that are of exceptional significance to the SHB are appropriately maintained.

The aim of this report is to identify heritage items which may be impacted by the proposed works, determine the level of heritage significance of each item, assess the potential impact to those items, recommend mitigation measures to reduce the level of heritage impact, and identify other management or statutory obligations. Given that the proposal does not involve subsurface excavation, an archaeological assessment was not required as part of this report.

Overview of findings

The SHB and its approaches are listed on the National Heritage List (NHL) and the NSW State Heritage Register (SHR). The proposal is also near several heritage items and heritage conservation areas.

Overall, the impact of the proposal on the SHB would be moderate. The proposal would impact elements of the SHB that are of exceptional significance, with the proposed updated AMUs extending across the full length of the iconic main arch structure. The proposal would result in permanent physical and visual changes to component parts of the main arch structure, including removal of walkways, steel treads, handrails and rivets that are of high significance. The proposal would result in the removal of the existing AMUs, which are of little significance, and installation of two AMUs that would introduce new elements to the SHB. The overall moderate impact of the proposal could be offset by the mitigation measures outlined below.

The proposal, by removing decommissioned elements and installing updated maintenance technology, is considered essential to improve the efficiency, safety and accessibility of critical maintenance and conservation activities on the SHB. This would provide an opportunity to enhance the bridge's ongoing use and longevity. The proposal has been developed, where possible, to minimise the physical impact to significant fabric of the SHB. The design of the proposal has been carefully developed to reduce the visual prominence of the new AMUs and to maintain and enhance the bridge's distinctive character and setting. It has been assessed that the proposal would not degrade, damage, obscure or diminish the national and state heritage values of the SHB, and is

consistent with the policies contained in the SHB Conservation Management Plan (CMP) 2007. The proposal is therefore considered acceptable from a heritage perspective.

The proposal would result in negligible visual impacts on nearby heritage items including the Sydney Opera House World Heritage Buffer Zone, the Millers Point & Dawes Point Village Precinct, Millers Point Conservation Area, Bradfield Park and the North Sydney Olympic Pool. The proposal would result in neutral physical impacts to these items. Potential visual impacts could be offset by the mitigation measures outlined in the recommendations below.

The impact to the social values relating to maintenance activities on the bridge was previously impacted significantly by the replacement of the original painting cranes in 1997. Therefore, the removal of the now decommissioned replacement AMUs will have a negligible impact on the social significance of the cranes and gantries and the SHB as a whole. Recommendations regarding interpretation within this report are designed to reintegrate social connections with the maintenance activities and history as a tangible element of the SHB, and are included below.

Recommendations & mitigation measures

The recommendations set out below will aid in mitigating the impact of the proposal on the SHB and nearby heritage items and heritage conservation areas.

Section 60 application required

The proposal would require a Section 60 application form to be submitted to the NSW Heritage Council, using this document as support for the application.

Material palette

The materials utilised in new works as part of the proposal would be congruent with the aesthetic character of the SHB and surrounding fabric. This includes selection of modern and lightweight materials that are, where appropriate, coloured to match the existing fabric of the SHB including existing steelwork tones of the overall bridge structure. The material palette of the proposal would be consistent with other SHB related projects.

Design of elements to minimise visual impact

Where feasible, works would be designed to reduce the visual prominence of new elements along the top of the main arch structure. This involves employment of appropriate modern and lightweight designs that seek to reduce the visual ‘bulk’ of new structures. Any associated infrastructure regarding upgrades to the AMUs would be sensitively designed and integrated, and wherever possible kept to a minimum to avoid introducing new visual elements to the SHB. This will assist in reducing potential visual impact on significant views and to surrounding heritage items.

Archival Recording

Prior to removal of the 1997 AMUs and metal walkways on the top chords of the SHB main arch structure, a Photographic Archival Recording (PAR) would be prepared for these items. The report would consist of an archival standard photographic record of the site, noting the location and details of the items as well as demonstrating the overall setting within the SHB. The recording shall be undertaken in accordance with the guidelines for *Photographic Recording of Heritage Items Using Film or Digital Capture* prepared by the NSW Office of Environment & Heritage. The PAR would be submitted to North Sydney Council and the City of Sydney Council, and copies would be retained as per the standards.

The 1997 AMUs and metal walkways would be archived and recorded on the Roads and Maritime Heritage and Conservation Register.

Sensitive design of new walkways

The installation of new walkways on the outer edges of the top chords of the bridge arches would be sensitively designed to match and complement the physical character of the SHB main arch structure, while being distinguishably new elements. The walkways would be lightweight in construction and colour matched to the surrounding steelwork. This includes careful design of the walkway railings to minimise the width and bulk of structural elements. As covered above, installation of walkways would, wherever possible, utilise existing attachment points from removed rivets to minimise impact to the original steel plates.

Minimise additional drilling to original steel plates

In order to retain and respect the integrity of the significant fabric of the SHB, drilling additional holes into the original steel plates of the bridge would, wherever possible, be minimised. Where the proposal requires removal of external rivets on the top chords, the existing attachment points would be used for installation of new infrastructure i.e. new rails for upgraded AMUs, new walkways etc. Wherever possible, new bolt fixings that are introduced would be capped and painted to match existing.

Parking strategy for new AMUs

A parking strategy would be prepared and implemented to reduce potential visual impacts. When non-operational and when maintenance activities are not being carried out, the gantries would be ‘parked’ across horizontal members on the lower rises of the SHB main arch structure, with the AMUs ‘folded’ inside the base. This will assist in maintaining the legibility of the SHB main arch structure including the significant form and pattern of the steelwork, and significant views and setting of the SHB.

Interpretation strategy

There is an opportunity for provision of interpretation measures outlining the history, evolution and significance of the SHB including the evolution of maintenance technology and activities to the people that use the bridge. This particularly relates to pedestrians using the walkway on the eastern side of the SHB and the entry/exit points to the SHB. Two of the original 1930s painting cranes have been conserved. It is understood that while one of these cranes is on permanent loan to the National Museum of Australia, Roads and Maritime are currently in the process of exploring potential display opportunities for the second crane. Further investigation could also be given to the reuse of removed rivets as part of the proposal for interpretive purposes.

The proposal presents an opportunity to build on the mitigation measures previously undertaken, and for the interpretation of the maintenance activities on the bridge as part of an overall interpretation of the history of the bridge to be conveyed. In order to avoid a ‘piecemeal’ approach to interpretation, which could potentially obscure or undermine the significant values of the SHB, interpretation would be approached holistically and be directed by an Interpretation Strategy. This would consider interpretation opportunities in the context of other relevant SHB projects.

Cumulative impact

The cumulative impact of the proposal in relation to other SHB related projects would be considered. This includes ensuring minimisation of physical impact to significant fabric of SHB, consistency in the design, style, aesthetic character and material palette of works relating to the SHB, and a coordinated approach to provision of interpretation. Compliance of projects with the *Sydney Harbour Bridge*

Conservation Management Plan will assist in ensuring consistency across SHB projects and retention and potential enhancement of the significant values of this item.

Protection of significant SHB fabric

The proposal involves works in close proximity to significant fabric of the SHB main arch structure. In particular, this includes the steelwork of the trusses, lateral bracing and hangers. These significant components of the SHB would be appropriately protected for the duration of the installation period to minimise potential physical impact, particularly relating to removal of rivets and the installation of the proposed AMUs and associated infrastructure by crane.

Heritage induction for workers

In order to retain and respect the national and state heritage values of the SHB, a heritage induction would be provided for all workers prior to works commencing.

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1.0 INTRODUCTION

1.1 Background

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1.2 Proposal

Key features of the proposal include:

- Removal of existing AMUs and associated modern infrastructure
- Relocation of walkways from the centre of the top chords to the outer edge of the chords. This would require the replacement of the hand rails and stair treads. The proposed stair treads would be made from carbon fibre and colour match the existing treads.
- Installation of initial rail section along the top chords of bridge arches
- Installation of two gantry structures (one for each half of the arch), each with two BMUs with cradles for access to the lateral bridge members
- Completion of rail installation using new bridge maintenance unit.

A detailed scope of the works is provided in Section 6.1.

1.3 Site location

1.3.1 Proposal area

The proposal area encompasses the top chords (east and west) of the SHB main arch structure. The SHB spans between Milsons Point to the north and Dawes Point to the south.

The bridge comprises the arch, four granite-faced pylons, railway line and cycleway on the western side, the footpaths and roads on the eastern side, and the approaches from the CBD in the south and North Sydney in the north. The arches, comprising silicon steel trusses and joists painted dark grey, are part of the main arch truss which, with 40 silicon steel hangers connected to latticed cross girders beneath the railway and roadway, hold the bridge deck.

1.3.2 Study area

For the purpose of this investigation, a study area has been defined as a 50-metre buffer around the proposal (Figure 1). The application of a buffer helps to identify heritage items within the visual catchment of the project where potential visual impacts on that item may occur. Any reference to the 'study area' includes reference to the 50-metre buffer, unless otherwise stated.

Figure 1: Location of project area.

Document Path: C:\Users\GIS\Desktop\GIS\GIS_Mapping\170212 SHB AMUs\MXD\Study_Area.mxd

1.4 Methodology

This SoHI has been prepared with reference to the following:

- *Statement of Heritage Impact 2002*, NSW Heritage Manual 2002 (NSW Heritage Office)
- Roads and Maritime requirements for preparation of SoHI reports
- *Sydney Harbour Bridge Conservation Management Plan* (SHB CMP) 2007
- Statements of significance from existing heritage assessments and registers, such as the State Heritage Inventory (SHI), have been included and additional heritage assessment was not necessary for this report. Details of the existing heritage assessments for each item are provided as an appendix
- DesignInc, December 2017. 'Sydney Harbour Bridge (SHB) Arch Crane & Walkways Replacement: Urban Design Report including Landscape Character and Visual Impact Assessment (VIA) (included as Appendix B).

1.4.1 Significance criteria

National Heritage Listing Criteria

Heritage significance for heritage items considered to have national significance are assessed using the National Heritage List Criteria, presented in Table 1.

Table 1: National heritage assessment criteria

Criteria	Description
A – Historic	The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history.
B – Rarity	The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.
C – Scientific	The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.
D – Representative	The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: i. a class of Australia's natural or cultural places; or ii. a class of Australia's natural or cultural environments
E – Aesthetic	The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.
F – Creative/Technical	The place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.
G – Social	The place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

Criteria	Description
H – Associative	The place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.
I – Indigenous	The place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.

NSW Heritage Assessment Criteria

Heritage significance for heritage items in New South Wales are assessed using the NSW Heritage Assessment Criteria, presented in Table 2.

Table 2: NSW heritage assessment criteria

Criteria	Description
A – Historical Significance	An item is important in the course or pattern of the local area's cultural or natural history.
B – Associative Significance	An item has strong or special associations with the life or works of a person, or group of persons, of importance in the local area's cultural or natural history.
C – Aesthetic or Technical Significance	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in the local area.
D – Social Significance	An item has strong or special association with a particular community or cultural group in the local area for social, cultural or spiritual reasons.
E – Research Potential	An item has potential to yield information that will contribute to an understanding of the local area's cultural or natural history.
F – Rarity	An item possesses uncommon, rare or endangered aspects of the local area's cultural or natural history.
G – Representative	An item is important in demonstrating the principal characteristics of a class of NSWs (or the local area's): • cultural or natural places; or • cultural or natural environments.

1.4.2 Significance grading

This report includes an assessment of the relative contributions of individual components of the SHB, nearby heritage items and heritage conservation areas, to the heritage value of the item, as outlined in Table 3.

Table 3: Standard grades of significance

Grading	Justification	Status
Exceptional (E)	Rare or outstanding element directly contributing to an item's local and state significance.	Fulfils criteria for local or state listing
High (H)	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or state listing
Moderate (M)	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfils criteria for local or state listing
Little (L)	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or state listing
Intrusive (I)	Damaging to the item's heritage significance.	Does not fulfil criteria for local or state listing

1.4.3 Impact assessment

In order to consistently identify the potential impact of the proposed works, the terminology contained in Table 4 has been referenced throughout this document.

Table 4: Terminology for assessing the magnitude of heritage impact

Grading	Definition
Major	Actions that would have a long-term and substantial impact on the significance of a heritage item. Actions that would remove key historic building elements, key historic landscape features, or significant archaeological materials, thereby resulting in a change of historic character, or altering of a historical resource. These actions cannot be fully mitigated.
Moderate	Actions involving the modification of a heritage item, including altering the setting of a heritage item or landscape, partially removing archaeological resources, or the alteration of significant elements of fabric from historic structures. The impacts arising from such actions may be able to be partially mitigated.
Minor	Actions that would result in the slight alteration of heritage buildings, archaeological resources, or the setting of an historical item. The impacts arising from such actions can usually be mitigated.
Negligible	Actions that would result in very minor changes to heritage items.
Neutral	Actions that would have no heritage impact.

1.5 Report authorship

This report was prepared by Charlotte Simons (Heritage Consultant) with input from Matthew Alexander (Project Leader). Dr Sandra Wallace (Director) reviewed the report.

2.0 STATUTORY CONTEXT

A number of planning and legislative documents govern how heritage is managed in NSW and Australia. The following section provides an overview of the requirements under each as they apply to the proposal.

2.1 The World Heritage Convention

The Convention Concerning the Protection of World Cultural and National Heritage (the World Heritage Convention) was adopted by the General Conference of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) on 16 November 1972, and came into force on 17 December 1975. The World Heritage Convention aims to promote international cooperation to protect heritage that is of such outstanding universal value that its conservation is important for current and future generations. It sets out the criteria that a site must meet to be inscribed on the World Heritage List (WHL) and the role of State Parties in the protection and preservation of world and their own national heritage.

The concept of a buffer zone was first included in the Operational Guidelines for the Implementation of the Wold Heritage Convention in 1977 and recognises the value of the environment that surrounds a site. The buffer zone acts as an additional layer of protection for World Heritage sites. It is a space that is itself not of outstanding universal value, but that influences the value of a World Heritage site.

2.1.1 World Heritage List

The Sydney Opera House is listed on the WHL. The buffer for this heritage item covers areas north and south of the harbour due to the visual prominence of the Opera House itself. The study area is located within this buffer zone (Figure 3).

2.2 Commonwealth legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legislative framework for the protection and management of matters of national environmental significance, that is, flora, fauna, ecological communities and heritage places of national and international importance. Heritage items are protected through their inscription on the World Heritage List (WHL), Commonwealth Heritage List (CHL) or the National Heritage List (NHL).

Under Part 9 of the EPBC Act, approval under the EPBC Act is required for any action occurring within, or outside, a Heritage place that has, will have, or is likely to have a 'significant impact' on the heritage values of a World, National or Commonwealth heritage listed property (referred to as a 'controlled action' under the Act). A 'significant impact' is defined as:

> *an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts*.

The EPBC Act stipulates that a person who has proposed an action that will, or is likely to, have a significant impact on a site that is listed on the WHL, National Heritage List or Commonwealth

Heritage List must refer the action to the Minister for Environment and Energy (hereafter Minister). The Minister will then determine if the action requires approval under the EPBC Act. If approval is required, an environmental assessment would need to be prepared. The Minister would approve or decline the action based on this assessment.

2.2.1.1 National Heritage List

The NHL was established under the EPBC Act, which provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. Under the EPBC Act, nationally significant heritage items are protected through listing on the NHL or the Commonwealth Heritage List.

- The SHB was included on the NHL in 2007. The listing includes the bridge, pylons, constructed approaches, and parts of Bradfield and Dawes Point Parks. The NHL curtilage is the same as the SHR curtilage (Figure 2), except that the northern extent of the NHL listing ends at Lavender Street, Milsons Point, while the SHR curtilage ends at Blues Street, North Sydney.

The listing of the SHB on the NHL potentially has implications for the proposal and may require referral under the EPBC Act depending on the level of impact. Proposed development (or 'actions') that will have, or are likely to have, a 'significant impact' on the world heritage values of a declared World Heritage property (the Sydney Opera House), or on the National Heritage values of a National Heritage Place (the SHB), must be referred to the Minister.

A 'significant impact' is defined as an action that has an important, notable consequence, dependent upon the sensitivity, value and quality of the environment that is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. The Significant Impact Guidelines state that an action is likely to have a significant impact on the National Heritage values of a place is there is a real chance or possibility that it will cause:[1]

- One or more of the National Heritage values to be lost
- One or more of the National Heritage values to be degraded or damaged
- One or more of the Nation Heritage values to be notable altered, modified, obscured or diminished.

2.3 State legislation

2.3.1 Heritage Act 1977

The NSW *Heritage Act 1977* (Heritage Act) is the primary piece of State legislation affording protection to heritage items (natural and cultural) in New South Wales. Under the Heritage Act, 'items of environmental heritage' include places, buildings, works, relics, moveable objects and precincts identified as significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. State significant items can be listed on the NSW State Heritage Register (SHR) and are given automatic protection under the Heritage Act against any activities that may damage an item or affect its heritage significance. The Heritage Act also protects 'relics', which can include archaeological material, features and deposits.

[1] Commonwealth of Australia, Department of the Environment 2003, 'Matters of National Environmental Significance: Significant Impact Guidelines 1.1'

In some circumstances a section 60 permit may not be required if works are undertaken in accordance with the Standard Exemptions for Works Requiring Heritage Council Approval or in accordance with agency specific exemptions.

The following SHR items are located within the project area:

- Sydney Harbour Bridge, approaches and viaducts (road and rail) (SHR No. 00781).

The following SHR items are located within the study area:

- Millers Point & Dawes Point Village Precinct (SHR No. 01682).

On 16 November 2017, the Heritage Council Government Sub-Committee was held. It is noted that presentation of the SHB AMUs Project was well received, with the Sub-Committee in support of the project and its ability to maintain the SHB.

2.3.2 Section 170 registers

The Heritage Act requires all government agencies to identify and manage heritage assets under their ownership and control. Under Section 170 of the Heritage Act, government instrumentalities must establish and keep a register which includes all items of environmental heritage listed on the SHR, environmental planning instruments or which may be subject to an interim heritage order that are owned, occupied or managed by that government body. Government agencies must also ensure that all items entered on its register are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Minister on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of identified sites, items and objects and are based on relevant NSW heritage legislation and statutory guidelines.

2.3.2.1 Roads and Maritime Section 170 Register

The 'Sydney Harbour Bridge, Approaches and Viaducts' are included in the Roads and Maritime Section 170 Register. Items of moveable heritage associated with the SHB are also included in the Roads and Maritime Section 170 Register, under the listing for 'Roads and Maritime Moveable Heritage Collection (SHI 4311604).

The following items listed on the Roads and Maritime Section 170 Register are located within the project area:

- Sydney Harbour Bridge, including Dawes Point tar-ra Park (Roads and Maritime Section 170 Register No. 4301067).

2.3.2.2 RailCorp (Sydney Trains) Section 170 Register

The following items listed on the Railcorp Section 170 Register are located within the study area:

- Sydney Harbour Bridge (Rail Property Only) (Railcorp Section 170 Register No. 4801059).

2.3.3 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development;

this includes impacts on cultural heritage items and places as well as archaeological sites and deposits. The proposal is subject to assessment under Part 5 of the EP&A Act.

The EP&A Act also requires that local governments prepare planning instruments (such as Local Environmental Plans [LEPs] and Development Control Plans [DCPs]) in accordance with the EP&A Act to provide guidance on the level of environmental assessment required.

The current proposal location falls within the boundaries of the City of Sydney and North Sydney LGAs. Schedule 5 of the North Sydney LEP 2013 and Sydney LEP 2012 includes a list of items/sites of heritage significance within the respective LGAs (refer to Section 2.4 below).

Sydney Regional Environmental Plan (REP) (Sydney Harbour Catchment) 2005

The Sydney REP (Sydney Harbour Catchment) 2005 was prepared under the EP&A Act and includes the *'Sydney Harbour Bridge, including approaches and viaducts (road and rail)'* in its schedule of heritage items. It also includes the Sydney Opera House Buffer Zone.

2.3.4 State Environmental Planning Policy (Infrastructure) [ISEPP] 2007

State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of the Infrastructure SEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The definition of road infrastructure facilities of Infrastructure SEPP includes vehicle or pedestrian bridges.

As the proposal is for a road infrastructure facility and is to be carried out by Roads and Maritime, it can be assessed under Part 5 of the EP&A Act. Development consent is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy No. 14 - Coastal Wetlands, State Environmental Planning Policy No. 26 - Littoral Rainforests. The proposal does not affect land or development regulated by State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005.

Part 2 of the Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

2.4 Local legislation

2.4.1 Local Environmental Plans (LEPs)

North Sydney LEP 2013

The North Sydney LEP lies within the North Sydney LGA. The North Sydney LEP aims to make local environment provisions for land in North Sydney in accordance with relevant standard environmental planning instrument under section 33A of the Act.

Sydney LEP 2012

Sydney LEP 2012 lies within the City of Sydney LGA and specify conditions of development consent within heritage listed items. The aim of the LEP and DCP in relation to heritage is to conserve the

heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views. The LEP lists items of heritage significance areas.

The project area contains one locally listed heritage item. This item is summarised in Table 5. The study area contains several locally listed heritage items and heritage conservation area. These items are summarised in Table 6.

2.4.2 Development Control Plans

Development Control Plans (DCPs) support the provisions of LEPs and the heritage environment. DCPs generally contain detailed development controls which aim to facilitate quality development and protect the amenity of adjoining development. In particular, a DCP may set requirements for site amalgamations, setbacks, building envelopes, landscape treatments, privacy and parking. In town centres, the controls promote design quality, housing choice and more attracted public spaces.

2.4.3 Non Statutory registers

Register of the National Estate

The Register of the National Estate is a list of natural, Aboriginal and historic heritage places throughout Australia. It was originally established under the Australian Heritage Commission Act 1975. Under the Act, the Australian Heritage Commission entered more than 13,000 places on the register. Following amendments to the *Australian Heritage Council Act 2003*, the Register of the National Estate (RNE) was frozen on 19 February 2007 and ceased to be a statutory register in February 2012. The RNE is now maintained on a non-statutory basis as a publicly available archive and educational resource.

Register of the National Trust

The National Trust of Australia is a community-based, non-government organisation committed to promoting and conserving Australia's Indigenous, natural and historic heritage. The Register of the National Trust (RNT) was established in 1949. It is a non-statutory register.

2.5 Summary of heritage listings

A search of all relevant registers for items within the study area was undertaken on 11 May 2017. The results for heritage items within the project area (i.e. the SHB) are displayed below in Table 5. The results for heritage items and heritage conservation areas outside the project area but within the study area are provided in Table 6.

The SHB curtilages of the entries for the NHL and SHR, as well as the curtilages for the heritage items listed within the project area and study area are illustrated in Figure 3 to Figure 5.

Table 5: Register search for Sydney Harbour Bridge (project area)

Register	Listing
World Heritage List	The Sydney Harbour Bridge **is not** registered on the World Heritage List
National Heritage List	Sydney Harbour Bridge **is registered** on the National Heritage List (NHL No. 105888)
Commonwealth Heritage List	Sydney Harbour Bridge **is not registered** on the Commonwealth Heritage List

State Heritage Register	Sydney Harbour Bridge, approaches and viaducts (road and rail) **is registered** on the State Heritage Register (SHR No. 5045703)
Section 170 Registers	Sydney Harbour Bridge, approaches and viaducts **is listed** on the Roads and Maritime Section 170 Heritage and Conservation Register (Section 170 No. 4301067) Sydney Harbour Bridge (Rail Property Only) **is listed** on the Railcorp Section 170 Heritage and Conservation Register (Section 170 No. 4801059)
North Sydney LEP 2013	Sydney Harbour Bridge approach viaducts, arches and bays under Warringah Freeway **is listed** on the North Sydney LEP 2013 (LEP Item No. I0530)
Sydney LEP 2012	Sydney Harbour Bridge approaches group including pylons, pedestrian stairs and access roads **is listed** on the Sydney LEP 2012 (LEP Item No. I539)
Register of the National Estate (non-statutory)	Sydney Harbour Bridge **is listed** on the Register of the National Estate (RNE No.1857)
Register of the National Trust of Australia (non-statutory)	Sydney Harbour Bridge **is listed** on the Register of the National Trust of Australia (NSW)

Table 6: Listed heritage items within the study area (50m buffer).

Item Name	Address	Lot No.	Significance	Item/Listing Number
Sydney Opera House (Buffer Zone)	2 Circular Quay east, Sydney (buffer zone extends to Argyle Street)	Lot 4 DP 787933 Lot 5 DP 775888	World	WHL NHL No. 105738 SHR No. 01685 City of Sydney LEP 2012 Item No. 1064 RNE No. 2353
Millers Point & Dawes Point Village Precinct	Upper Fort Street, Millers Point		State	SHR No. 01682
Millers Point Conservation Area	Millers Point		Local	Sydney LEP 2012 Item No. C35
Bradfield Park (including northern section)	Alfred Street South, Milsons Point		Local	North Sydney LEP 2013 Item No. I0538
North Sydney Olympic Pool	4 Alfred Street South, Milsons Point		Local	North Sydney LEP 2013 Item No. I0537

2.6 Sydney Harbour Bridge Conservation Management Plan

An endorsed Conservation Management Plan (CMP) for SHB prepared by GML in 2007 (CMP 2007) provides a framework for its ongoing care and management, including decisions about its conservation, use and development, and to provide a reference for future applications for works to the bridge. At the time of this report the CMP was being updated but has yet to be endorsed by the Heritage Council. The CMP 2007, including relevant policies, has been referenced in this report to guide conservation and heritage approaches for this assessment.

Figure 2: National Heritage List curtilage boundary of the SHB, with the indicative location of the project area marked in purple.

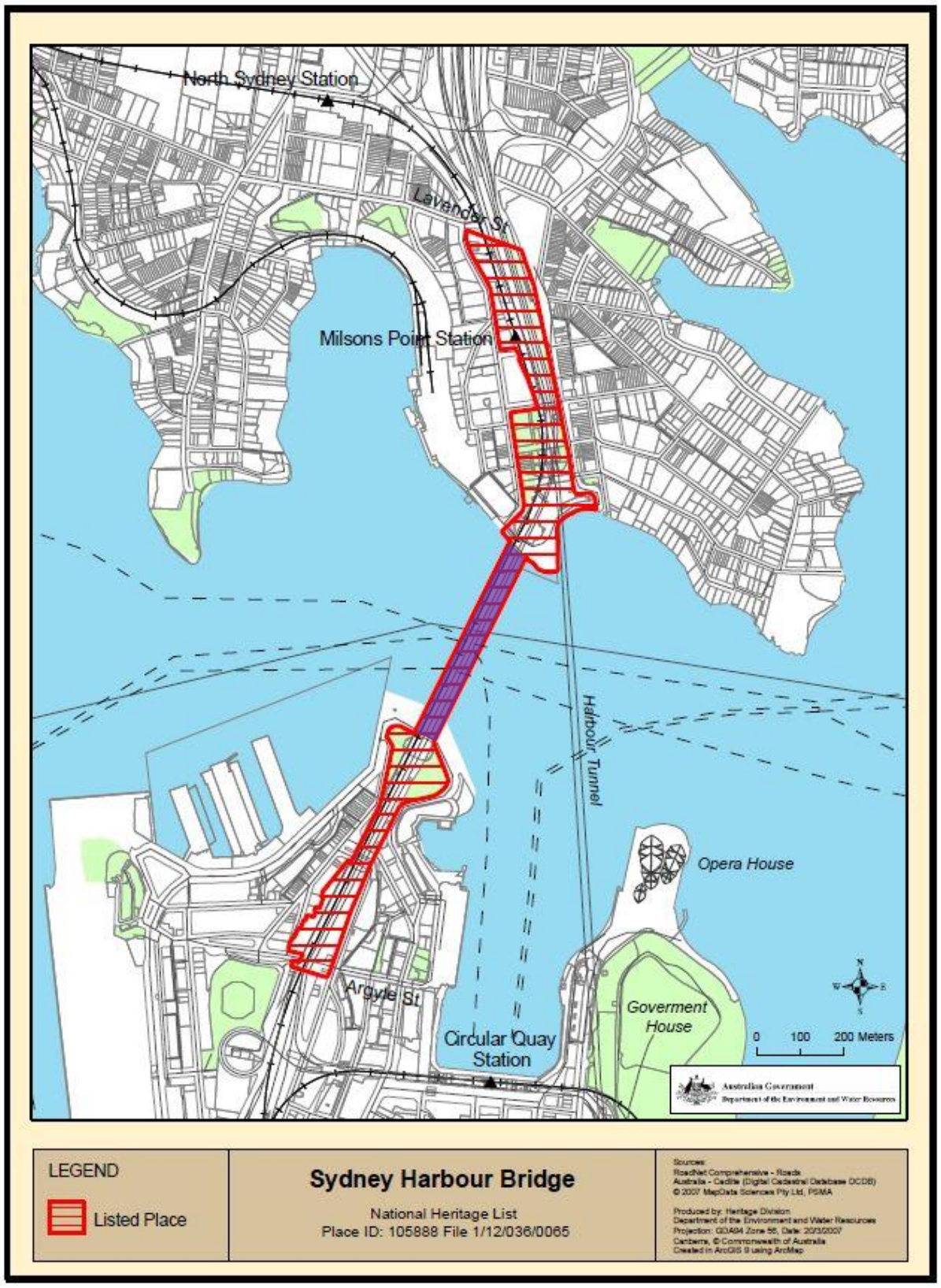
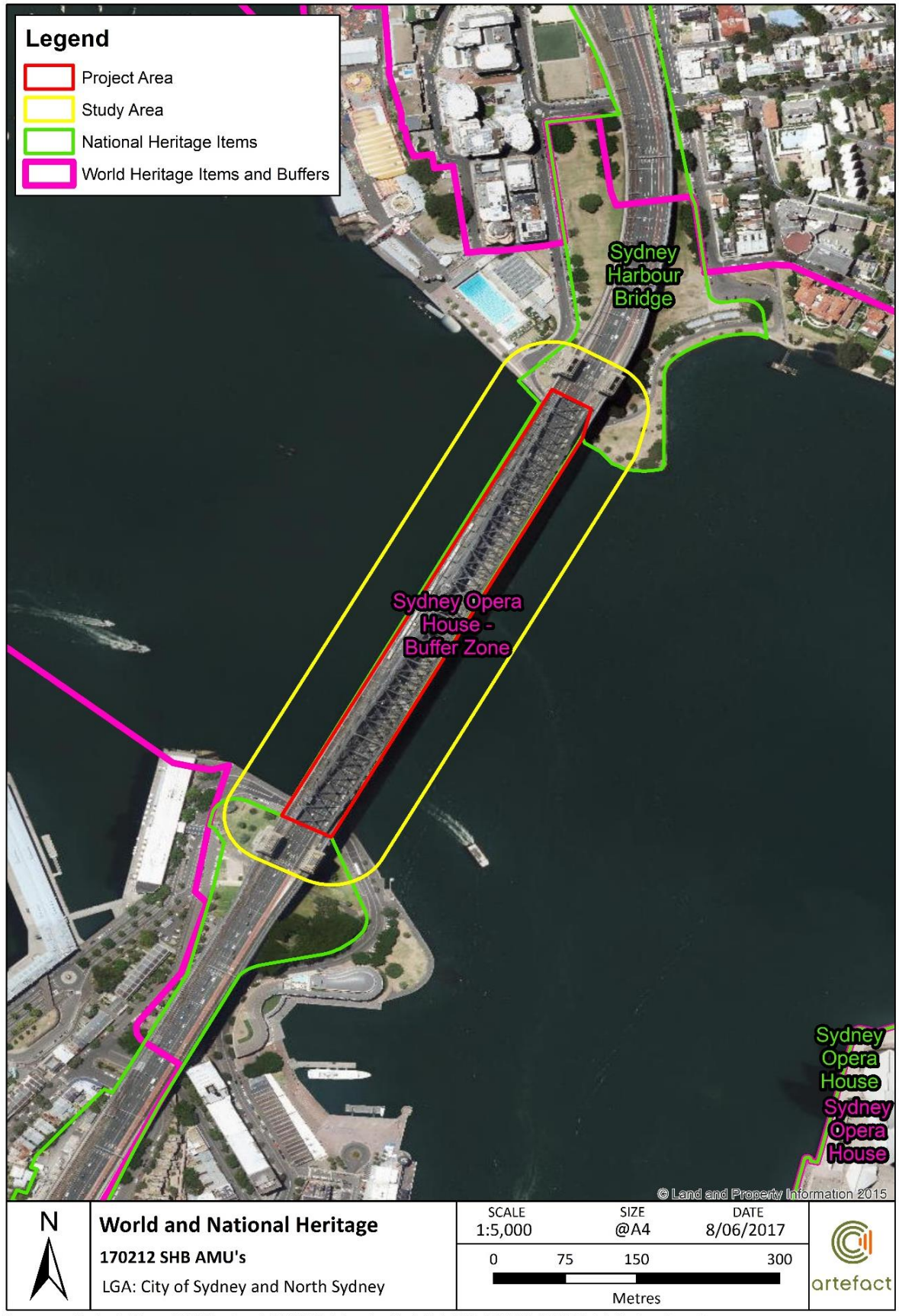


Figure 3: Curtilages of World and National listed items within project area and study area.



Document Path: C:\Users\GIS\Desktop\GIS\GIS_Mapping\170212 SHB AMUs\MXD\World_National.mxd

Figure 4: Curtilages of State heritage items within project area and study area.

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Figure 5: Curtilages of local heritage items within project area and study area.

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3.0 HISTORICAL BACKGROUND

3.1 Sydney Harbour Bridge

As early as 1815, Francis Greenway had suggested to Governor Macquarie that a bridge be constructed across the harbour, and throughout the 19th century various proposals were made.

Tenders were eventually called for the design of a bridge in 1923, with specifications set out by J.J.C Bradfield, who had been appointed as Chief Engineer, Sydney Harbour Bridge, City Transit and Metropolitan Railway Construction. Bradfield recommended the arch design of the English firm Dorman Long & Co Ltd, which was accepted by the Government in March 1924.[2]

During the early 1920s, hundreds of buildings on either side of the harbour were resumed and demolished to make room for the bridge and approaches. The first sod was turned on 28 July 1923, and work on the approach spans was carried out during 1923 and 1924. In January 1925, excavation began at Dawes Point and the foundation stone for the southern abutment towers was laid in March. By the end of March, the first shipment of steel had arrived from England and fabrication workshops were built at Lavender Bay.[3]

The construction of the approaches of the SHB included the construction of the railway infrastructure. On 26 October 1928, erection of the arch structure began. On 19 August 1930, the two spans of the arches touched for the first time. In June 1931, the creeper cranes were dismantled and the remaining major tasks involved the completion of the pylons above the deck level and surfacing the deck with asphalt.

The final rivet was driven on 21 January 1932, signifying completion of construction of the SHB. In February, the bridge was test loaded. At the time of its completion, the SHB was the largest structure in Sydney. It was officially opened on 19 March 1932 by Premier Jack Lang, followed by a parade over the bridge.[4] It was at the top of the south bridge stairs that the famous incident when Captain F.E. de Groot prematurely slashed the blue ribbon with his sword at the Bridge opening occurred.

Various changes have been made to the SHB since its construction, generally in response to changes in transport, traffic management and safety standards. The approaches of the SHB have been modified over time to facilitate increased traffic since the opening of the bridge. This has included connection with the Cahill Expressway and the replacement of the tramways in 1958, connection with the Warringah Expressway in 1968, and the establishment of bus lanes in 1972.[5]

The metal walkways on the top chords of the bridge arches were originally installed during the bridge's construction to provide safe access for maintenance workers. In 1988, BridgeClimb activities commenced on the bridge, offering an experience for the general public to climb the southern end of the east top chord. During this time, sections of the stairs were replaced in some locations.

Other changes have involved additions of new features along the deck of the bridge. In 1935, protective barriers were added to the water side of the footways on each side of the Bridge, primarily to discourage suicide attempts. Roadway crash barriers were installed in 1958, and in 2005-6 mesh fencing was erected along the roadway side of each footway to prevent pedestrian access to the road deck.[6]

[2] GML 2007, 'Sydney Harbour Bridge Conservation Management Plan': 12.
[3] GML 2007:12-4.
[4] GML 2007:17-8.
[5] GML 2007:21.
[6] GML 2007:21.

Figure 6: Aerial view of construction of the SHB and its southern approaches, c1920s. (Source: National Library Australia)

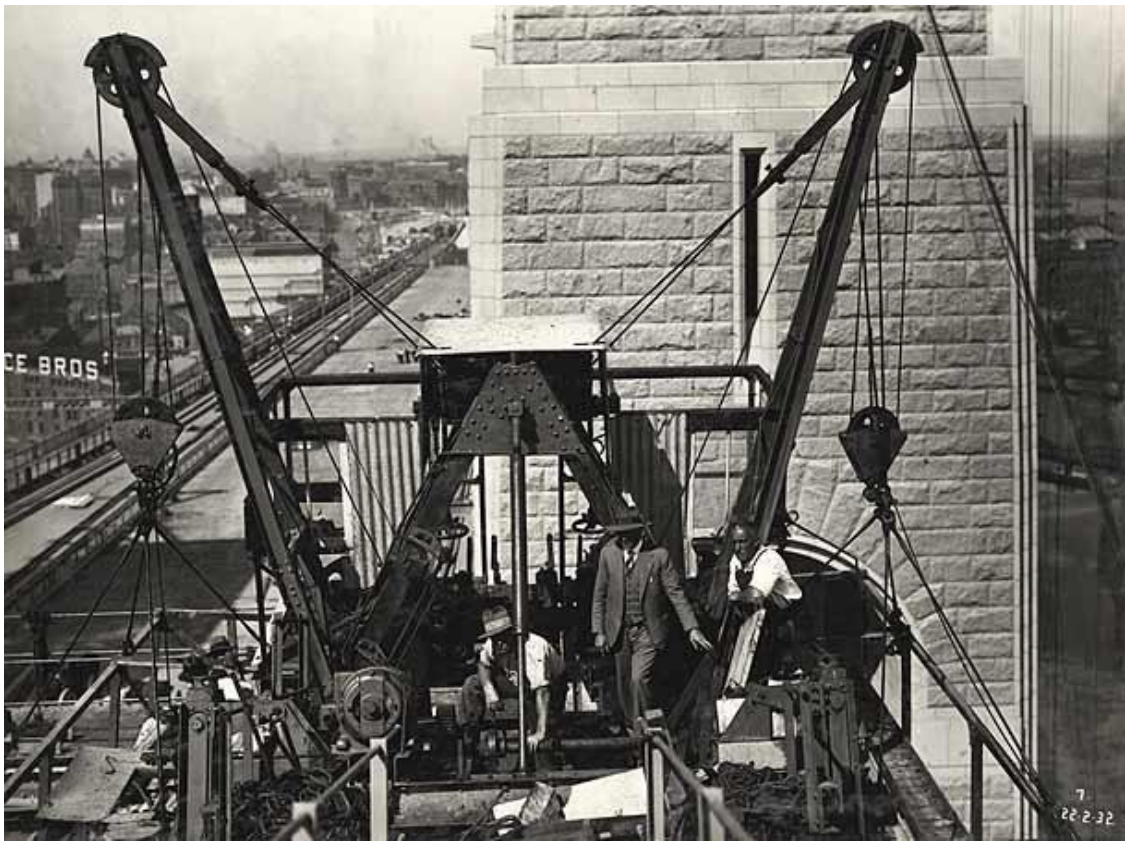
Figure 7: Construction of SHB showing creeper cranes in place, 1930. (Source: State Records NSW, Digital ID: 12685_a007_a00704_8729000194r)

3.2 Arch Maintenance Units

Four AMUs were part of the original design for the SHB to provide access for the ongoing maintenance activities to the bridge. In 1930, two AMUs were installed to service the southern half of the bridge, and in 1931, two AMUs were installed to service the northern half of the bridge.[7] Capable of lifting up to 2.5 tonnes, the AMUs were designed by English firm Wellman Smith and Owen, and were installed by the bridge buildings Dorman Long & Co Ltd.[8]

In the 1930s during the construction of the SHB, two large electronic creeper cranes moved inwards from the harbour shoreline carrying steel girders for the construction of the arch structure. The AMUs followed behind the creeper cranes to allow workers to set rivets and accommodate paint works.[9] On 19 August 1930, the arch was joined.[10] Upon completion of the bridge, the main creeper cranes returned to the pylons prior to their dismantling. The AMUs remained on the top of the bridge arch, and became a familiar sight on the SHB silhouette.[11]

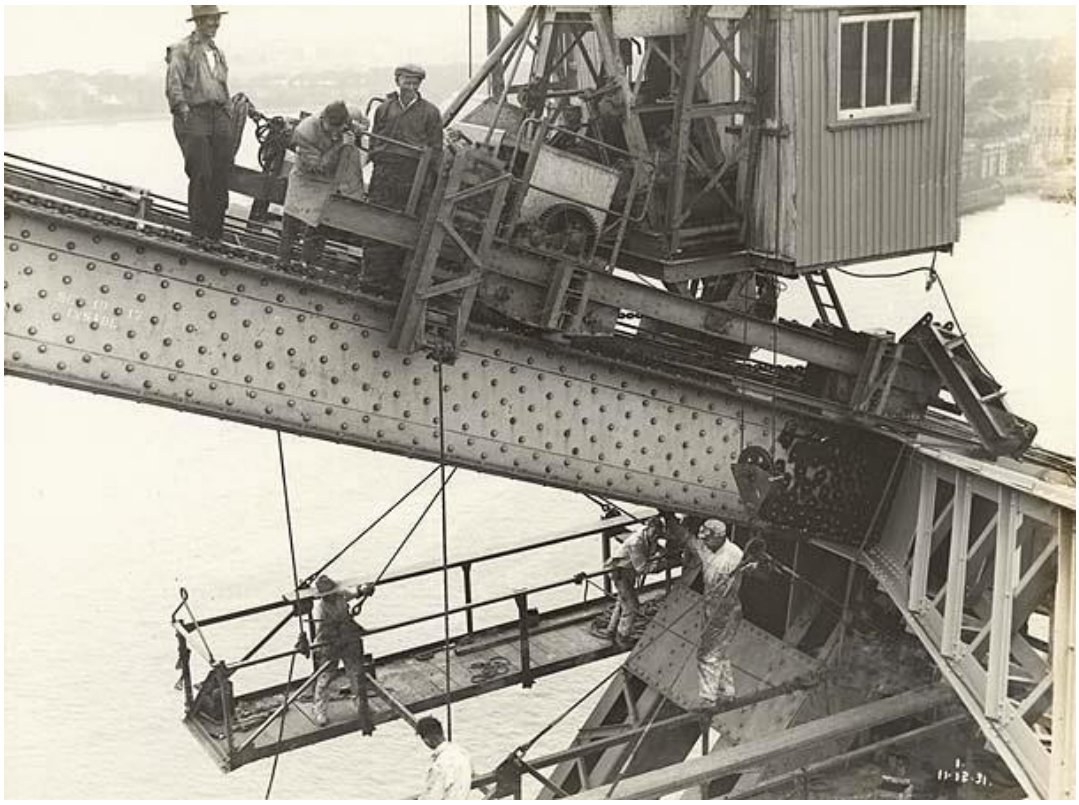
Figure 8: Historical photo showing original AMU at southern end of SHB during painting works, 1932.
(Source: State Records NSW. Digital ID: 12685_a007_a00704_8734000018r)



[7] West, D., Acton, K., Crompton, R., Sampaga, E. and Treadgold, F. 2011, 'Conserving the Sydney Harbour Bridge Arch Maintenance Units, 16th Engineering Heritage Australia Conference Hobart November 2011:2.
[8] SHB CMP 2015 Vol. 2 Inventory Record 3.3:1.
[9] West, D. et al, 2011:2.
[10] SHB CMP 2015 Vol. 2 Inventory Record 3.3:1.
[11] SHB CMP 2015 Vol. 2 Inventory Record 3.3:1.

Figure 9: Historical photo showing original AMU during construction of SHB, 1931. (Source: State Records NSW. Digital ID: 12685_a007_a00704_8733000078r)

Figure 10: Historical photo showing original AMU during construction of SHB, 1931. (Source: State Records NSW. Digital ID: 12685_a007_a00704_8733000077r)



Following completion of the SHB in 1932, the AMUs continued to be used in the preceding decades as part of the ongoing maintenance routine carried out on the bridge. In 1997, after 67 years of operation, the original AMUs were deemed to have reached the end of their working life. By this time, the AMUs had become outdated pieces of maintenance equipment, and were non-compliant with new legislation regarding Occupational Health and Safety. The increased role of tourism at the SHB and proposed BridgeClimb experience provided an additional impetus for the removal of the original AMUs, which posed a physical barrier for groups climbing the SHB.[12]

The combination of the pressures described above resulted in the removal of the original AMUs in 1997 and their replacement with new maintenance cranes. The new AMUs were designed to be similar in form and appearance to the original cranes, and featured a double jib supporting a working platform. To facilitate improved access and circulation of visitors climbing the bridge, the design of the new AMUs featured a space underneath to allow visitors to pass without mounting or passing through the AMU cabin. Despite these changes, however, the new AMUs largely operated in the same manner as the original cranes.[13] Replacement of the existing AMUs was first proposed in 2015.[14]

Figure 11: Photograph of existing 1997 AMUs, taken in 2015.

[12] West, D. et al, 2011:2.
[13] West, D. et al, 2011:2.
[14] SHB CMP 2015 Vol. 2 Inventory Record 3.3:3.

4.0 SITE ANALYSIS

4.1 Introduction

A site inspection of the study area was conducted on 17 May 2017 by Charlotte Simons (Heritage Consultant) and Stephanie Moore (Heritage Consultant). The aim of the survey was to inspect the study area to assess the current condition of heritage items and areas that may be impacted by the proposal. The inspection was undertaken on foot and a photographic record was made.

4.2 Site description

The SHB main arch structure is constructed of silicon steel trusses and joists. These steel members are painted dark grey. The entire structure comprises riveted straight steel angles and plates. The bridge deck is hung from the main arch truss by 40 silicon steel hangers that are connected to latticed cross girders beneath the railway and road surface.

The SHB main arch structure is accessed via ladders that are fixed to the first truss diagonal. While the redundant and non-compliant northern ladders were removed in 2014, both southern ladders remain in use and continue to be utilised for BridgeClimb activities.

There are four existing AMUs on the SHB main arch structure, with two installed on each truss of the arch. The AMUs operate between the crown of the bridge and the lower end of the top chord. Designed to be similar in appearance and configuration to the original SHB painting cranes, the AMUs feature two jibs supporting a working platform.

The AMUs travel along the top chords and pass over the central walkways as shown in Figure 17. Bordered by steel handrails, these metal stairs with checker plate treads installed to provide safe access for maintenance workers, span from the king posts to the crown. While some of the original walkways remain, several have been replaced in locations for BridgeClimb activities.

Five original catwalks cross the top chords, at each end post, at the crown of the arch and midway up. Additional catwalks have been installed for BridgeClimb personnel. Non-compliant catwalks were replaced with fibreglass ramps. The apex of the arch features an air navigation beacon, comprising a flashing red light on a seven-metre-tall steel tower. Several modern aerials have also been installed.

Figure 12: View north east along the top of the arch towards the east top chord stairway. (Source: Roads and Maritime)

Figure 13: View south east along lateral truss members from west top chord stairway. (Source: Roads and Maritime)

Figure 14: View north east along the west top chord of the arch showing metal stairs. (Source: Roads and Maritime)

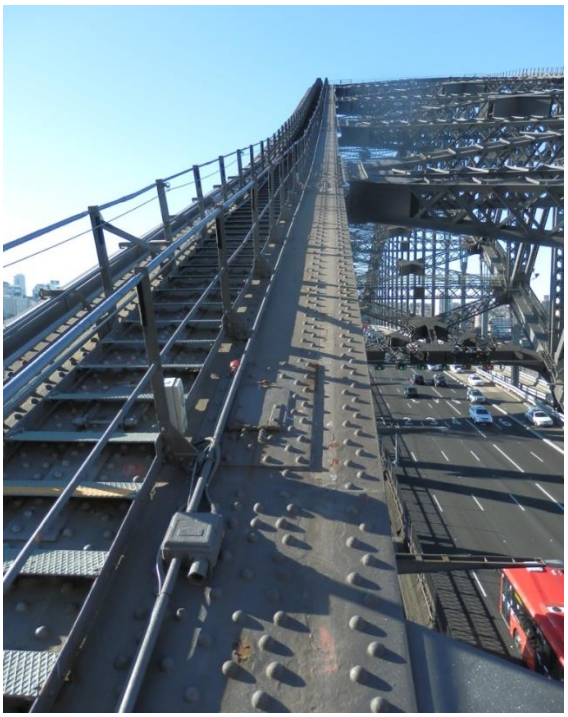


Figure 15: Detail shot of rivets on the east top chord near the metal stairway. (Source: Roads and Maritime)

Figure 16: View east along top of the arch towards an existing AMU operating on the east top chord. (Source: Roads and Maritime)

Figure 17: View north east towards existing AMU operating on the east top chord overhead walkway. (Source: Roads and Maritime)

Figure 18: View south east from existing AMU on the west chord operating near the crown of the arch.
(Source: Roads and Maritime)

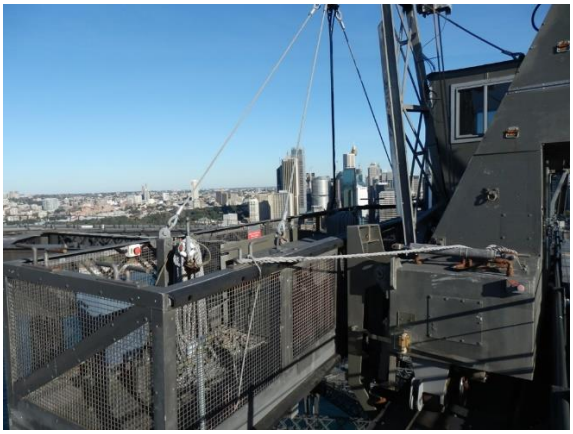


Figure 19: View south east from the west top chord of the arch, showing air navigation tower in centre.
(Source: Roads and Maritime)

Figure 20: View northeast across trusses towards an existing AMU operating on the east top chord. Catwalks seen in foreground.
(Source: Roads and Maritime)

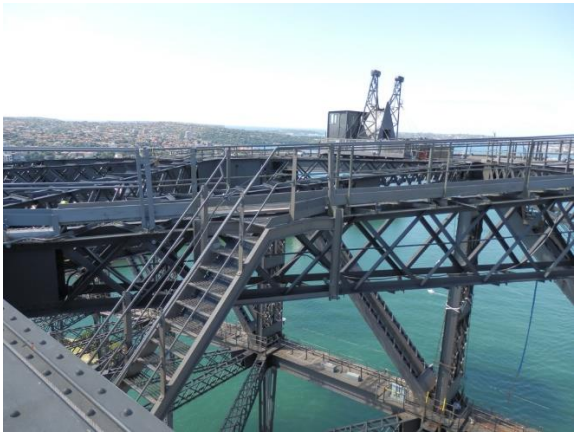


Figure 21: View down from a catwalk on the bridge arch apex towards the roadway deck below.
(Source: Roads and Maritime)

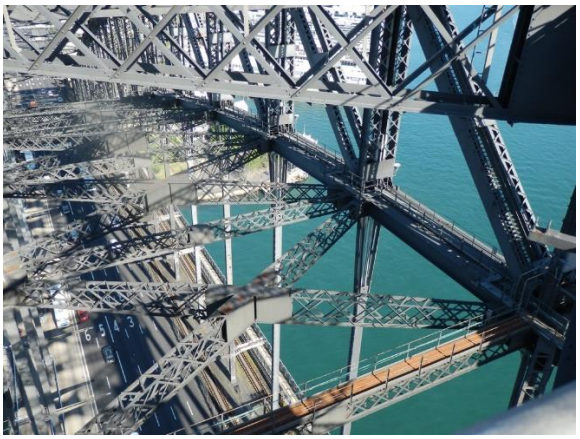


Figure 22: View up from bridge deck showing the distinctive significant pattern formed by the arch trusses.
(Source: Roads and Maritime)

Figure 23: View across existing SHB walkway showing fibreglass mesh
(Source: Roads and Maritime)

Figure 24: Detail shot of original steel stair treads on existing SHB walkway. (Source: Roads and Maritime)

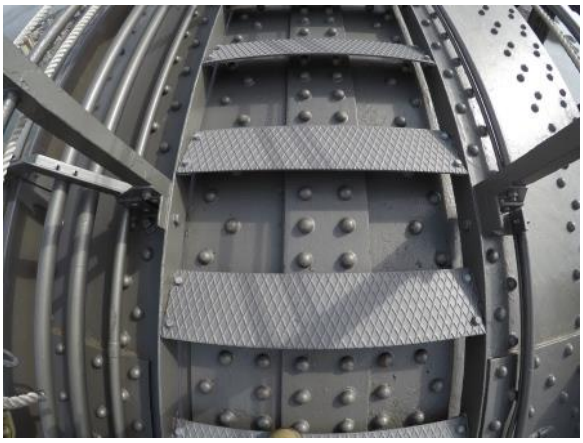
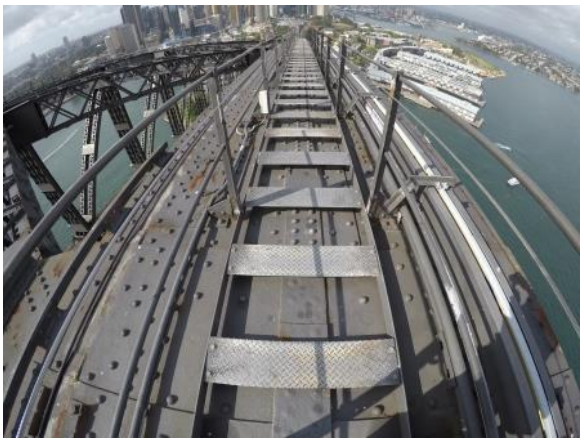


Figure 25: View down existing SHB walkway showing modern checker plate stair treads. (Source: Roads and Maritime)



4.3 View study

A view study was carried out on 1 June to document the visual catchment of the project. The study helps illustrate the surrounding context in Sydney Harbour as well as key views of the site from the public domain, in particular from around the harbour foreshore and from nearby heritage items.

A number of heritage listed items are located within the study area. On the north side of the SHB are Bradfield Park (Figure 32) and North Sydney Olympic Pool (Figure 33 and Figure 34). On the south side of the SHB is the Millers Point & Dawes Point Village Precinct, and Millers Point Conservation Area (Figure 26 and Figure 27). The project area is also located within the Sydney Opera House Buffer Zone, and key views from the Western Broadwalk at Bennelong Point are subsequently addressed (Figure 30).

A number of popular vantage points around Sydney Harbour that offer uninterrupted views of the bridge have also been included in this view study. This includes views towards SHB from Observatory Hill Park (Figure 26 and Figure 27), Barangaroo Reserve (Figure 28), Circular Quay foreshore walk (Figure 29), Blues Point (Figure 31) and Milsons Point (Figure 35).

Figure 26: View north from Observatory Hill Park towards Sydney Harbour across Millers Point & Dawes Point Village Precinct (SHB seen to right).

Figure 27: View north from Observatory Hill Park towards Sydney Harbour across Millers Point & Dawes Point Village Precinct (SHB seen centre).

Figure 28: View north east from Barangaroo Reserve towards SHB.

Figure 29: View north east from Hickson Road towards SHB.

Figure 30: View north west from Western Broadwalk of the Sydney Opera House towards the SHB (within Sydney Opera House Buffer Zone)

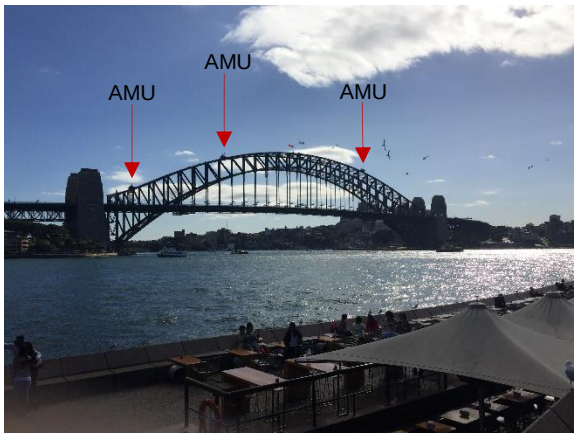


Figure 31: View east from Henry Lawson Reserve at Blues Point towards the SHB (Sydney Opera House seen in distance).

Figure 32: View south west from Milsons Point towards Bradfield Park and the SHB.

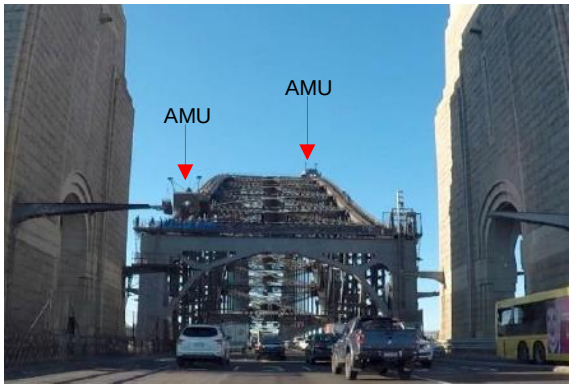
Figure 33: View south east from North Sydney Olympic Pool towards the SHB.

Figure 34: View south east from North Sydney Olympic Pool towards the SHB.

Figure 35: View south west from Milsons Point towards the SHB.

Figure 36: View south towards the SHB from the Cahill Expressway (Source: DesignInc 2017)

Figure 37: View north towards the SHB from Bradfield Highway (Source: DesignInc 2017)



5.0 HERITAGE SIGNIFICANCE

5.1 Introduction

This section identifies the significance of the SHB, and listed heritage items adjacent to and in proximity to the site location. Full significance assessments for nearby heritage listed items is located in Appendix A, at the end of this document.

5.2 Sydney Harbour Bridge

The SHB is a monumental landmark in Sydney and one of the most globally recognised bridges. It is an important visual element in the Sydney cityscape which can be viewed from many key points around the harbour. The steel arched form, Art Deco inspired granite pylons and composite approach spans create an iconic and dramatic composition that consistently evokes a positive response from observers.

The SHB is listed on several registers and has heritage value at a local, State and National level. The statement of significance included in the NHL and SHR listings are provided below. The assessments of the SHB against the national and NSW heritage assessment criteria is provided in Table 7 and Table 8 below.

5.2.1 National heritage values

The NHL database contains the following statement of significance:[15]

> *The building of the Sydney Harbour Bridge was a major event in Australia's history, representing a pivotal step in the development of modern Sydney and one of Australia's most important cities. The bridge is significant as a symbol of the aspirations of the nation, a focus for the optimistic forecast of a better future following the Great Depression. With the construction of the Sydney Harbour Bridge, Australia was felt to have truly joined the modern age, and the bridge was significant in fostering a sense of collective national pride in the achievement.*
>
> *The Sydney Harbour Bridge was an important economic and industrial feat in Australia's history and is part of the nationally important story of the development of transport in Australia. The bridge is significant as the most costly engineering achievement in the history of modern Australia, and this was extraordinary feat given that it occurred at the severest point of the Great Depression in Australia.*
>
> *The bridge is also significant for its aesthetic values. Since its opening in 1932, the Sydney Harbour Bridge has become a famous and enduring national icon, and remains Australia's most identifiable symbol. In its harbour setting, it has been the subject for many of Australia's foremost artists, and has inspired a rich and diverse range of images in a variety of mediums – paintings, etchings, drawings, linocuts, photographs, film, poems, posters, stained glass - from its construction phase through to the present.*

[15] Department of Environment and Energy Australian Heritage Database 2007, "Sydney Harbour Bridge, Bradfield Hwy, Dawes Point – Milsons Point, NSW, Australia".

The Sydney Harbour Bridge is also significant as one of the world's greatest arch bridges. Although not the longest arch span in the world, its mass and load capacity are greater than other major arch bridges, and no other bridge in Australia compares with the Sydney Harbour Bridge in its technical significance. In comparing Sydney Harbour Bridge with overseas arch bridges, Engineers Australia has drawn attention to its complexity in combining length of span with width and load carrying capacity. The construction of Sydney Harbour Bridge combined available technology with natural advantages provided by the site. The designers took advantage of the sandstone base on which Sydney was built, which enabled them to tie back the support cables during construction of the arch, and to experiment with massive structures. Although designed more than 80 years ago, the bridge has still not reached its loading capacity.

The bridge is also significant for its important association with the work of John Job Crew Bradfield, principal design engineer for the New South Wales Public Works Department, who ranks as one of Australia's greatest civil, structural and transport engineers.

The NHL database contains the following assessment of significance outlined in Table 7:[16]

Table 7: Significance assessment for the Sydney Harbour Bridge against the National heritage assessment criteria

Criterion	Explanation
A – Events, Processes	The building of the Sydney Harbour Bridge as a transport facility linking the city with the north shore was a major event in Australia's history, and represented a pivotal step in the development of modern Sydney and one of Australia's most important cities. The bridge became a symbol for the aspirations of the nation, a focus for 'optimistic prognostications of a better future' following the Depression. The bridge represented an important step in transforming the city of Sydney into a modern metropolis. Internationally, the bridge was recognised as a symbol of progress and a vision of a splendid future. The building of the Sydney Harbour Bridge was an important part of the technical revolution of the 1930s and seen as evidence of Australia's industrial maturity. The bridge represented the mechanical age displacing the pastoral and agricultural way of life on which Australia's economy had been based. The scale of the operations was enormous and at the time of its construction, it was the widest long-span bridge in the world. The Sydney Harbour Bridge includes a steel arch spanning the harbour between Milsons Point on the north side and Dawes Point on the south side, and elevated approaches to the arch from both the north and south sides. The arch is made up of two 28-panel arch trusses set in vertical planes, 30 metres apart centre to centre, and braced together laterally. Two granite-faced concrete pylons, with a height of 89 metres above mean sea level, are located at each end of the arch. A deck carrying road and rail traffic is suspended from the arch. Pairs of hangers, ranging in length from 7.3 metres to 58.8 metres, support cross-girders, each weighing 110 tonnes, which support the deck. The northern and southern approaches each contain five spans, constructed as pairs of parallel-chord, six-panel steel trusses. The spans are supported by pairs of concrete piers faced with granite. The combined length of the approach spans is 646 metres. The Sydney Harbour Bridge is an outstanding cultural landmark for the nation and represents a highly significant place in Australia's cultural history. The opening of the Sydney Harbour Bridge was a momentous occasion, drawing remarkable crowds estimated at nearly one million people.

[16] Department of Environment and Energy Australian Heritage Database 2007, "Sydney Harbour Bridge, Bradfield Hwy, Dawes Point – Milsons Point, NSW, Australia".

Criterion	Explanation
	Since its opening in 1932, the Sydney Harbour Bridge has become a famous and enduring national icon and symbol of Australia. The bridge remains one of Australia's most identifiable symbols.
E – Aesthetic characteristics	Sydney Harbour Bridge is an integral component of the Sydney Harbour vista and represents one of the most recognisable and iconic images in the world. It is the picturesque blending of the natural environment and man-made structures around the harbour foreshores that has proved an inspiration for generations of artists and writers. In its harbour setting, it has inspired a rich and diverse range of images in a variety of mediums – paintings, etchings, drawings, linocuts, photographs, film, poems, posters, stained glass - from the date of its construction through to the present day. The bridge is conceivably one of Australia's most-photographed cultural landmarks, and striking images of the bridge have been captured by some of Australia's best-known photographers The Sydney Harbour Bridge has also been replicated in tourist posters, postcards, crafts and the folk arts, its image reproduced in media including glass, ceramic, metal, shells and crochet cotton, embroidery and etchings in a huge array of objects.
F – Creative or technical achievement	The Sydney Harbour Bridge may be considered the world's greatest arch bridge. Although not the longest arch span in the world, its mass and load capacity are greater than other major arch bridges. No other bridge in Australia compares in its technical significance with the structure of the Sydney Harbour Bridge and its pylons and constructed approaches between Argyle Street in the south and Arthur Street in the north. The construction of Sydney Harbour Bridge combined available technology with natural advantages provided by the site. The bridge is an outstanding technical and construction achievement of the Twentieth Century. The designers took advantage of the sandstone base on which Sydney was built - which enabled them to tie back the cables during construction of the arch and to experiment with massive structures. Although designed during the 1920s and 1930s the bridge has still not reached its loading capacity.
G – Social value	It was part of John Job Crew Bradfield's vision for the bridge that it be used at times of national rejoicing. Since its opening it has regularly supported flags, banners, and especially fireworks, becoming a focus for national and local celebrations. Community ceremonial and celebratory occasions centred on Sydney Harbour Bridge, either for the people of Sydney or the broad Australian community, are well recognised and have been widely noted. Since 1932, the broad Australian community has identified the Sydney Harbour Bridge as one of the most nationally and internationally recognised symbol of Australia and the bridge in its harbour setting represents a composite national symbolic image.
H – Significant people	John Job Crew Bradfield ranks with other engineers whose close involvement in a broad range of projects contributed to Australia's national development. As principal design engineer for the New South Wales Public Works Department, Bradfield was largely responsible for finally bringing the Sydney Harbour Bridge to fruition. As Chief Engineer, he prepared the general design specification and supervised the whole project on behalf of the Government of New South Wales, also integrating the bridge into the Sydney road, tram and rail system. Bradfield was nationally recognised through his appointments to the Australian National Research Council and the Australian Commonwealth Standards Advisory Committee. The Institution of Engineers, Australia awarded him the Peter Nicol Russell Memorial Medal in 1932, and he also received the Kernot Memorial Medal from the University of Melbourne in 1933, and the Telford Gold Medal from the Institution of Civil Engineers, London in 1934.

5.2.2 State heritage significance

SHB, approaches and viaducts (road and rail) is listed on the SHR and has historical, aesthetic or technical, social and research potential heritage values. The State Heritage Inventory (SHI) database contains the following statement on the significance:[17]

> *The bridge is one of the most remarkable feats of bridge construction. At the time of construction and until recently it was the longest single span steel arch bridge in the world and is still in a general sense the largest. The bridge, its pylons and its approaches are all important elements in townscape of areas both near and distant from it. The curved northern approach gives a grand sweeping entrance to the bridge with continually changing views of the bridge and harbour. The bridge has been an important factor in the pattern of growth of metropolitan Sydney, particularly in residential development in post World War II years. In the 1960s and 1970s the Central Business District had extended to the northern side of the bridge at North Sydney which has been due in part to the easy access provided by the bridge and also to the increasing traffic problems associated with the bridge (Walker and Kerr 1974).*

The SHI database contains the following assessment of the significance outlined in Table 8:[18]

Table 8: Significance assessment for the Sydney Harbour Bridge, approaches and viaducts (road and rail) against the NSW heritage assessment criteria

Criterion	Explanation
A – Historical Significance	The bridge is one of the most remarkable feats of bridge construction. At the time of construction and until recently it was the longest single span steel arch bridge in the world and is still in a general sense the largest. (Walker and Kerr 1974). BRADFIELD PARK NORTH (SANDSTONE WALLS): "The archaeological remains are demonstrative of an earlier phase of urban development within Milsons Point and the wider North Sydney precinct. The walls are physical evidence that a number of 19th century residences existed on the site which were resumed and demolished as part of the Sydney Harbour Bridge construction" [Statement of Heritage Impact - Sandstone Walls: Bradfield Park North, Milsons Point (2003: 8), McFadyen and Stuart, HLA Envirosciences].
B – Associative Significance	The Sydney Harbour Bridge has strong associations with Dr JJC Bradfield, who was primarily responsible for its conception, design and construction. Bradfield was the Chief Engineer, SHB, City Transit and Metropolitan Railway Construction, and the leading figure in the development of Sydney's transport system in the first part of the twentieth century. The construction of the bridge is also associated with the British team of engineers, Sir Ralph Freeman and contractors Dorman Long and Co. The bridge was the outstanding work of Freeman's career but his contribution was marred by a dispute with Bradfield regarding who was actually responsible for its design. The bridge has strong associations with the families and descendants of the workers who built it, and who recognise its role during the Depression as the so-called 'iron lung' in providing employment and protection from hardship or the dole.
C – Aesthetic or Technical Significance	The bridge, its pylons and its approaches are all important elements in townscape of areas both near and distant from it. The curved northern approach gives a grand sweeping entrance to the bridge with continually changing views of the bridge and harbour. (Walker and Kerr 1974)

[17] OEH SHI 2007
[18] OEH SHI 2007

Criterion	Explanation
D – Social Significance	The bridge has been an important factor in the pattern of growth of metropolitan Sydney, particularly in residential development in post-World War II years. In the 1960s and 1970s the Central Business District had extended to the northern side of the bridge at North Sydney which has been due in part to the easy access provided by the bridge and also to the increasing traffic problems associated with the bridge. (Walker and Kerr 1974)
E – Research Potential	BRADFIELD PARK NORTH (SANDSTONE WALLS): "The archaeological remains have some potential to yield information about the previous residential and commercial occupation of Milsons Point prior to the construction of the Sydney Harbour Bridge transport link" [Statement of Heritage Impact - Sandstone Walls: Bradfield Park North, Milsons Point (2003: 8), McFadyen and Stuart, HLA Envirosciences].
F – Rarity	The bridge is a uniquely important development in Sydney's transportation network. As it introduced a main road and rail connection across Sydney Harbour, the bridge was the single most important factor in the expansion of metropolitan Sydney north of the harbour. The SHB Movable Heritage Collection is a collection of rare surviving relics relating to the construction methodology, technology and materials of the bridge, assembled as part of the overall construction program, the first time in Australia that the construction of a bridge had been approached in this manner. The SHB Movable Heritage Collection comprises original relics of the ceremonies and celebrations for the Opening Day of the Bridge and represents a rare record of Sydney society in the period during the construction of the Bridge. It also contains rare surviving relics of the fiftieth birthday celebrations of the Bridge and of the Bicentennial celebrations in 1988
G - Representative	The bridge is representative of a significant stage in the development of Sydney and associated changes in modes of transport, including the growing reliance on private motor vehicles. The SHB Movable Heritage Collection comprises components, materials, original memorabilia of the ceremonies and celebrations for the Opening Day of the Bridge. These items are representative of the technologies in use at the time and utilised for the construction of the bridge, and is representative of the aesthetic and cultural context during the construction of the bridge.

5.2.3 Project area components

Table 9 lists the individual elements of the SHB which are associated with the SHB AMUs and provides a significance grading for each, as per the CMP.

Table 9: Grades of significance for SHB arch components[19]

Component	Description	Grading
Existing unobstructed views of the SHB and approach spans including: • **views of the SHB end-on from the northern and southern approach roads.** • **Views of the SHB from ground level nearby and from the water; and** • **views of the steel structure and pylons from deck level.**	The views of the bridge from vantage points from ground level in surrounding areas along the Sydney Harbour foreshore, i.e. Kirribilli, Bradfield Park, Dawes Point, Bennelong Point and from the water. From these views, the existing AMUs on the arches are a distinguishable visual element of the SHB. The approaches afford impressive views of the SHB end-on, including distant views of the steel structure and pylons from deck level. This views include the existing AMUs on the arches, which are distinguishable against the silhouette of the steel structure. The views of the steel structure of the SHB from deck level offer opportunity of appreciation of the construction of the SHB and its significant arches. From this perspective, the existing AMUs are difficult to distinguish given the oblique viewing angle, and are a less noticeable visual element on the bridge.	**Exceptional**
Overall form of the arch and pylons, including: • **the pattern of steel structural members**	The main arch structure of the SHB is an integral element and one of the main recognisable components of the bridge. The arch directly contributes to the significance of the SHB. The pattern made by the structural members of the steelwork is a tangible aspect of the bridge's significance, expressing the aesthetic principles underpinning its design and construction methodology.	**Exceptional**
All steelwork of the trusses, lateral bracing and hangers, portal frames at end posts, floor laterals, cross girders, stringers, joists and bearings.	The project area encompasses the steelwork of the SHB main arch structure including trusses, lateral bracing and hangers, portal frames at end posts, floor laterals, cross girders ,stringers, joists and bearings. The existing 1997 AMUs do not provide access to lateral members of the steelwork.	**High**
All original access equipment, painting cranes, gantries, stairs, ladders and handrails.	The original SHB gantries and painting cranes are no longer extant, having been removed and replaced in 1997. The walkways feature steel treads and handrails designed to fold down flat across each other over the stairway to allow the original maintenance cranes to pass across. Commencement of BridgeClimb activities in 1988 necessitated replacement of the walkways in some locations.	**High**
Replacement painting cranes and gantries installed in 1997, and associated infrastructure.	The project area comprises four 1997 AMUs that replaced original gantries and painting cranes. While the AMUs retain a similar form and appearance to the original cranes, they do not constitute significant fabric and are therefore graded as being of little significance. Associated bridge maintenance infrastructure associated with the 1997 AMUs, including the electrical bus bar, cable anchorages and angles, do not constitute original fabric and are therefore graded as being of little significance.	**Little**

[19] The schedule of significant fabric is based on the SHB CMP (2007) and items noted during site inspections and historical research conducted in 2016.

5.3 Nearby heritage items

5.3.1 Millers Point & Dawes Point Village Precinct (SHR No. 01682)

The Millers Point & Dawes Point Village Precinct comprises a Conservation Area that is bound to the north by the Walsh Bay SHR listed precinct, on the far-north beyond by the Sydney Harbour near Ives Steps on Dawes Point/Tar-ra, to the north-east by the Bradfield Highway (SHB southern approaches) and the SHB, to the south by existing high-rise apartments, to the west by the edge of the Darling Harbour wharf aprons, and to the north west by the cliff-edges of Old Millers Point.

The Millers Point & Dawes Point Village Precinct is listed as a state significant heritage item due to its historical, associative, aesthetic, research potential, rarity and representativeness heritage values.

5.3.2 Millers Point Conservation Area

- Sydney Local Environment Plan 2012 (LEP No. I876)

The Millers Point Conservation area encompasses residential and commercial area that is bound on the north by Sydney Harbour, to the north-east by the SHB, to the east by Bradfield Highway, to the south by existing high-rise apartment buildings, to the west by Hickson Road and to the northwest by the cliff edges of Old Millers Point.

The Millers Point Conservation Area is listed as a heritage conservation area due to its historical, associative, aesthetic, social, research potential, rarity and representativeness heritage values.

Figure 38: View across Millers Point and Dawes Point from Observatory Hill Park (SHB seen to right of image).

5.3.3 Sydney Opera House Buffer Zone

The Sydney Opera House is a building recognised worldwide as an iconic landmark overlooking the waters of Sydney Harbour. In acknowledgement of its cultural significance, the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 has inserted buffer zone controls for the Sydney Opera House.

The buffer is intended to give additional protection to the world heritage values of the Sydney Opera House. The buffer intends to protect views of the site from public places on the foreshores that contribute to its world heritage significance balanced against the need for orderly and economic development of the land. The project area is within the Sydney Opera House Buffer Zone.

5.3.4 Bradfield Park (including northern section)

- North Sydney Local Environment Plan 2013 (LEP No. I0538)

The project site is located approximately 95 metres north of the park. Bradfield Park (including northern section) consists of a broad expanse of grassed parkland, gently sloping towards the water's edge below the Harbour Bridge. The main pylons of the SHB and the northern approach span run through the centre of the park. The park used to be part of the land acquired by Robert Campbell in 1801. After the SHB was constructed, the area around the northern approaches were landscaped as a park and named the Chief Engineer for the bridge constriction, J.J Bradfield.

Bradfield Park (including northern section) is considered to be of local significance due to its rarity and representativeness heritage values. Heritage significance criteria for this item are addressed in Appendix A. The SHI database contains the following statement of significance for the item:

> *Important local park with extensive views of Sydney harbour and the city skyline. Important locale for the historic icon of the Bow of the H.M.A.S. Sydney, a significant ship in Australian history. Associated with the harbour bridge construction and named for J.J.C. Bradfield. Formerly central township of Milsons Point and historically a most significant area for the North Shore.*

Figure 39: View north west across Bradfield Park beneath SHB.

5.3.5 North Sydney Olympic Pool

- North Sydney Local Environment Plan 2013 (LEP No. I0537)

The project site is located approximately 50 metres south of the North Sydney Olympic Pool. Designed in the Inter-War Free Classical style, the item consists of a full Olympic swimming pool with grandstand over amenities on the north side, offices and plant room son the west and boundary wall son the south and east sides, with a kiosk in the south-east corner. The south and east boundary walls, constructed of brick, are formed from a series of stilted semi-circular arches. These arches afford views out from the pool towards the Sydney CBD including views to the SHB.

North Sydney Olympic Pool is considered to be of local significance due to its rarity heritage value. Heritage significance criteria for this item are addressed in Appendix A. The SHI database contains the following statement of significance for the item:

> *The North Sydney Olympic Pool is an outstanding example of a 1930s Olympic Pool, principally due to its architectural style and detailing, its integration with its magnificent harbourside setting, and the 1930s sophistication of its facilities. Historically significant as the venue for two Empire Games (1938 and 1958) and the setting for the establishment of 86 world records in swimming and diving events. Associated with adjacent Luna Park stylistically and functionally. Popular and significant recreational facility in the region, used by many from outside North Sydney.*

Figure 40: View west to North Sydney Olympic Pool main entrance.

6.0 PROPOSED WORKS

6.1 Proposed works

The proposal consists of a series of proposed works which are detailed below. These works are illustrated in Figure 41 to Figure 50.

6.1.1 Work activities

Details of the proposed work activities to upgrade the SHB AMUs are provided below. It is noted these are subject to development during the detail design phase of the proposal.

Key aspects of the proposal would involve:

- Removal of existing AMUs using a crane positioned on the road deck. The unit would then be placed on a truck and disposed of at a licensed waste facility
- Removal of redundant bridge maintenance infrastructure (i.e. electrical bus bar, cable anchorages and angles associated with 1997 AMUs)
- Removal of the metal walkways on the centre line of each top chord
- Installation of the initial rail section (30 metres) along the centre line of each top chord, using an appropriate rivet removal procedure to be resolved during detail design
- Use of crane positioned on the road deck to lift the new gantries and bridge maintenance units onto new rail section, with logistics to be resolved during detail design
- Each proposed AMU would be mounted on a platform spanning 30 metres between the two top chords
- Use of new AMUs to continue installing new rails over the length of each top chord of the arches
- Installation of replacement metal walkways on the outer web-plate of each top chord (walkway connection design in progress).

Figure 41: Plan and sections of the proposed AMUs and indicative new walkways. (Source: Manntech)

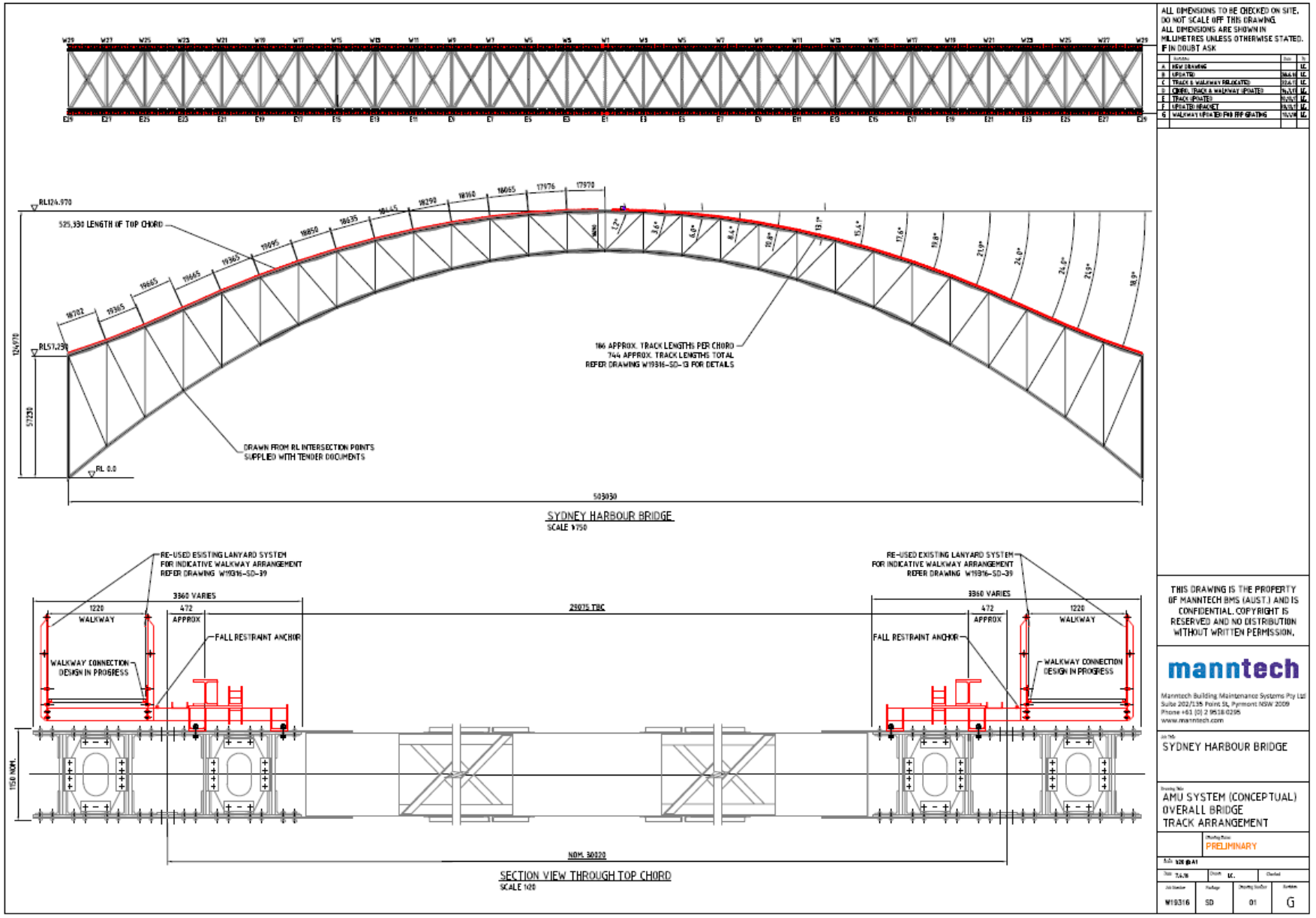


Figure 42: Sections of the proposed AMUs, showing indicative new walkways. (Source: Manntech)

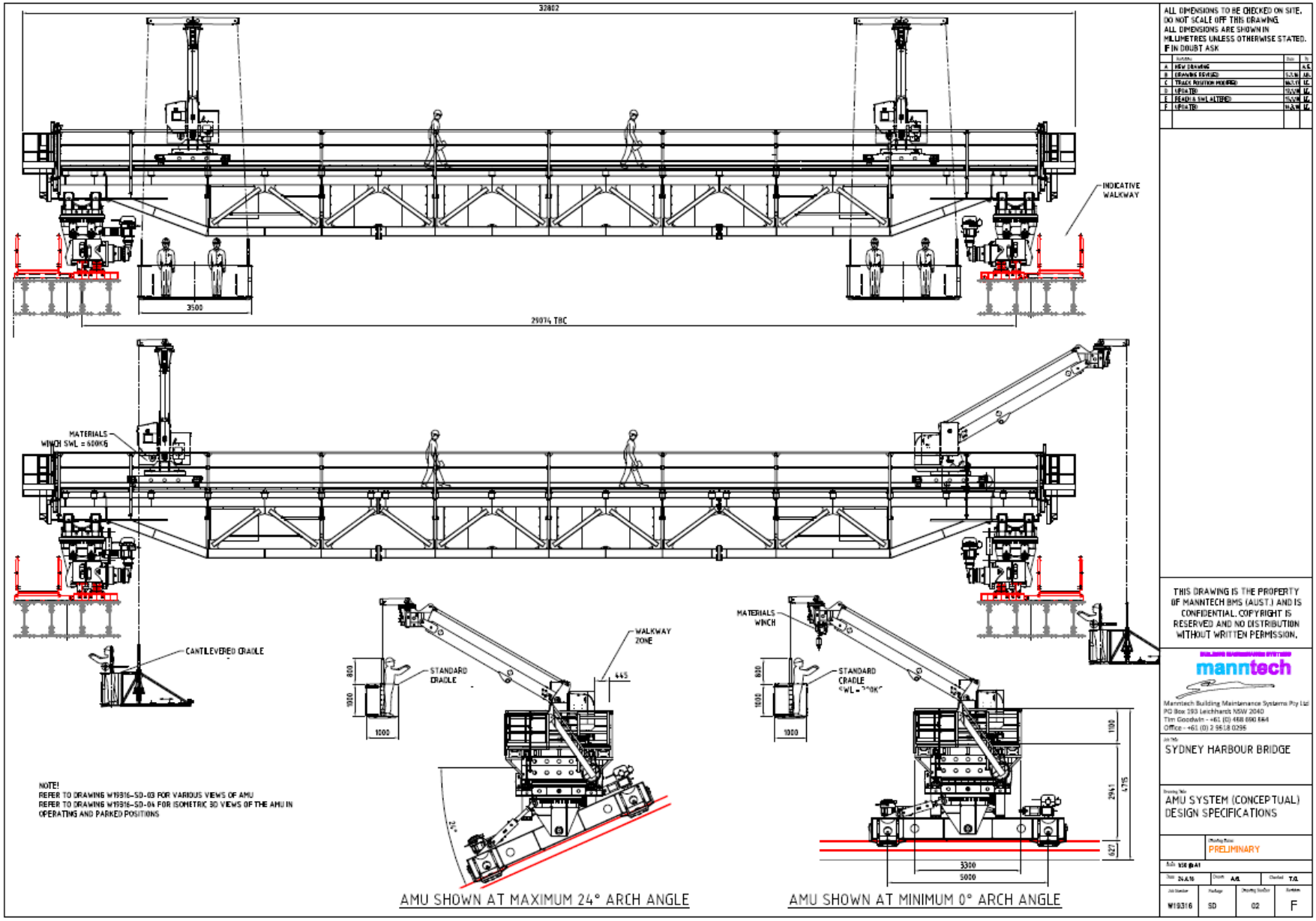


Figure 43: Plans, elevation and sections of the proposed AMUs.
(Source: Manntech)

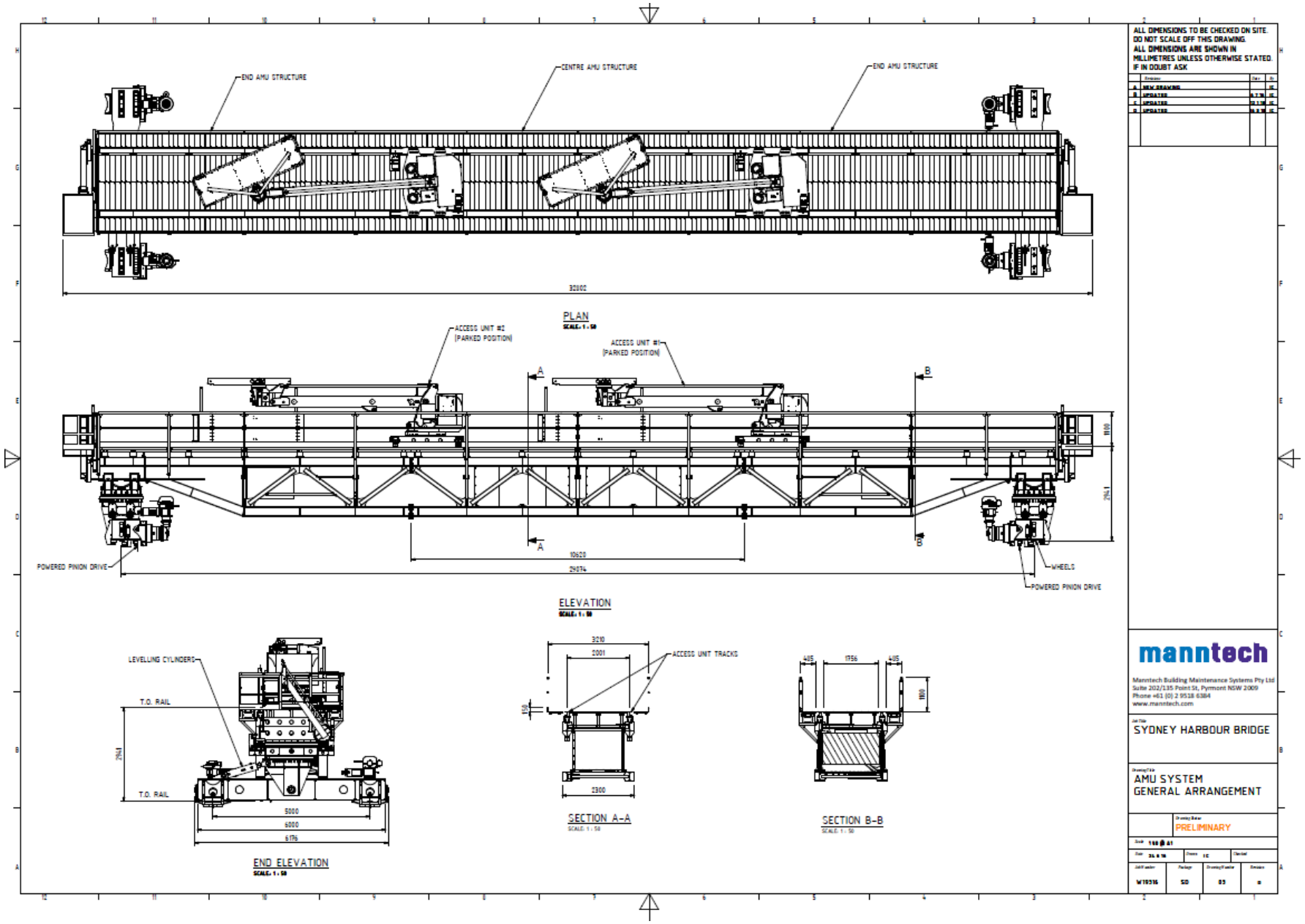


Figure 44: Isometric drawings of the proposed AMUs.
(Source: Manntech)

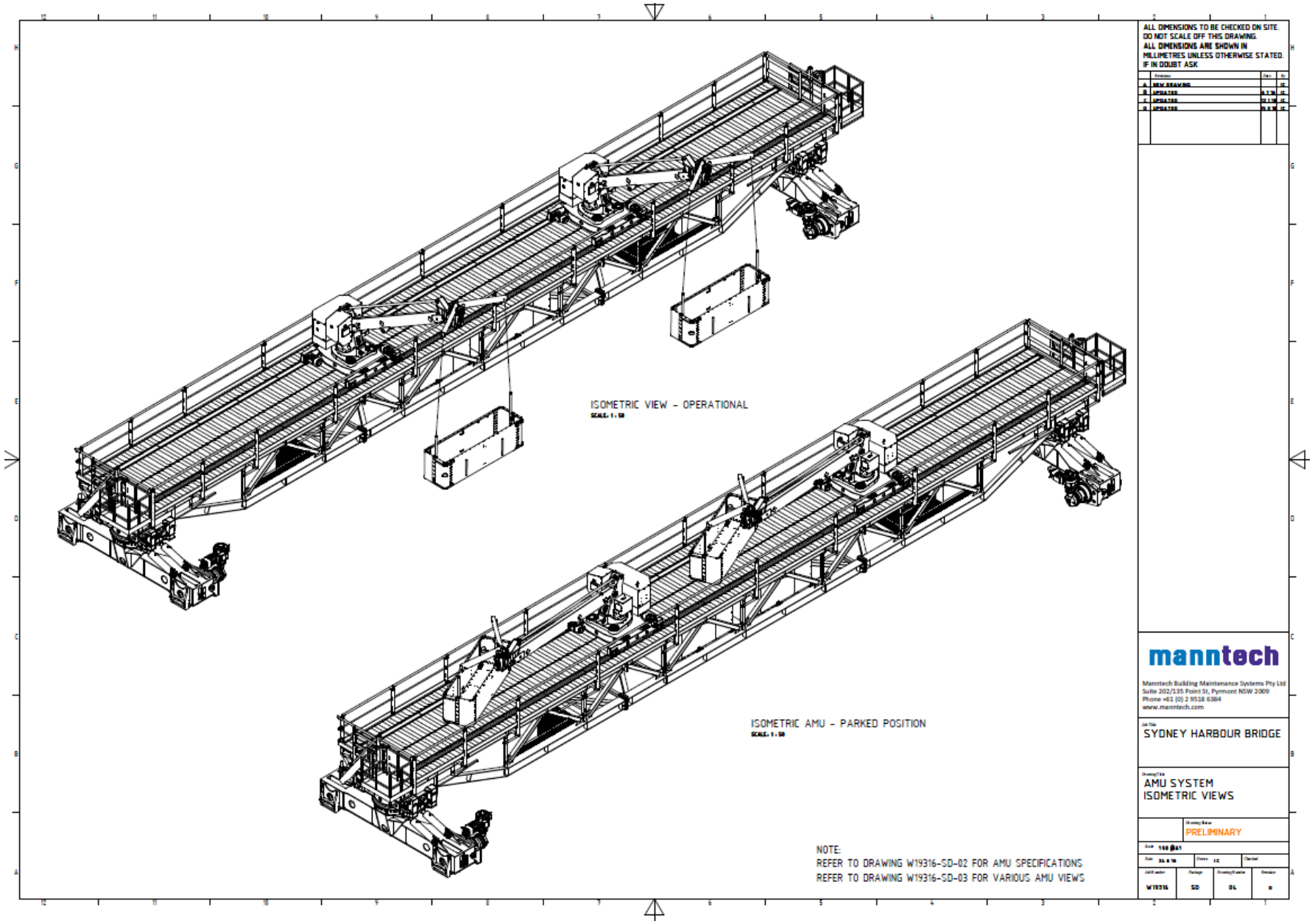


Figure 45: Render of end on view of proposed AMUs in 'operational' mode along the arch. (Source: Manntech)

Figure 46: Render of end on view of proposed AMUs in non-operational 'park' mode. (Source: Manntech)

Figure 47: Render of overhead view of proposed AMUs in operational mode. (Source: Manntech)

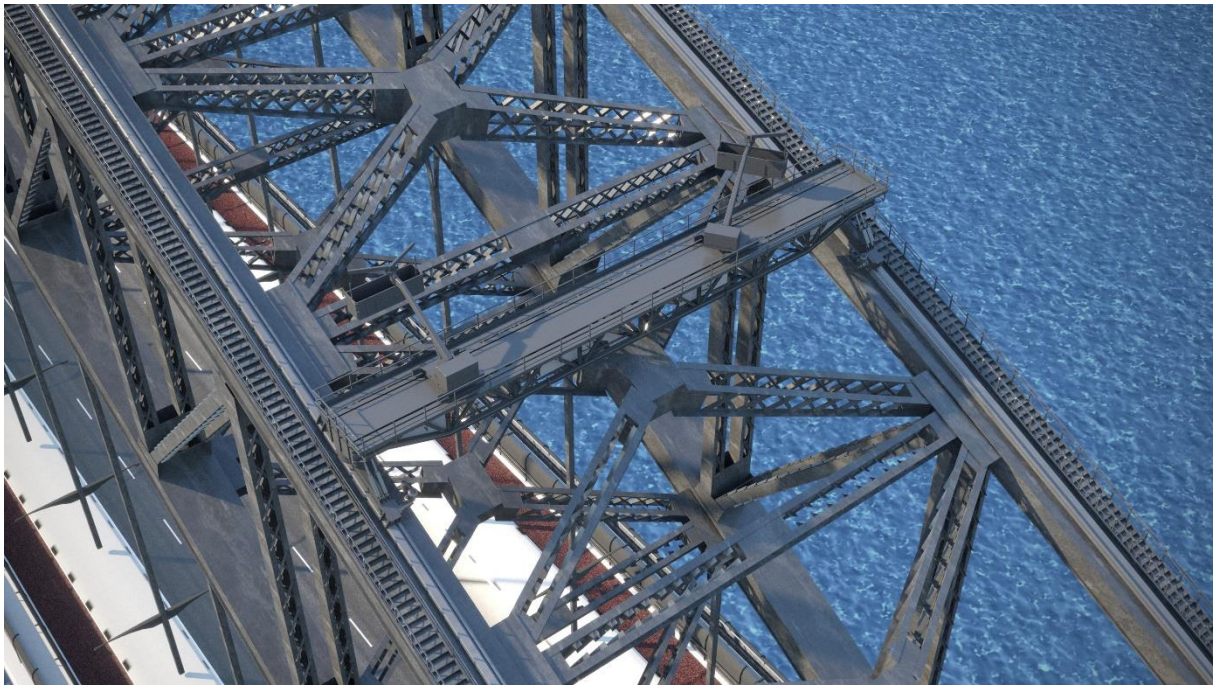


Figure 48: Render of overhead view of proposed AMUs in non-operational 'park' mode. (Source: Manntech)

Figure 49: Render of view from Bennelong Point (Sydney Opera House Western Broadwalk) of proposed AMUs in non-operational 'park' mode.
(Source: Manntech)

Figure 50: Render of view from Bennelong Point (Sydney Opera House Western Broadwalk) of proposed AMUs in operational mode.
(Source: Manntech)

7.0 HERITAGE IMPACT ASSESSMENT

7.1 Introduction

This section will assess heritage impacts to the listed items within and adjacent to the study area. Impacts to the SHB will be assessed in terms of its NHL significance, as well as the SHR significance of the approaches and viaducts group.

The visual impacts of the new AMUs while in operation during maintenance activities would potentially increase the prominence of the proposal from surrounding vantage points around Sydney Harbour including from nearby heritage items and conservation areas. Potential impact of the proposal to nearby heritage items is discussed in Section 7.6.

7.2 Assessment of impact to SHB

7.2.1 Impact to fabric

Removal of existing 1997 AMUs

The proposal involves removal of the 1997 AMUs from the SHB main arch structure. These machinery components, which do not constitute original fabric of the SHB, have been identified as being of little significance (refer to Section 5.2.3). While they are similar in design and form to the original (and since removed) SHB painting cranes that are of high significance, the subsequent 1997 AMUs have become redundant and restrict the functionality and maintenance activities occurring on the bridge.

The removal of the existing AMUs would involve removal of redundant associated infrastructure including the electrical bus bar and cable anchorages. The significance gradings for these associated infrastructure elements of the 1997 AMUs have not been identified in the CMP, although these are considered to be of little significance as per the grading of the 1997 AMUs.

The proposed removal of the 1997 AMUs is near significant fabric including the steelwork elements of the main arch structure. There is potential for the removal of the AMUs to impact on this fabric. Roads and Maritime would follow the recommendations relating to temporary protection measures in Section 8.0 to avoid inadvertent damage to significant fabric. The proposal would require removal of the metal walkways and rivets for the installation of a new rail for the upgraded AMUs, as discussed below.

The proposed removal of the 1997 AMUs would have a minor physical impact on the heritage significant fabric of the SHB main arch structure.

Removal of metal walkways

The proposal involves total removal of the existing metal walkways that extend along the centre line of each top chord. These components are identified as being of high significance (refer to Section 5.2.3). The walkways were originally installed at the time of the bridge's construction to provide safe access for maintenance workers. While the overall form and configuration of the stairs remains largely intact, it is noted that sections of the walkways and stairs have been modified or replaced in locations since commencement of BridgeClimb activities on the southern end of the east top chord.

While removal of fabric of high significance would be offset by the desired outcome of maintaining the structural integrity and longevity of the SHB, the impact on the significant values of this component of the SHB would be major given their removal.

The proposed removal of existing metal walkways would have a major physical impact on the heritage significant fabric of the SHB main arch structure.

Installation of new rail for AMUs

The proposal involves installation of new rail on the SHB main arch structure to allow new AMUs to traverse the length of the top chord members and access all required areas of the bridge. The staged construction of the rail, which would first involve installation of a 30 metre section of rail, would result in the removal not only of existing metal walkways but also a series of external rivets along a proposed path on the centre line of the top chords.

The significance grading for the original rivets of the SHB main arch structure is not identified in the CMP 2007. These elements, however, are an intrinsic element of the SHB and a tangible part of its physical character as a riveted structure. The rivets are therefore considered a highly significant aspect of the bridge's aesthetic and technical significance, and also retain significant social values for the workers involved in the bridge's construction.

It is noted that samples of original steel rivets are currently contained in the SHB Movable Heritage Collection. This collection, containing original fabric elements, provides future opportunity for materials testing and analysis. Given the relative scale of the project area compared to the overall SHB structure, which contains approximately 6 million rivets, this impact to heritage significant fabric is considered minor. The procedure for rivet removal is yet to be resolved by RMS bridge engineers, and this should seek to avoid and minimise impact to the surrounding significant steelwork.

The proposed installation of new rail for the AMUs would have a would have a moderate physical impact on the heritage significant fabric of the SHB main arch structure.

Installation of new AMUs

The proposal involves installation of two new AMUs consisting of two movable gantries each with two movable BMUs on the SHB main arch structure to provide for enhanced ongoing maintenance activities along the full length of the arch above deck level. As covered above, the installation of the new AMUs would involve constructing a new rail system, which would necessitate removal of original steel rivets and metal walkways on the top chords of the bridge arches, and potentially involve drilling additional holes into the original steel plates.

It is understood that positioning of workers in a cradle supported by the AMU, and cradles positioned as semi-platforms attached to bridge members for longer term access, would not result in any physical impact to bridge fabric. While there is a possibility of the proposed works requiring modification to the cable supports of the air navigation beacon located at the bridge's apex, the proposal would not directly impact on this element of the SHB. Installation of the new AMUs would result in modification of walkways crossing the top chords, while the summit crossing would not be impacted.

The proposed installation of new AMUs would have a minor physical impact on the heritage significant fabric of the SHB main arch structure.

Installation of new walkways

The proposal involves removal of the existing metal walkways and replacement with new walkways on the outer edges of each top chord of the bridge arches. This would permit installation of the new AMUs along the centre line of the top chords, which is understood to be preferable structurally. While the detail design of the walkways has not yet been developed, it is understood installation of the walkways would utilise existing rivet holes where possible, and appropriate materials and colour

palette so as to minimise indirect impacts. Additional holes would potentially be drilled to facilitate installation of new walkways.

The proposed installation of new walkways would have a moderate physical impact on the heritage significant fabric of the SHB main arch structure.

7.2.2 Visual impact

The SHB is a landmark structure and is a visually prominent feature within its significant setting. The SHB main arch structure is visible from many vantage points along the SHB approaches, views on and around Sydney Harbour, and from other landmarks such as the Sydney Opera House, Circular Quay and Barangaroo Reserve. Views towards the SHB are covered in Section 4.3 and are also identified in the VIA prepared by DesignInc.[20]

Existing unobstructed views of the SHB and the overall visual form and pattern of the steel structural members comprising the main arch structure, are of exceptional significance. The proposal would result in installation of permanent new elements that would cause visual changes to the silhouette and form of the SHB main arch structure. This particularly relates to the installation of the two new movable gantries with platforms and each with two BMUs, and the removal and replacement of the walkways on the top chords of the arches.

The proposed 'knuckle jib' BMUs and truss gantry designs represent a departure from the 'double jib' design of the earlier AMUs on the SHB. While in operation, the new BMUs would have an increased visual impact, extending to reach a required length of 10.7 metres. The proposed AMUs, featuring platforms that span between the two top chords, would introduce prominent new visual elements that would potentially obscure the legibility of the SHB main arch structure. This particularly applies to close angle views from deck level, end on views along the approaches, and from ground level vantage points around the Sydney Harbour foreshore, which capture the pattern of the steel structural members of the SHB (Figure 51 and Figure 52). These views are identified as being of exceptional significance (refer to Section 5.2.3) and are identified in the VIA prepared by DesignInc as being of High visual sensitivity. The VIA assessed that distant views to the SHB and views that capture the main arch structure in elevation would not be negatively affected by the proposed AMUs (Figure 53 and Figure 54).

The proposal has been designed to minimise where possible impact on key views and the setting of the SHB. While in 'park' mode and non-operational, the BMUs would be compact in appearance and have been designed to not exceed the visual envelope of the existing 1997 AMUs. New elements would be painted 'bridge grey' to visually match to the existing material palette and significant character of the surrounding steelwork and associated infrastructure. The truss design of the proposed gantries and utilisation of perforated mesh on the platforms would maximise the transparency of new structures, thereby minimising the visual 'bulk' and discernibility of the proposed AMUs within the context of the SHB and its broader setting.

It is noted that potential visual impacts of the proposed installation of new AMUs that are described above would be dependent on the location, timing and frequency of maintenance activities carried out on the SHB main arch structure. The proposed AMUs, which would operate along the length of the SHB main arch structure, would not be in a fixed location. As such, potential increased visual impacts are considered to be temporary in nature. Moreover, the form of cranes carrying out maintenance activities has been a lasting element on the silhouette of the SHB since its construction and is an intrinsic aspect of the bridge's visual character. The changed design of the new AMUs does not seek

[20] DesignInc, December 2017. 'Sydney Harbour Bridge (SHB) Arch Crane & Walkways Replacement: Urban Design Report including Landscape Character and Visual Impact Assessment': pp22-39

to mimic or replicate the original painting cranes, and honestly reflects updates and advancements in bridge maintenance technology.

Figure 51: View north along SHB approaches showing existing AMUs and walkways on the SHB (Source: DesignInc 2017).

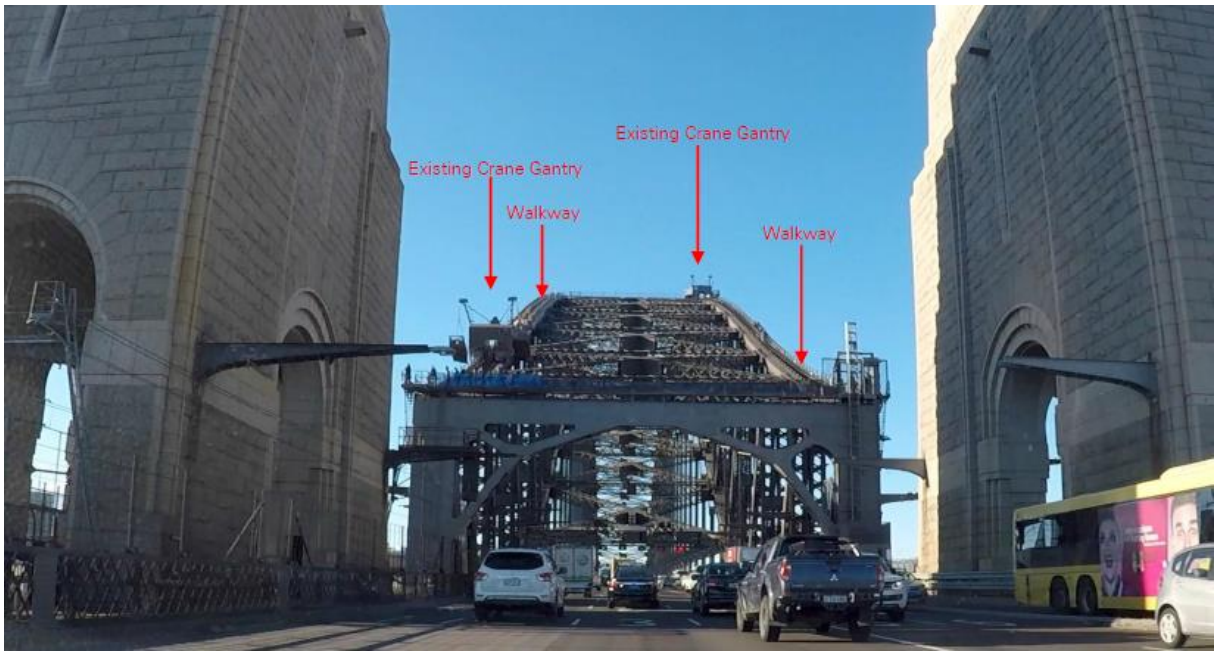


Figure 52: View north along SHB approaches showing one of the two proposed AMUs on the SHB (Source: DesignInc 2017).

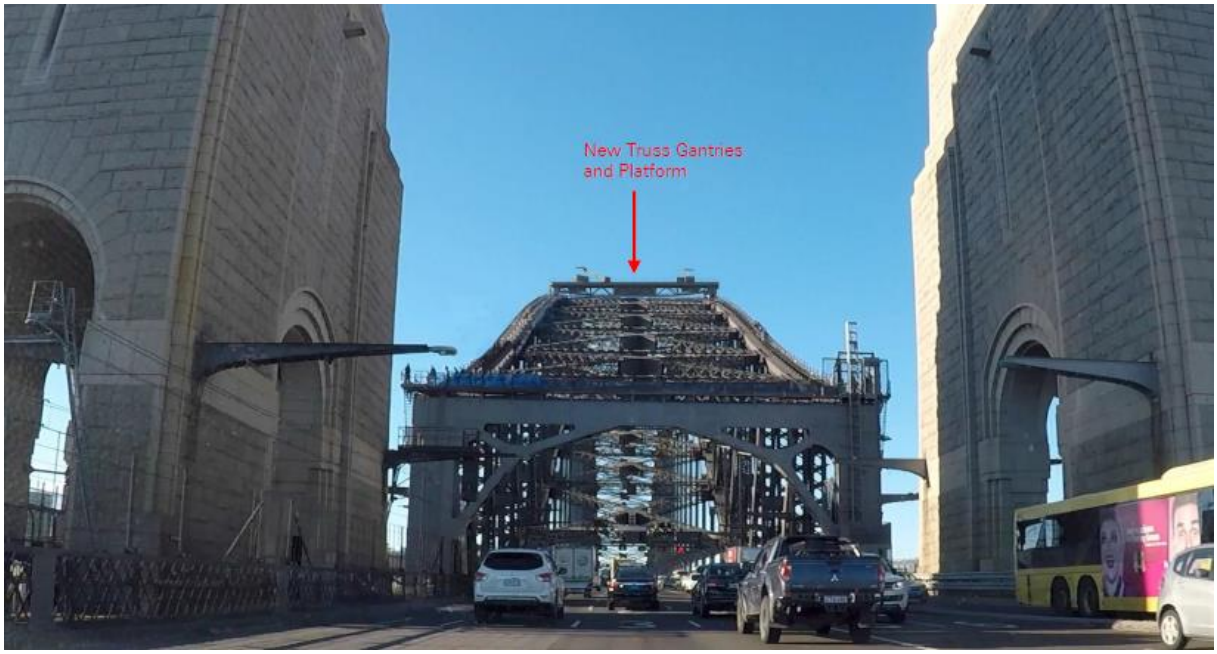


Figure 53: View west across Sydney Harbour from the Sydney Opera House showing existing AMUs on the SHB (Source: DesignInc 2017).

Figure 54: View west across Sydney Harbour from the Sydney Opera House showing proposed AMUs on the SHB (Source: DesignInc 2017).

The proposed replacement of walkways on the main arch structure would result in discrete visual changes to the SHB main arch structure, in particular the relocation of the walkways to the outer edges of the top chords and adjustments to the configuration of the railings. In order to meet current Australian Safety standards, the height of new railings would be increased and would feature additional vertical railing supports. Changes to the walkways would alter the visual configuration of the SHB main arch structure, particularly for people accessing the top chords including maintenance workers and participants of BridgeClimb activities. While the walkways are a familiar and functional component permitting accessibility of the SHB main arch structure, the walkways themselves are relatively modest and are not considered to be a visually significant element of the SHB.

The VIA prepared by DesignInc identifies that while the replacement walkways and adjustments to the railings would not be distinguishable visually from distant views and from vantage points that capture the SHB main arch structure in elevation, they would be more visible from end on views along the SHB approaches. The VIA notes that in these locations, while they the walkways are discernible, they would be less prominent than surrounding elements including the new AMUs and their associated gantries, platforms and BMUs.

It is understood the design of the walkways would be developed to visually match and respond to the existing colour palette and character of the surrounding steelwork and associated infrastructure. While the proposed use of fibreglass for the new stair treads would depart from the traditional material palette of the bridge, this material would allow for ease of maintenance and ongoing longevity of the walkways, as many of the original steel treads exhibit signs of corrosion and ongoing deterioration. The proposed replacement and relocation of walkways would not impact on the overall form and visual character of the SHB, or its significant setting.

The VIA prepared by DesignInc assessed that in general, the proposal would not impact distant views of the SHB or views towards the main arch structure in elevation. The assessment identified that close-range views towards the main arch structure, including from pedestrian pathways or road carriageways, would be greater due to the solid platform deck of the gantries, and that potential visual impacts could be mitigated during detail design.

The proposal, involving installation of new AMUs and removal and replacement of walkways, would have a moderate visual impact on the setting and character of the SHB main arch structure.

7.2.3 Summary of impact to SHB

The proposed works would result in a number of minor to major impacts, both physical and visual, to the heritage significance of the SHB main arch structure. These impacts are generally restricted to localised areas on the main arch structure, which is an element of the broader Sydney Harbour Bridge Approaches and Viaducts group that is of exceptional significance. Enhancement of critical maintenance activities on the steel structural members of the SHB will maintain the key function of the SHB and support its ongoing use and longevity, and is considered a fundamental part of the bridge's conservation. The overall level of impact of the proposal to the SHB as a whole would be moderate.

Given the scope of projects that are currently underway or otherwise envisaged for the SHB, it is important to consider the cumulative impact of the proposed SHB AMUs project in the context of other projects on the significant values of the SHB. This cumulative impact assessment is covered in Section 7.2.6. The proposed works would result in a neutral physical impact, and negligible visual impacts to surrounding heritage items, as discussed and summarised in Section 7.4. Potential physical and visual impact of the proposal could be mitigated with reference to the recommendations and mitigation measures outlined in Section 8.0.

7.2.4 Proposal justification

The proposed removal of the 1997 AMUs, which increasingly undermine and restrict the efficiency, accessibility and safety of maintenance operations on the bridge, would not adversely affect the overall significance or integrity of the SHB. While works would impact elements of the SHB that are of exceptional and high significance, introduction of state of the art maintenance technology represents an opportunity to enhance the effectiveness, efficiency, accessibility and safety of critical maintenance activities.

The proposal has been designed to achieve 'lightweight' AMUs structures that are visually recessive and compatible with the aesthetic qualities and character of the SHB main arch structure. Utilisation of a truss gantry design and appropriate selection of materials and colours would assist in minimising

visual impact of the new AMUs in regard to maintaining the form of the SHB main arch structure. This includes from significant views on the approaches, from ground level at vantage points in the public domain around the Sydney Harbour foreshore, and from nearby heritage items and heritage conservation areas.

While works would impact on the bridge's significance, this would be offset by improvements in the effectiveness, efficiency, accessibility and safety of critical maintenance activities. Potential impacts of the proposal would improve conservation outcomes that would safeguard the longevity of the SHB. The overall impact of the proposal to the SHB, which has been assessed as moderate, is therefore considered acceptable from a heritage perspective.

7.3 Assessment of impacts on SHB NHL values

The Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (2013) pose a series of questions on the nature of the impact to the heritage values of a World Heritage Property or National Heritage Place which are to be considered when assessing the potential impact of a proposed action on items of work World or National heritage.

These questions have been considered with reference to the potential impacts associated with the proposal as follows:

1. *Are there any matters of national environmental significance located in the area of the proposed action (noting that 'the area of the proposed action' is broader than the immediate location where the action is undertaken; consider also whether there are any matters of national environmental significance adjacent to or up/ downstream from the immediate location that may potentially be impacted)?*

Construction of the proposed action would occur within the NHL curtilage of the SHB and the World Heritage buffer zone of the Sydney Opera House.

2. *Considering the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), is there potential for impacts, including indirect impacts, on matters of national environmental significance?*

The proposed action would not significantly impact or undermine the NHL values of the SHB. The design of the proposed gantries and AMUs and associated infrastructure has been developed to minimise impact to the fabric and setting of the bridge, and to sensitively respond to the existing aesthetic character of the SHB. The proposed action would potentially strengthen the NHL values of the SHB, by allowing for enhanced maintenance procedures that would safeguard the longevity of the bridge.

No impacts to World Heritage Values associated with the Sydney Opera House are anticipated by the proposed action. While the proposal is within the visual catchment and harbour setting of the Sydney Opera House, the proposed AMUs have been sensitively designed to minimise the size and visual bulk of new elements. It is also noted that the presence of maintenance infrastructure on the SHB has been a familiar part of the character of the bridge since its construction. Impact to the Sydney Opera House World Heritage Buffer Zone is covered in detail in Section 7.6.1 below.

3. *Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the 'significant impact' threshold)?*

The proposed works have been carefully designed to minimise any potential visual impact that would undermine the NHL values and symbolic landmark qualities of the SHB. This has been achieved by

way of sensitive and sympathetic selection and refinement of the form, materiality and colour palette of the proposed gantries and BMUs.

The sympathetic material palette that has been developed for the proposed action would incorporate structural members that respond to the significant steel structure of the SHB by way of appropriate colour matching. The design of the gantries has been rigorously refined to utilise a truss structure and perforated mesh on the platform deck to maximise the visual transparency of the item. This would result in reduced discernibility of the proposal.

The proposal has been designed to maintain the structural integrity of the bridge, which is a key part of the item's creative and technical values. The opportunity to enhance maintenance procedures on the SHB would strengthen the conservation of the NHL values of the SHB by way of ensuring its ongoing structural integrity and longevity. As such, the proposal would maintain the Nationally significant events/processes, aesthetic characteristics, creative or technical achievement, social value and significant people heritage values of the SHB.

While the study area is within the World Heritage buffer zone of the Sydney Opera House, no impacts to World Heritage Values associated with the Sydney Opera House are anticipated by the proposed action. The proposed AMUs have been designed to minimise the size and visual bulk of new elements and the discernibility of new development within the significant harbour setting of the Sydney Opera House. As such, the proposal would not impact significant view lines from this iconic building. Impact to the Sydney Opera House World Heritage Buffer Zone is covered in detail below.

4. *Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)?*

The proposed action would result in the removal of sections of original fabric, i.e. sections of original walkways and series of rivets, which are associated with the aesthetic and technical/creative NHL values of the bridge. It is noted that impacts are generally restricted to localised areas that are relatively small in relation to the extent of the arch and the overall scale of the bridge. Overall, the proposed works and removal of localised sections of original fabric would not obscure, diminish, modify, damage or degrade the NHL values of the SHB.

Significant impact criteria

The significant impact criteria outlined in the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (2013)* are intended to assist in determining whether the impacts of a proposed action on any matter of national environmental significance are likely to be significant impacts.

Table 10 presents an assessment against the heritage values for the SHB.

Table 10: Assessment against Significant Impact Criteria

Significant Impact Criteria	Impact to SHB
Permanently remove, destroy, damage or substantially alter the fabric of a World Heritage property or National Heritage Place in a manner which is inconsistent with relevant values	No
Extend, renovate, refurbish or substantially alter a World Heritage property or National Heritage Place in a manner which is inconsistent with relevant values	No
Permanently remove, destroy, damage or substantially disturb archaeological deposits or artefacts in a World Heritage property or National Heritage Place	No

Significant Impact Criteria	Impact to SHB
Involve activities in a World Heritage property or National Heritage Place with substantial and/or long–term impacts on its values	No
Involve construction of buildings or other structures within, adjacent to, or within important sight lines of, a World Heritage property or National Heritage Place which are inconsistent with relevant values	No
Make notable changes to the layout, spaces, form or species composition in a garden, landscape or setting of a World Heritage property or National Heritage Place which are inconsistent with relevant values	No
Alter the setting of a World Heritage property or National Heritage Place in a manner that is inconsistent with relevant values	No

7.3.1 Summary of impact to NHL values

This report has assessed that following the proposed works the national heritage values of the SHB would not be significantly impacted, and would continue to meet the criteria of events/processes, aesthetic characteristics, creative or technical achievement, social value and significant people heritage values.

The proposal would result in minor to major localised impacts to aspects of the SHB and its elements. In the context of the overall Sydney Harbour Bridge Approaches and Viaducts group, and balanced by the positive impact of enhanced maintenance and conservation outcomes, the overall impact is considered moderate. The proposal has not been assessed as resulting in the loss, damage or notable alteration of any of the SHB National Heritage values.

7.4 Conservation Management Plan policies

A number of conservation policies have been established for the management of the SHB in the CMP 2007 prepared by GML. Policies relevant for the proposal are described below, with an assessment of the project impacts against each of these policies.

Policy 9—Management Objectives

9.1— Ongoing management of the bridge should provide for:

- *retention of the fundamental cultural heritage values and attributes of the bridge;*
- *conservation (including ongoing maintenance) of significant elements;*
- *enhanced opportunities for presentation and interpretation of the bridge and its history for public appreciation; and*
- *continued and enhanced linkage with associated elements adjacent to the bridge, including Bradfield Park and Plaza, Dawes Point and other foreshore areas within the view lines of the bridge (via interpretation, related activities, transport routes etc).*

The proposed SHB AMUs replacement project, facilitating ongoing management of the bridge, would provide for the operational requirements necessary to support the fundamental role of the SHB as the main traffic network across Sydney Harbour. Enhanced maintenance operations would maintain and potentially strengthen the significance of the bridge as the world's greatest example of a two-pin steel arch design. Opportunities for interpretation of the maintenance activities of the bridge, as part of a holistic interpretation strategy, would increase and strengthen public appreciation and engagement with the evolution of the SHB and its day-to-day operation.

Policy 11—Maintaining Key Views of the Sydney Harbour Bridge in its Setting

11.1—The significant physical and visual character of the Sydney Harbour Bridge within its harbour setting should be appropriately conserved.

11.2—Views and vistas to and from Sydney Harbour Bridge to the north, south, east and west should be maintained.

The proposal maintains significant views and vistas to and from SHB from ground level vantage points including along the Sydney Harbour foreshore, and on the bridge's northern and southern approaches. The new AMUs have been designed to minimise introduction of visual 'bulk'. Their compact and relatively lightweight construction and utilisation of a truss design for the gantries means they are more porous in appearance than the existing 1997 AMUs. As such, the proposal not only maintains but would potentially enhance the physical and visual character of the bridge and its iconic position within its harbour setting. While the detail design of new walkways has not yet been resolved, it is understood this aspect of the proposal would be developed to sensitively respond to the existing character and aesthetic qualities of the surrounding steelwork of the bridge arch.

Policy 13—Integrity of Original Design

13.1—The clarity of the structural form and silhouette of the bridge, and its associated elements when viewed from key points around the harbour, should be maintained and not obscured.

13.4—The fabric and design integrity of the main components of the bridge, comprising the arch, hangers, roadway, pylons, approach spans, piers and approaches including tunnels, tenancy spaces and Milsons Point railway station, should be conserved.

13.6—The arrangement of internal spaces in the abutment towers, pylons and approach structures should be conserved.

The proposal, including removal of redundant AMUs and upgrade with AMUs of enhanced functionality, would maintain the fabric and design integrity of the SHB main arch structure. The proposed replacement AMUs have been designed to be lightweight in construction and as visually unobtrusive as possible in order to maintain the clarity of the structural form and silhouette of the bridge including main arch. Designed to fit within the envelope of the existing AMUs when in 'park' mode, the new BMUs would be painted 'bridge grey' to retain and respect the existing material palette and physical character of the SHB. Utilisation of a truss design for the proposed new gantries

sensitively responds to the existing character and visual qualities of the bridge arch. It is noted that the cumulative impact of the suite of projects that are underway or otherwise envisaged for the SHB has potential to obscure the integrity and legibility of the original design, and these should therefore be managed in accordance with the recommendations in Section 8.

Policy 14—Maintenance and Repair Works Generally

14.1 —Appropriate repair and maintenance works should be carried out on an ongoing basis. The works should seek to secure fabric against further deterioration and retain as much as possible of the integrity and historical fabric and construction methods.

14.3 —Structures, machinery/equipment and other elements should be regularly inspected and maintained.

The proposal, involving upgrades to the existing maintenance provisions of the SHB, would enhance the ongoing operability and longevity of the SHB including the main arch structure. The replacement of the existing 1997 AMUs allows improvements in the functionality of the bridge as a major transportation route and provides for continued conservation of the Nationally significant SHB.

Policy 16—Records of Intervention and Maintenance

16.1 —All works to the Sydney Harbour Bridge should be appropriately recorded and permanently stored as part of the archival recording of the history and significance of the item.

16.2 —Documentation of conservation works should include the rationale and methods employed and monitor performance.

Design plans for the SHB AMUs project would be included in planning archives for the SHB. Refer to the recommendations in Section 8 regarding these processes.

Policy 18—Management of Adaptation and Change

18.1—All decisions for intervention and change should be evaluated in terms of the nature of the proposal, its purpose, long term context and how this relates to the identified cultural heritage values of the bridge. Protection and enhancement of the fundamental significant elements of the place through appropriate adaptation and change for new or additional necessary functions should be a key management goal.

The provision of improved accessibility, efficiency and safety of maintenance activities on the SHB main arch structure is consistent with the long-term aim of retention of the bridge's identified cultural heritage values. The proposal offers an opportunity to protect and conserve components of high significance of the main arch structure, which is an exceptional element of the SHB. Improved

maintenance of the SHB would enhance the bridge's longevity and support its ongoing role as a major transportation route of significant public utility.

Policy 19—New Development

19.1—New development should enhance the function and use of the bridge without obscuring or damaging the integrity of the original design or significant fabric.

19.2—New work should be designed to respond to the character of the existing significant design and fabric.

19.3—Before committing to any proposal for change to the bridge, including the introduction of new uses, the impact of the proposed changes on the cultural heritage values of the bridge as a whole, any operational and security requirements, and other relevant agreements regarding the use of the bridge, should be assessed.

The proposal represents an opportunity to upgrade and enhance the maintenance and operability of the SHB. By providing increased functionality and safety of critical maintenance procedures, the proposal would support the structural integrity of the main arch structure and its role not only as an iconic landmark but also as a primary component of Sydney's transport system. The proposed replacement AMUs have been designed to be lightweight and visually unobtrusive to maintain the clarity of the structural form and silhouette of the bridge's main arch structure. Designed to fit within the envelope of the existing AMUs when in 'park' mode, the new AMUs would be painted 'bridge grey' and adopt a truss design to retain and respect the existing material/colour palette and physical character of the SHB.

While significant fabric would be impacted by the proposed works, including removal of original rivets and metal walkways and possible drilling of additional holes into original steel plates, the area that would be impacted is relatively small compared to the total expanse of the bridge. The proposal avoids impacting fabric of exceptional significance and does not substantially alter the exceptionally significant form of the SHB main arch structure.

Policy 26—Movable Items

26.1— All equipment or elements considered redundant or surplus to requirements and assessed to be of heritage significance must be suitably archived and recorded on the RTA Heritage and Conservation Register.

26.2— Management of equipment or elements of movable heritage should be undertaken with reference to the Sydney Harbour Bridge Movable Heritage Conservation Strategy 2007, the RTA Heritage Guidelines 2004—Version 2 and the Sydney Harbour Bridge Interpretation Plan 2007.

An archival recording of proposed removed structures would be carried out prior to commencement of works. Refer to the recommendations in Section 8 regarding these processes.

Policy 36—Interpretation Requirements

36.1—Measures to appropriately interpret the major aspects of significance of the bridge should be considered in conjunction with all future proposals for change and development.

Policy 37—Machinery and Equipment

37.1— The history and heritage significance of machinery and equipment specifically related to the bridge should be actively interpreted to the public.

Maintenance cranes have been an intrinsic component of the SHB's silhouette since its construction, and are part of the day-to-day operations of the bridge. There is opportunity for increased interpretation as part of an holistic interpretation strategy to communicate the history of the cranes operating on the SHB main arch structure and the evolution of bridge maintenance technology. Refer to the recommendations in Section 8 regarding these processes.

It is understood that negotiations are taking place over the proposed installation of one of the original 1930s painting cranes in a location along the Bradfield Park foreshore precinct at Milsons Point to interpret the maintenance history of the SHB and associated infrastructure. Refer to the recommendations in Section 8 regarding these processes.

Summary

The proposed works represent an opportunity to enhance the efficiency and functionality of the maintenance provisions on the SHB main arch structure, in accordance with the policies and recommendations contained in the CMP 2007.

The assessment of impact to the heritage values of the SHB main arch structure has determined the impacts to be minor to major. The overall impact on the significance of the SHB as a whole would be moderate. These impacts are balanced by the opportunities the proposal provides in improving accessibility and safety of maintenance activities that will assist in supporting the bridge's ongoing conservation and longevity, and are therefore considered acceptable from a heritage perspective.

7.5 Cumulative impact assessment

The proposal forms part of a suite of projects that are underway or otherwise planned for the SHB. These projects, involving upgrades to provide improved accessibility and maintenance and upgrades for increased vehicle traffic safety and efficiency, seek to support and enhance the accessibility and functionality of the SHB not only as an item of national heritage significance, but also the main transportation route across Sydney Harbour.

The context of the proposal in relation to these other projects is an important consideration to understand its cumulative impact on the significant values of the SHB. Key projects to consider include the Lantern Replacement and Security Upgrade projects. The cumulative physical and visual impact assessment of these projects on the SHB main arch structure is covered in the discussion that follows.

Impact to Fabric

As described in the preceding assessment, the proposal to install upgraded AMUs involves interventions to significant fabric of the SHB main arch structure including removal of original rivets and walkways and potential drilling of additional holes into the original steel plates of the top chords. These interventions have been assessed as having minor to major physical localised impacts on the SHB main arch structure, and a moderate impact to the overall significance of the SHB. Other projects relating to the SHB may have similar potential impacts to the fabric of the SHB main arch structure.

The Security Upgrade project would involve installation of anti-climb mesh on hanger posts and replacement of security fencing on the pedestrian walkway on the SHB. The project is aimed at improving safety for bridge users by preventing persons from climbing the hanger posts of the main arch structure and reducing opportunities for people to throw objects or jump from the bridge. Involving fabric of high significance including hanger posts, the project is being designed to be reversible and not involve physical impact on original fabric. Barbed wire of moderate significance would be removed form anti-suicide fencing.

The Lantern Replacement project, works of which are currently underway, aims to restore the excitement and approach experience of crossing the SHB by reinstating replicas of the original bronze lanterns. Most of the original SHB lanterns were removed from the bridge during the 1970s, and only a few types remain. All of the original lanterns on the light arms were removed and are no longer in storage. The project involves removal of the modern lighting that is identified in the CMP 2015 as being ‘intrusive’ fabric on the SHB main arch structure.

These projects are considered to involve relatively minor impact to the physical fabric of the SHB. Collectively, the projects offer opportunities to strengthen the conservation and interpretation of the significant SHB main arch structure. Numerous interventions to the configuration of the SHB main arch structure, however, could potentially undermine the integrity and intactness of this significant element of the SHB. It is noted, though, that the proposal does not involve direct impact to fabric of exceptional significance. In order to minimise the cumulative impact of works, physical impact to the fabric of the SHB main arch structure would, wherever possible, be avoided and restricted to localised areas.

Visual Impact

As previously discussed, the proposal involves interventions that would have minor to moderate localised visual impacts on the SHB main arch structure including removal of original rivets and walkways, and potential drilling of additional holes into the original steel plates, in order to install new AMUs. The installation of new AMUs has been assessed as having a moderate visual impact on the SHB. It is noted that the proposed AMUs in non-operational ‘park’ mode are contained within the envelope of the existing cranes, and would not be in a fixed location. The new gantries of the AMUs will be lightweight in construction, adopting a truss design for the gantry structure and painted ‘bridge grey’ to retain the bridge’s existing visual and physical character.

The Security Upgrade project, with installation of anti-climb mesh on hanger posts and replacement of security fencing on the pedestrian walkway on the SHB, would introduce new visual elements on the main arch structure. While planning for this project and detail design is still underway, it is understood the anti-climb mesh and replacement security fencing would be carefully designed to minimise visual ‘bulk’ and to more successfully complement the significant visual character and material palette of the SHB. The removal of unsightly barbed wire from the anti-suicide fencing is considered a positive visual impact.

The Lantern Replacement project that is underway will have a positive visual impact on the SHB and the SHB main arch structure. Lighting was an important part of the original design and visual quality of the SHB. Upon completion, the bridge boasted a comprehensive lighting scheme of classical cast iron lanterns for the road, rail and footways of the SHB. The removal of intrusive modern lighting components and reinstatement of accurate replicas of original bronze lanterns on the SHB will enhance appreciation of the original visual character and design of the SHB.

While these other projects relating to the SHB have respectively sought to minimise potential visual impact, their collective visual impact must also be considered. Should the designs be developed in isolation of one another, there is a risk of potential cumulative impact whereby the visual clarity and character of the SHB, including the SHB main arch structure, is diminished by projects of conflicting or contrasting designs.

In order to avoid this potential impact, it is important that the design of the proposal be consistent, where feasible, with the design of other related SHB projects. In order to retain the visual clarity and character of the SHB, the materiality, finishes, style and interpretation of any works in the proposal would be compatible with the existing material palette and character of the SHB and wherever possible be consistent with other SHB projects. This will assist in maintaining and enhancing appreciation and legibility of the SHB and its significant values. It is important that the design of the proposed upgraded AMUs take into account this key consideration to minimise potential cumulative impact.

Justification

The proposal forms part of a suite of current or otherwise planned projects relating to the SHB that seek to enhance the accessibility, functionality, safety and maintenance of the SHB. The overall combined impact of these projects will maintain the key function of the SHB and support its ongoing use and longevity as an item of national and state significance.

While the cumulative impact of these projects could potentially affect the fabric, visual character and setting of the SHB including the main arch structure, it is considered this impact can be mitigated and managed with careful coordination and consideration of design consistency across the various projects underway or otherwise envisaged for the SHB. Key recommendations to mitigate or reduce potential impact are outlined in Section 8.

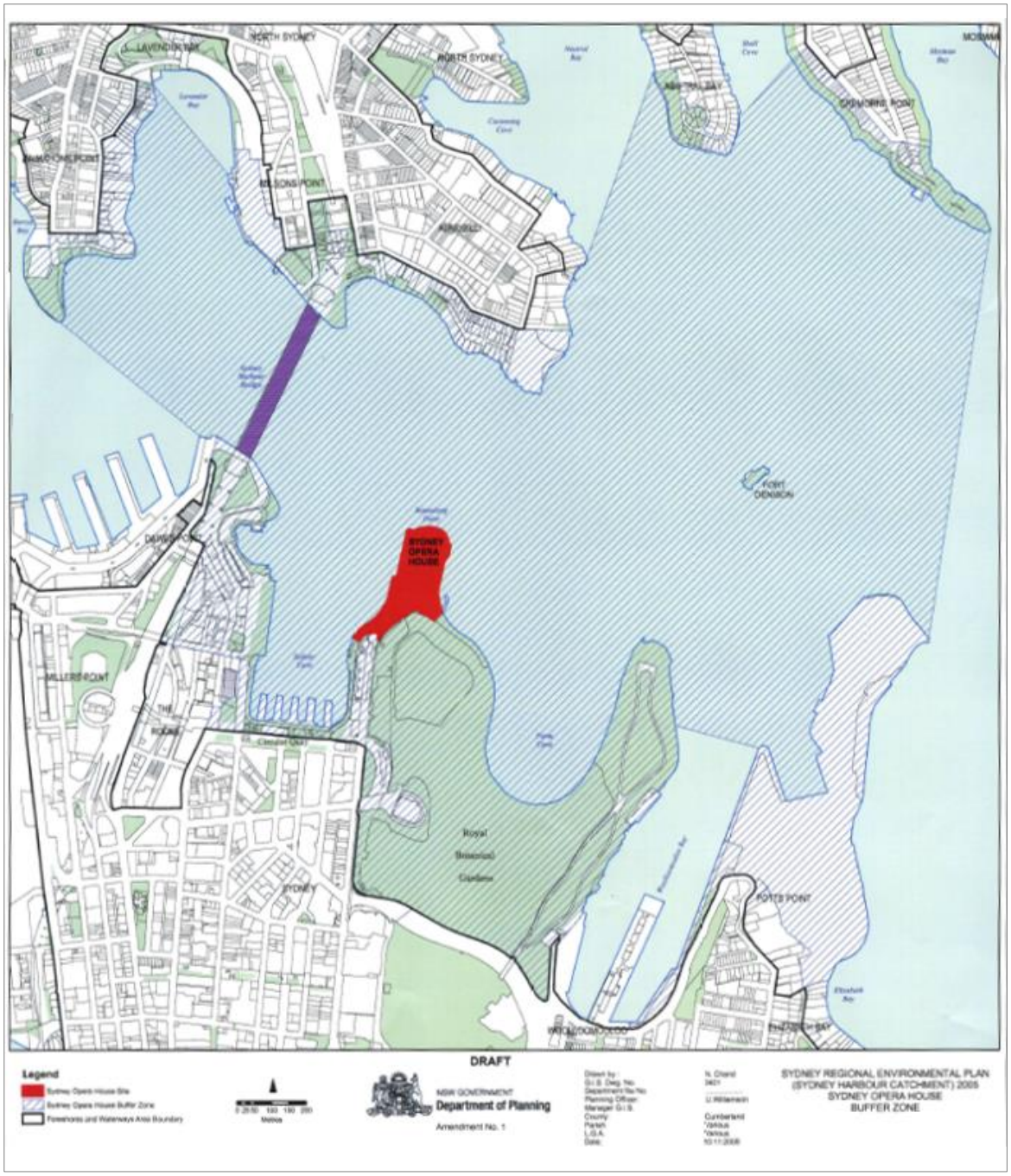
The cumulative impact of the project is not currently considered to require referral under the EPBC Act, however, with additional projects proposed to follow those listed above, levels of impact may reach threshold at the requirement for referral to the Minister. As such, Section 8 provides recommendations for future cumulative impact assessment and management.

7.6 Impact to nearby heritage items

7.6.1 Sydney Opera House (World Heritage buffer zone)

The project area is located within the WHL buffer zone of the Sydney Opera House, which addresses and seeks to conserve the significant visual values and setting of the Sydney Opera House (Figure 55). There are direct sightlines between the Sydney Opera House and the SHB including the proposed locations for the upgraded AMUs. The SHB is located approximately 500 metres to the north west of the Sydney Opera House.

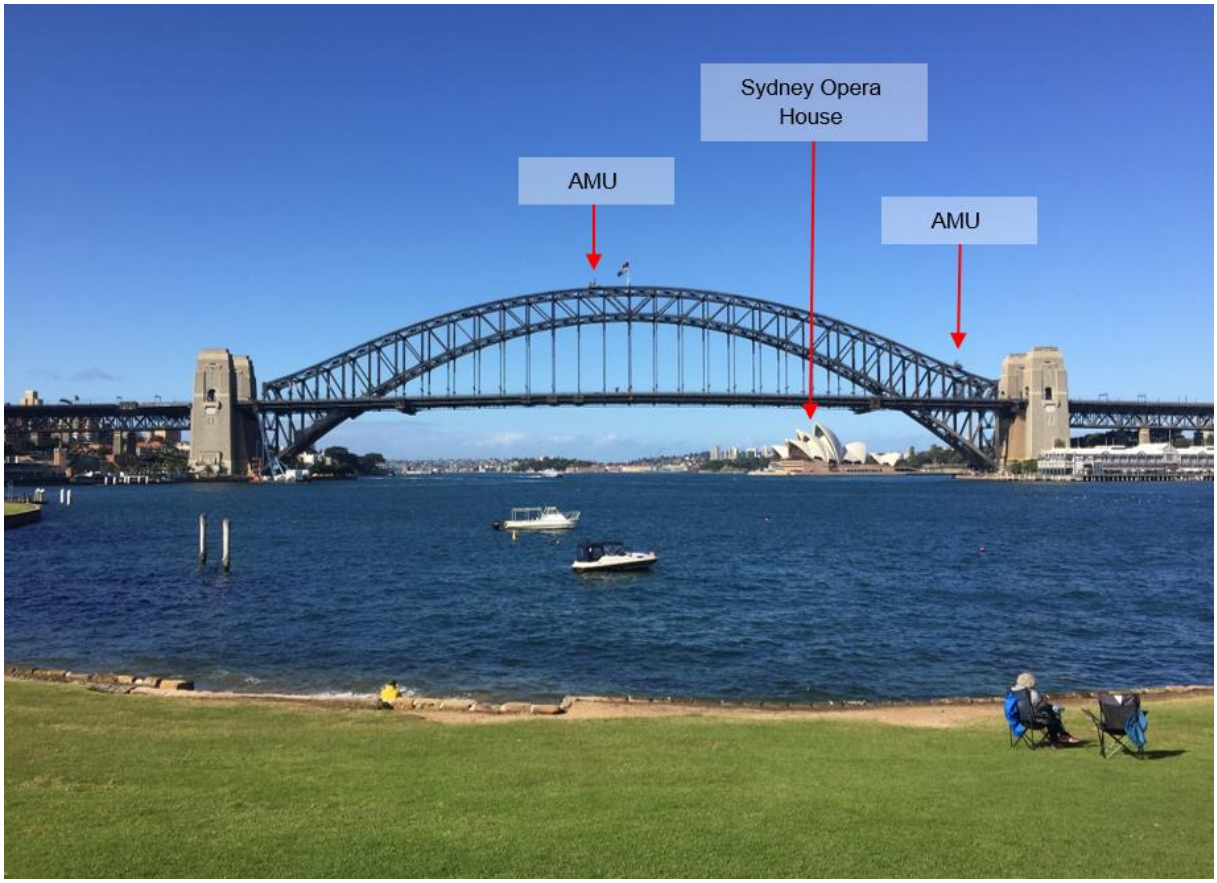
Figure 55: Sydney Opera House World Heritage buffer zone (study area shaded purple) (Source: UNESCO)



The Sydney Opera House is also seen in tandem with the SHB from numerous vantage points around Sydney Harbour including (but not limited to) McMahons Point, Mrs Macquarie's Chair, Cremorne Point and Lavender Bay. The existing 1997 AMUs are discernible from these distant views. It is important that new elements on the SHB do not obstruct or diminish the significant views and vistas within the Sydney Opera House buffer zone, or detract from the significant visual qualities of this iconic building.

There are distant views towards the Sydney Opera House from vantage points around Sydney Harbour that also capture the SHB, for example from McMahons Point (refer to Figure 56 below). While the existing 1997 AMUs, comprising two on each chord, are vaguely discernible on the silhouette of the SHB, the distance from the bridge and the percentage of the view that is occupied by the relatively small spatial envelopes of the cranes means that their visual presence in relation to the harbour and the Sydney Opera House is minimal.

Figure 56: View west to the SHB from the Sydney Opera House Western Broadwalk (location of existing AMUs indicated by arrows).



The existing AMUs are discernible on the top chord of the steel arch trusses from the Sydney Opera House, in particular from key vantage points along the Western Broadwalk. The low angle of views of the SHB arched truss structure from this point, however, and the distance of views means that the AMUs are relatively inconspicuous in relation to the overall bridge and harbour setting. It is noted the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction, and are an everyday feature of its function and maintenance within its wider harbour context.

The design of the proposed AMUs has been developed wherever possible to minimise the visual prominence of new elements. When not in operation, the new gantries and AMUs would not exceed the existing spatial envelope of the 1990s cranes, although it is noted that when in operation and 'extended', the new BMUs would have an increased temporary visual impact. Moreover, the scale and form of the proposed AMUs would utilise a truss structure for the gantries and mesh for the platform decks to reduce the visual bulk of new elements. The proposed gantries and associated AMUs as well as new walkways would be 'blended' in colour and materiality to match the surrounding truss structure. Given their scale and distance from the Sydney Opera House, the proposed new walkways would not be visually distinguishable.

Figure 57: View west to the SHB from the Sydney Opera House Western Broadwalk (location of existing AMUs indicated by arrows).

The VIA prepared by DesignInc identifies key views within the Sydney Opera House buffer zone as having 'high' visual sensitivity to the proposal. Analysis of the proposal identified that the visual impact of the proposal from the Western Broadwalk of the Sydney Opera House would be 'low' due to the angle and distance of these views, and the reduction in visual bulk on the top chord skyline compared to the existing crane structures (refer to Figure 58 and Figure 59 below). These findings from the VIA align with this assessment.

Figure 58: View west to the existing AMUs on the SHB from the Sydney Opera House Western Broadwalk as addressed in the VIA (Source: DesignInc 2017).

Opera House– Existing View

Figure 59: View west to the proposed AMUs on the SHB from the Sydney Opera House Western Broadwalk as addressed in the VIA (Source: DesignInc 2017).

Opera House– Proposed View

Overall, the proposal and new AMUs would not detract from or compete with the Sydney Opera House, nor undermine the prominence of this WHL item within its significant harbour setting. The VIA prepared by DesignInc corroborates these findings, and assesses the potential visual impact as being 'low'. Impacts to the views and setting of the Sydney Opera House World Heritage buffer zone are therefore not anticipated.

7.6.2 Other heritage items

Heritage items located near the project area will not be directly affected by the proposed works. The impact of the proposal to heritage items located with the study area are outlined in Table 11.

Table 11: Impact to heritage items within study area

Item name	Physical Impact	Visual impact
Millers Point & Dawes Point Village Precinct	The proposal does not involve any works or interventions that directly affect physical fabric of the SHR listed Millers Point & Dawes Point Village Precinct. The project site is elevated from the ground surface and is located over 25 metres away from the conservation area. Vibration range impacts are therefore not anticipated. **The proposal would result in a <u>neutral</u> physical impact to the Millers Point & Dawes Point Village Precinct.**	There are direct sightlines between the project site (top chords of the main arch structure) and items within the Millers Point & Dawes Point Village Precinct. This includes views from key vantage points in the public domain encompassing Observatory Hill Park and the foreshore walkways along Sydney Harbour near Dawes Point. The proposed removal and upgrading of the AMUs would be visible, but the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction. The relative scale and form of the proposed AMUs is considered to 'blend' with the surrounding character and form of the SHB. This would be accentuated by the oblique angle of views from key localities towards the SHB and proposed AMUs. During operation, the new AMUs would have an increased temporary visual impact, although these are considered negligible in the overall scale of the SHB and its broad context within Sydney Harbour. **The proposal would result in <u>negligible</u> visual impacts to the Millers Point & Dawes Point Village Precinct.**
Millers Point Conservation Area	The proposal does not involve any works or interventions that directly affect physical fabric of the Millers Point Conservation Area. The project site elevated from the ground surface and is located over 25 metres away from the conservation area. Vibration range impacts are therefore not anticipated. **The proposal would result in a <u>neutral</u> physical impact to the Millers Point Conservation Area.**	There are direct sightlines between the project site (top chords of the main arch structure) and Millers Point Conservation Area. This includes views from key vantage points in the public domain encompassing Observatory Hill Park and the foreshore walkways along Sydney Harbour near Dawes Point. The proposed removal and upgrading of the AMUs would be visible, but the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction. The relative scale and form of the proposed AMUs is considered to 'blend' with the surrounding character and form of the SHB. During operation, the new AMUs would have an increased temporary visual impact. **The proposal would result in <u>negligible</u> visual impacts to the Millers Point Conservation Area.**

Item name	Physical Impact	Visual impact
Bradfield Park	The proposal does not involve any works or interventions that directly affect physical fabric of Bradfield Park. The project site elevated from the ground surface and is located over 25 metres away from the park. Vibration range impacts are therefore not anticipated. **The proposal would result in a <u>neutral</u> physical impact to Bradfield Park.**	There are direct sightlines between the project site (top chords of the main arch structure) and Bradfield Park. This includes oblique views from the park at the foreshore at Milsons Point and from the park's western boundary at Alfred Street. Some of these low angle views from nearby vantage points at the approach spans capture prominent views of the AMUs in operation on the facing top chord. The proposed removal and upgrading of the AMUs would be visible, but the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction. The relative scale and form of the proposed AMUs is considered to 'blend' with the surrounding character and form of the SHB. During operation, the new AMUs would have an increased temporary visual impact. **The proposal would result in <u>negligible</u> visual impacts to Bradfield Park.**
North Sydney Olympic Pool	The proposal does not involve any works that directly affect physical fabric of the North Sydney Olympic Pool. The project site elevated from the ground surface and is located over 25 metres away from the item. Vibration range impacts are therefore not anticipated. **The proposal would result in a <u>neutral</u> physical impact to the North Sydney Olympic Pool.**	There are direct sightlines between the project site (top chords of the main arch structure) and North Sydney Olympic Pool. These low angle views from nearby vantage points at the approach spans capture prominent views of the AMUs in operation on the facing top chord. The proposed removal and upgrading of the AMUs would be visible, but the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction. The relative scale and form of the proposed AMUs is considered to 'blend' with the surrounding character and form of the SHB. During operation, the new AMUs would have an increased temporary visual impact. **The proposal would result in <u>negligible</u> visual impacts to the North Sydney Olympic Pool.**

7.7 Statement of Heritage Impact

Table 12 includes a summary assessment of the respectful aspects of the proposal in contrast with the aspects that may have a detrimental impact on the SHB. A summary of the justifications of impacts is also included. This has been prepared in accordance with the guidelines contained within *Statements of Heritage Impact* (OEH, 2001).

Table 12: Summary of impact as per OEH guidelines

Development	Discussion
What aspects of the proposal respect or enhance the heritage significance of Sydney Harbour Bridge and nearby heritage items?	The proposed SHB AMUs Upgrade Project, which would provide state-of-the-art maintenance technology, offers an opportunity to improve accessibility, efficiency and safety of critical maintenance and conservation activities. These works would ensure the longevity of the SHB and enhance the physical character and structural integrity of the bridge, and support its fundamental role as the main traffic network across Sydney Harbour. The proposal has been designed not only to minimise, where feasible, physical impact to significant fabric of the SHB, but also to visually maintain the bridge's character and significant setting. The proposed new movable gantries and AMUs have been designed to be lightweight and as visually unobtrusive as possible. Contained within the envelope of the existing 1997 AMUs when non-operational, they would be matched to blend with the existing material and colour palette of the bridge's steelwork. The design has also been developed to maintain significant views and vistas of the SHB from approaches, at ground level and from vantage points around Sydney Harbour. The proposal would not result in any significant impacts, either physical or visual, to nearby heritage items and heritage conservation areas. This includes neutral or negligible impacts to the World Heritage Buffer Zone of the Sydney Opera House, the Millers Point & Dawes Point Village Precinct, Millers Point Conservation Area, Bradfield Park and the North Sydney Olympic Pool.
What aspects of the proposal could have a detrimental impact on the heritage significance of the Sydney Harbour Bridge and nearby heritage items?	The proposal would result in changes to the form and configuration of the SHB main arch structure, which is of exceptional significance. The proposal would involve removal of significant fabric including original rivets and walkways, and potentially involve drilling additional holes into the original steel plates of the top chords, which in themselves constitute fabric of the SHB that is of high significance. The total removal of the metal walkways would mean that no examples of this original element would be retained on the bridge. The proposal, involving installation of two movable gantries spanning the top chords of the SHB main arch structure, would depart from the familiar design and form of the existing and original AMUs, which have been a familiar component of the bridge's silhouette since its construction. Spanning across the top chords, the new movable gantries and platforms would have a temporary visual impact by obscuring the form of the arch. This particularly relates to legibility of the pattern of steel structural members.
What are the justifications for impact?	The existing AMUs pose limitations on the efficiency, safety and accessibility of critical maintenance activities on the SHB. The proposal's departure from the form and design of the existing and original AMUs reflects an evolution in maintenance technology and activities. These improvements would support the bridge's ongoing use, structural integrity and longevity, and would allow the SHB to be maintained to a high standard as an item of State and National significance. The works and potential impacts to items of exceptional and high significance on the SHB would be balanced by the opportunity of enhancing conservation and maintenance activities on the main arch structure. This would support the significant values, use and structural integrity of the SHB main arch structure, the form and pattern of which is an element of exceptional significance.

Have more sympathetic options been considered and discounted?	Development of the proposal involved consideration of several options and also variations of the current proposed works that are each discussed below. **Option 1** considered the potential to do nothing. While negating potential physical and visual impacts of interventions, this option would not address the problems currently encountered with the existing AMUs, which limit and undermine the accessibility, safety and efficiency of critical maintenance activities. This option was therefore discounted. **Option 2** considered utilisation of scaffolding systems to carry out maintenance activities. While the use of scaffolding would permit increased accessibility to the SHB main arch structure including lateral members and would not involve direct impact to the fabric of the SHB, this option did not address the safety risks associated with erection and removal of scaffolding above live traffic. Additionally, this option would be labour intensive and involve ongoing long-term operational costs. Moreover, the extent and nature of the scaffolding would potentially result in an increased temporary visual impact. This option was therefore discounted. **Option 3** considered utilisation of a gantry system to provide limited access across diagonal bridge members. While explored variations of the option provided increased accessibility, including extendable platforms with rotational attachments, the drawbacks included associated costs and complexity of operations. Of relevance, the gantry systems would require much larger rail systems compared to the proposed AMUs, and would result in increased physical and visual impacts to the SHB main arch structure. This option was therefore discounted. **Option 4** involved the installation of upgraded AMUs. This would option was found to best respond to the objectives of enhancing the efficiency, safety and accessibility of conservation and maintenance activities. While this selected option involves minor to moderate impacts to components of the SHB main arch structure, the overall impact to the SHB as a whole has been assessed as minor and is offset by the opportunity to enhance the bridge's structural integrity and longevity. This option was therefore selected. A variation of the current proposal was considered, whereby the metal walkways on the top chords would be retained in their current location and the new rail for the movable gantries and AMUs would occupy the adjacent inner section of the top chords. This variation, however, was found to potentially undermine the structural integrity of the bridge arches, and was therefore discounted and the current proposal developed.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The SHB and its approaches are listed on the National Heritage List (NHL) and the NSW State Heritage Register (SHR). The proposal is also near several heritage items and heritage conservation areas.

Overall, the impact of the proposal on the SHB would be moderate. The proposal would impact elements of the SHB that are of exceptional significance, with the proposed updated AMUs extending across the full length of the iconic main arch structure. The proposal would result in permanent physical and visual changes to component parts of the main arch structure, including removal of walkways, steel treads, handrails and rivets that are of high significance. The proposal would result in the removal of the existing AMUs, which are of little significance, and installation of two AMUs that would introduce new elements to the SHB. The overall moderate impact of the proposal could be offset by the mitigation measures outlined below.

The proposal, by removing decommissioned elements and installing updated maintenance technology, is considered essential to improve the efficiency, safety and accessibility of critical maintenance and conservation activities on the SHB. This would provide an opportunity to enhance the bridge's ongoing use and longevity. The proposal has been developed, where possible, to minimise the physical impact to significant fabric of the SHB. The design of the proposal has been carefully developed to reduce the visual prominence of the new AMUs and to maintain and enhance the bridge's distinctive character and setting. It has been assessed that the proposal would not degrade, damage, obscure or diminish the national and state heritage values of the SHB, and is consistent with the policies contained in the SHB Conservation Management Plan (CMP) 2007. The proposal is therefore considered acceptable from a heritage perspective.

The proposal would result in negligible visual impacts on nearby heritage items including the Sydney Opera House World Heritage Buffer Zone, the Millers Point & Dawes Point Village Precinct, Millers Point Conservation Area, Bradfield Park and the North Sydney Olympic Pool. The proposal would result in neutral physical impacts to these items. Potential visual impacts could be offset by the mitigation measures outlined in the recommendations below.

The impact to the social values relating to maintenance activities on the bridge was previously impacted significantly by the replacement of the original painting cranes in 1997. Therefore, the removal of the now decommissioned replacement AMUs will have a negligible impact on the social significance of the cranes and gantries and the SHB as a whole. Recommendations regarding interpretation within this report are designed to reintegrate social connections with the maintenance activities and history as a tangible element of the SHB, and are included below.

8.2 Recommendations & mitigation measures

The recommendations set out below will aid in mitigating the impact of the proposal on the SHB and nearby heritage items and heritage conservation areas.

Section 60 application required

The proposal would require a Section 60 application form to be submitted to the NSW Heritage Council, using this document as support for the application.

Material palette

The materials utilised in new works as part of the proposal would be congruent with the aesthetic character of the SHB and surrounding fabric. This includes selection of modern and lightweight materials that are, where appropriate, coloured to match the existing fabric of the SHB including existing steelwork tones of the overall bridge structure. The material palette of the proposal would be consistent with other SHB related projects.

Design of elements to minimise visual impact

Where feasible, works would be designed to reduce the visual prominence of new elements along the top of the main arch structure. This involves employment of appropriate modern and lightweight designs that seek to reduce the visual 'bulk' of new structures. Any associated infrastructure regarding upgrades to the AMUs would be sensitively designed and integrated, and wherever possible kept to a minimum to avoid introducing new visual elements to the SHB. This will assist in reducing potential visual impact on significant views and to surrounding heritage items.

Archival Recording

Prior to removal of the 1997 AMUs and metal walkways on the top chords of the SHB main arch structure, a Photographic Archival Recording (PAR) would be prepared for these items. The report would consist of an archival standard photographic record of the site, noting the location and details of the items as well as demonstrating the overall setting within the SHB. The recording shall be undertaken in accordance with the guidelines for *Photographic Recording of Heritage Items Using Film or Digital Capture* prepared by the NSW Office of Environment & Heritage. The PAR would be submitted to North Sydney Council and the City of Sydney Council, and copies would be retained as per the standards.

The 1997 AMUs and metal walkways would be archived and recorded on the Roads and Maritime Heritage and Conservation Register.

Sensitive design of new walkways

The installation of new walkways on the outer edges of the top chords of the bridge arches would be sensitively designed to match and complement the physical character of the SHB main arch structure, while being distinguishably new elements. The walkways would be lightweight in construction and colour matched to the surrounding steelwork. This includes careful design of the walkway railings to minimise the width and bulk of structural elements. As covered above, installation of walkways would, wherever possible, utilise existing attachment points from removed rivets to minimise impact to the original steel plates.

Minimise additional drilling to original steel plates

In order to retain and respect the integrity of the significant fabric of the SHB, drilling additional holes into the original steel plates of the bridge would, wherever possible, be minimised. Where the proposal requires removal of external rivets on the top chords, the existing attachment points would be used for installation of new infrastructure i.e. new rails for upgraded AMUs, new walkways etc. Wherever possible, new bolt fixings that are introduced would be capped and painted to match existing.

Parking strategy for new AMUs

A parking strategy would be prepared and implemented to reduce potential visual impacts. When non-operational and when maintenance activities are not being carried out, the gantries would be 'parked' across horizontal members on the lower rises of the SHB main arch structure, with the AMUs

'folded' inside the base. This will assist in maintaining the legibility of the SHB main arch structure including the significant form and pattern of the steelwork, and significant views and setting of the SHB.

Interpretation strategy

There is an opportunity for provision of interpretation measures outlining the history, evolution and significance of the SHB including the evolution of maintenance technology and activities to the people that use the bridge. This particularly relates to pedestrians using the walkway on the eastern side of the SHB and the entry/exit points to the SHB. Two of the original 1930s painting cranes have been conserved. It is understood that while one of these cranes is on permanent loan to the National Museum of Australia, Roads and Maritime are currently in the process of exploring potential display opportunities for the second crane. Further investigation could also be given to the reuse of removed rivets as part of the proposal for interpretive purposes.

The proposal presents an opportunity to build on the mitigation measures previously undertaken, and for the interpretation of the maintenance activities on the bridge as part of an overall interpretation of the history of the bridge to be conveyed. In order to avoid a 'piecemeal' approach to interpretation, which could potentially obscure or undermine the significant values of the SHB, interpretation would be approached holistically and be directed by an Interpretation Strategy. This would consider interpretation opportunities in the context of other relevant SHB projects.

Cumulative impact

The cumulative impact of the proposal in relation to other SHB related projects would be considered. This includes ensuring minimisation of physical impact to significant fabric of SHB, consistency in the design, style, aesthetic character and material palette of works relating to the SHB, and a coordinated approach to provision of interpretation. Compliance of projects with the *Sydney Harbour Bridge Conservation Management Plan* will assist in ensuring consistency across SHB projects and retention and potential enhancement of the significant values of this item.

Protection of significant SHB fabric

The proposal involves works in close proximity to significant fabric of the SHB main arch structure. In particular, this includes the steelwork of the trusses, lateral bracing and hangers. These significant components of the SHB would be appropriately protected for the duration of the installation period to minimise potential physical impact, particularly relating to removal of rivets and the installation of the proposed AMUs and associated infrastructure by crane.

Heritage induction for workers

In order to retain and respect the national and state heritage values of the SHB, a heritage induction would be provided for all workers prior to works commencing.

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10.0 APPENDICES

Appendix A

Assessment of significance tables

Millers Point & Dawes Point Village Precinct

Significance assessment for Millers Point & Dawes Point Village Precinct against the SHR assessment criteria

Criterion	Explanation
	Millers Point & Dawes Point Village Precinct is of state significance for its ability to demonstrate, in its physical forms, historical layering, documentary and archaeological records and social composition, the development of colonial and post-colonial settlement in Sydney and New South Wales. The natural rocky terrain, despite much alteration, remains the dominant physical element in this significant urban cultural landscape in which land and water, nature and culture are intimately connected historically, socially, visually and functionally. The close connections between the local Cadigal people and the place remain evident in the extensive archaeological resources, the historical records and the geographical place names of the area, as well as the continuing esteem of Sydney's Aboriginal communities for the place. Much (but not all) of the colonial-era development was removed in the mass resumptions and demolitions following the bubonic plague outbreak of 1900, but remains substantially represented in the diverse archaeology of the place, its associated historical records, the local place name patterns, some of the remaining merchants villas and terraces, and the walking-scale, low-rise, village-like character of the place with its central 'green' in Argyle Place, and its vistas and glimpses of the harbour along its streets and over rooftops, the sounds of boats, ships and wharf work, and the smells of the sea and harbour waters.
A – Historical Significance	The post-colonial phase is well represented by the early 20th century public housing built for waterside workers and their families, the technologically innovative warehousing, the landmark Harbour Bridge approaches on the heights, the parklands marking the edges of the precinct, and the connections to working on the wharves and docklands still evident in the street patterns, the mixing of houses, shops and pubs, and social and family histories of the local residents. Millers Point & Dawes Point Village Precinct has evolved in response to both the physical characteristics of its peninsular location, and to the broader historical patterns and processes that have shaped the development of New South Wales since the 1780s, including the British invasion of the continent; cross-cultural relations; convictism; the defence of Sydney; the spread of maritime industries such as fishing and boat building; transporting and storing goods for export and import; immigration and emigration; astronomical and scientific achievements; small scale manufacturing; wind and gas generated energy production; the growth of controlled and market economies; contested waterfront work practises; the growth of trade unionism; the development of the state's oldest local government authority the City of Sydney; the development of public health, town planning and heritage conservation as roles for colonial and state government; the provision of religious and spiritual guidance; as inspiration for creative and artistic endeavour; and the evolution and regeneration of locally-distinctive and self-sustaining communities. The whole place remains a living cultural landscape greatly valued by both its local residents and the people of New South Wales. (HO)

Criterion	Explanation
B – Associative Significance	Millers Point & Dawes Point Village Precinct is of State significance for its many associations with many women and men significant in the history of NSW. These include the Cadigal people of the area; Colbee, a Cadigal 'leading man' in the 1790s; Lt William Dawes, first colonial astronomer (commemorated in the place-name Dawes Point); Jack 'the miller' Leighton, wind mill owner; William Walker, merchant; Henry Moore, merchant; Robert Towns, merchant; Norman Selfe, engineer; Sisters of St Joseph, Catholic nuns at St Brigit's; the 'Millers Point Push', gangsters of the Point; Ted Brady, wharf labourer, ALP and Communist Part stalwart; Arthur Payne, first sufferer of the Plague in 1900; William Morris Hughes, union leader and later prime minister; RRP Hickson, chairman Sydney Harbour Trust; Waterside Workers Federation (WWF), union established in 1902; Jim Healy, general secretary WWF 1937-1961; Harry Jensen, Lord Mayor of Sydney 1957-1965; and the multi-generational 'Pointer' families that give the Precinct its distinctive social character.
C – Aesthetic Significance	Millers Point & Dawes Point Village Precinct is of state significance for its landmark qualities as a terraced sandstone peninsula providing an eastern 'wall' to the inner harbour and supporting the fortress-like southern approaches to the Sydney Harbour Bridge; for its aesthetic distinctiveness as a walking-scale, low-rise, village-like harbourside district with its central 'green' in Argyle Place, and its vistas and glimpses of the harbour along its streets and over rooftops, the sounds of boats, ships and wharf work, and the smells of the sea and harbour waters; as well as for the technical innovations evident in the remoulding of the natural peninsular landform from the hand-picked Argyle Cut to the ongoing levelling and terracing of the western slopes to the highly planned and mechanically created Walsh Bay and Darling Harbour docklands of the 20th century. The Precinct has long been a source of creative inspiration, being imaginatively depicted by painters such as Joseph Fowles, James Taylor, Frederick Gosling, Eugene Delessert, Rebecca Hall, Samuel Elyard and John Rae in the mid-19th century and Lionel Lindsay, Sydney Long and Harold Greenhill in the early to mid-20th century; by photographers such as Johann Degotardi and Bernard Holtermann in the 1870s, John Harvey and Melvin Vaniman in the early 20th century, and Harold Cazneaux and Sam Hood in the 1930s; as well as being cartographically rendered by colonial map makers such as Dawes (1788), Lesueur (1802), Meehan (1807) and Harper (1823) and later engravers such as those working for Gibbs Shallard (1878) and the Illustrated Sydney News (1888). The whole precinct demonstrates a range of technologies and accomplishments dating from the period 1820s to 1930s; this relates to landscaping, residential dwellings, industrialisation, public areas, warehousing, maritime and religious structures. Millers Point is an intact example of early twentieth century shipping facilities and transport technology. It has a range of architectural styles that are both intact and excellent examples of their type, many of which are rare surviving shops and dwellings, with specific importance attributed to the Observatory, Fort Street School, and Holy Trinity Church, as well as colonial housing, hotels, and commercial amenities. It demonstrates characteristic dramatic harbourside topography that has been modified for human purposes, boasting extensive views, and is regarded as a complete and cohesive area due to contributory materials, form and scale, with clear definition brought about through the location of the Sydney Harbour Bridge and Bradfield Highway, Walsh Bay and Darling Harbour.
D – Social Significance	Millers Point & Dawes Point Village Precinct is significant through associations with a community in NSW for social, cultural and spiritual reasons. A proportion of the existing population is descended from previous generations of Millers Point locals, and has fostered a strong and loyal sense of community and solidarity. The preservation of the physical and social components of Millers Point has both provided insight into, and ensured the continuity of, early twentieth century inner Sydney lifestyles. The post-resumption phase of its history shows the establishment of social and public works, with building improvements brought about through the suburb's consolidation as a company port town. The role of the Sydney Harbour Trust entailed the construction of worker housing and support services, and the improvement in existing building stock and amenities. The modern Millers Point community is still administered under a similar arrangement with the Department of Housing, with a proportion of the area held as public domain and private ownership. It retains evidence of educational and social

Criterion	Explanation
	improvement programmes carried out at church and school sites such as St Brigid's School and the Fort Street School. Additional traces of spiritual contribution and social relevance relates to the Anglican Holy Trinity (Garrison) Church and the Catholic-based St. Brigid's Church and school, which remains a centre catering for the Irish working class community.
E – Research Potential	Millers Point & Dawes Point Village Precinct is of state significance for its potential to yield information from its archaeological resources not readily available elsewhere. The building and archaeological fabric of the place has remained intact through community opposition to redevelopment, resulting in a large number of sites within the locale that remain comparatively or minimally undisturbed. This physical evidence of the area's history is complemented by the wealth of oral history contained within the existing resident population, which is a rare resource that allows a greater opportunity to understand the historic role of Millers Point and its social frameworks
F – Rarity	Millers Point & Dawes Point Village Precinct is of state significance as a rare, if not the only, example of a maritime harbourside precinct that contains evidence of over 200 years of human settlement and activity that spans all historical phases in Australia since 1788. While there are other historical maritime precincts in Australia that might show a comparable mix of historical and contemporary values, none are as old or so intimately associated with the spectrum of historical, social, aesthetic, technological and research values that have shaped Australian society since 1788. The precinct is conceivably unique in Australia because of a strong sense of cohesion facilitated by a range of complementary architectural, structural, physical and social elements. The maintenance of both original fabric in a more or less intact state, and the successive generations of Millers Point residents, allows for a degree of rarity and authenticity that is unmatched on a national scale. In conjunction with these key features, Millers Point has the earliest above-ground archaeological evidence from the colonial period, has significant structures, and has in close proximity a range of shipping and wharf structures that are believed to be of international significance. Finally, it has a range of early buildings with specific functions that are rare within the Australian context, such as the Lord Nelson Hotel and the Observatory
G – Representativeness	Millers Point & Dawes Point Village Precinct is of state significance for its ability to demonstrate the principle characteristics of 19th and 20th century Australian maritime harbourside or dockland precincts, such as a close proximity between workplace and work residence; the development of new methods for moving produce and passengers between land and water; interaction between natural elements such as water and wind and cultural elements such as wharves, boatyards and warehouses; and the constant remaking of the shoreline and its hinterland in response to changing economic, social, political and environmental factors in order for it to remain viable as a living, working place. The precinct typifies the nineteenth and twentieth century residential and maritime environments through the retention of a range of architectural styles and buildings. It contains good examples of both domestic and commercial Australian building forms, including a clearly discernible staged evolution of housing progression of housing from the Ark on Kent Street to early twentieth century Australian Edwardian terrace houses. Similarly, the social and public nature of neighbourhood hotels and corner shops can be identified as typical of nineteenth century social spaces. The retention of such structures are demonstrative of the earlier 'everyday' environment of Millers Point, with the combination of formerly commonplace buildings within a distinct space making the representative nature of Millers Point of extremely high standard

Millers Point Heritage Conservation Area

Significance assessment for the Millers Point Heritage Conservation Area against the SHR assessment criteria

Criterion	Explanation
A – Historical Significance	The area was occupied by the Cadigal, Wangal, Borogegal and Gameragal clans. The Precinct retains some of these clans place names and is illustrated by several early colonial artists and cartographers in its pre-colonial landform and vegetation, sometimes with Aboriginal people in view, making it one of the oldest places on the continent so depicted. There is evidence that there were Aboriginal people using Millers Point until at least the 1840s.• Millers Point & Walsh Bay Special Area is of state significance for its ability to demonstrate, in its physical forms and associated documentary evidence, over 200 years of European settlement – making it one of a few sites in Australia to display the oldest such continuum of evidence on one site since the beginning of British colonisation in 1788. The elevated height, abundance of sandstone and long shoreline of Aboriginal middens along Darling Harbour was important in encouraging industrial, commercial and defence activities in the area. British settlement in the area began with the first colonial fortifications, then the development of wharves and dock facilities and their associated housing. The outbreak of the Plague in 1900 and the consequent mass-resumption of the area and its large-scale rebuilding during the early 20th century was a significant period. It was followed with the development of waterside trade, underlain by a continuing separation from the rest of the City of Sydney by topography and social differentiations to the present day. All of these historical phases remain evident in the area. The area is of state and national significance due to its unique characteristics, composition, architectural diversity and its continuity of nineteenth and twentieth century residential and maritime elements. It is a living community with clearly discernible links to the maritime industries that formed the village's core from the early part of the nineteenth century, and one that has long-term memories of the precinct's fabric and relevance. Its architecture is representative of each decade from the 1820s to the 1930s, with many structures of excellent aesthetic, technical or rare value. The street pattern of this suburb demonstrates both early nineteenth century transport routes, early haphazard development and replanning and urban design in the latter part of the nineteenth century. Further, it provides evidence of early twentieth century government policy, with large portions of the landscape re-shaped in response to the bubonic plague health crisis and through resumption by the State government. It features, virtually intact, residential areas, port and stevedoring works created by the Sydney Harbour Trust, 1900 1930, in response to the Sydney plague and the requirements of maritime trade at that time Millers Point contains dwellings, shops, businesses, warehouses,, churches, schools, institutions and related maritime structures that remain closely affiliated to the community today in a meaningful fashion. The area contains both private and government controlled components that merge seamlessly into a cohesive whole. An important feature of the area is the circular stone excavation for the Cahill Expressway that separated the school grounds from observatory hill and from the National Trust Centre (former school buildings) as it marks a phase of development of the city where the whole of the Millers Point area was at considerable risk of loss through new planning policies and development. The National Trust Centre (and associated buildings) are significant as part of the first 'model school' of the Board of Education, established in Sydney during the mid 1850s and also as a remnant of the first military hospital. The buildings have had a lengthy association with a variety of historically important persons and organisations and are significant as a design of the colony's first Schools Architect, Henry Robertson. The buildings are a remnant of the first Military Hospital. They have historic significance at a State level.

Criterion	Explanation
	The Observatory's dominant location beside and above the port town, and later, city of Sydney, made it the site for a range of changing uses. All of these were important to, and reflected changes in the development of the colony.
B – Associative Significance	Millers Point is of State significance for its many associations with many women and men significant in the history of NSW. Indigenous Cadigal people of the area; Colbee, a Cadigal 'leading man' in the 1790s; Non Indigenous Jack 'the miller' Leighton, wind mill owner; William Walker, merchant; Henry Moore, merchant; Robert Towns, merchant; Sisters of St Joseph, Catholic nuns at St Brigit's; the 'Millers Point Push', gangsters of the Point; Ted Brady, wharf labourer, ALP and Communist Part stalwart; Arthur Payne, first sufferer of the Plague in 1900; William Morris Hughes, union leader and later prime minister; Waterside Workers Federation (WWF), union established in 1902; • Jim Healy, general secretary WWF 1937-1961; Harry Jensen, Lord Mayor of Sydney 1957-1965; 'Pointer' families that give the Precinct its distinctive social character; Colonial merchant class, represented by ownership of Bligh House (43 Lower Fort St) know also as 'Clydebank' by the Campbell family which Robert Crawford, Principal Clerk to Alexander Macleay lived in; Later merchant class who invested in major warehouses (Towns and Parbury); Prominent Sydney citizens of the mid nineteenth century such as John Fairfax of the Sydney Morning Herald who enjoyed the proximity to the town. (The relatively modest scale of the houses at Miller's Point, and the relative importance of its pre 1870 inhabitants reflects the economic circumstances and the aspirations of the citizens of the town of Sydney); 1880s property investors who built substantial rows of terrace houses of which 1-19 Lower Fort Street is the finest in Miller's Point, and the grandest surviving terrace in New South Wales; • Publicans, as key civic figures, for example, the Armstrong family of the Palisade Hotel; the Irish community, as a major social group, Significant architects and their work: H. Ginn & E. Blacket : Holy Trinity Church; W. L. Vernon : Post Office; A. Dawson : Observatory; J. Watts and M. Lewis : Fort Street School (also H. Robertson); M. Lewis : Richmond Villa, Kent Street (moved from Domain c.1975); J. Verge : 39 41 Lower Fort Street; G. McRae : 1910s workers' housing; V. Parkes : proposals c.1910 to Sydney Redevelopment Advisory Board for new hygienic tenaments between Argyle Place and Windmill Street; W. Wardell : Grafton Bond Store, Members of the Sydney Harbour Trust Board: RRP Hickson, chairman Sydney Harbour Trust Artists, and the discovery of the pictorial qualities of Australia including urban squalor, waterfront incident and the harbour bridge: Prout and Rae 1840s in Sydney Illustrated; S. Elyard 1860s; Lindsay family c.1900; W. Hardy Wilson c.1910;Cazneaux c.1920; Dorrit Black c.1930. The Observatory has an association with an extensive array of historical figures, most of whom have helped shape its fabric. These include colonial governors, military officers and enginers, convicts, architects and astronomers (Kerr 1991: 39)
C – Aesthetic or Technical Significance	Millers Point is of state significance for its landmark qualities as a terraced sandstone peninsula providing an eastern 'wall' to the inner harbour and supporting the fortress-like southern approaches to the Sydney Harbour Bridge; for its aesthetic distinctiveness as a walking-scale, low-rise, village-like harbourside district with its central 'green' in Argyle Place, and its vistas and glimpses of the harbour along its

Criterion	Explanation
	streets and from escarpments, as well as for the technical innovations evident in the remoulding of the natural peninsular landform from the hand-picked Argyle Cut to the ongoing levelling and terracing of the western slopes.. The area contains numerous original and characterful views to and from the harbour that are formed by a combination of dramatic topography and long physical evolution. It is the extent, the expansiveness, the change of view of individual buildings as the viewer moves around the water that gives the place distinction and significance. The area is distinctive in that the escarpment edge is sharply defined by rock faces, concrete walls and vertical barriers that separate it from the waterfront. The area is distinctive in that it has no single character but is made up of contrasts; juxtapositions of often disparate elements such as the stark edge of cliff or wall against the softer park or walkway; redefined and rebuilt wharf structures with new gently uses that belie their history, stylistically defined period of housing development that follows a well established pattern of small lot housing now contrasted with modern apartment/warehouse style dwellings. The variety, complexity and scale of views from the wharfs, observatory hill, from roadways, edges of escarpments and walls are significant in defining the character of the area. The area is significant as aside from the southern edge of the precinct it is not overpowered by city scale development. The area contains numerous streets and lanes of historical and aesthetic interest. The area contains numerous features such as steps, fences, rock cuttings of historical and aesthetic interest. The value of the area is further enhanced by its separation from the Rocks precinct which is predominantly commercial in use with Millers Point retaining its residential character, in particular worker housing. This is a rare continuing use. The character of the area is almost defined on a street by street basis rather than a broad precinct basis. With very few exceptions every element of the precinct contributes to the whole in a significant way. The area has long been a source of creative inspiration, being imaginatively depicted by painters such as Joseph Fowles, James Taylor, Frederick Gosling, Eugene Delessert, Rebecca Hall, Samuel Elyard and John Rae in the mid-19th century and Lionel Lindsay, Sydney Long and Harold Greenhill in the early to mid-20th century; by photographers such as Johann Degotardi and Bernard Holtermann in the 1870s, John Harvey and Melvin Vaniman in the early 20th century, and Harold Cazneaux and Sam Hood in the 1930s; as well as being cartographically rendered by colonial map makers such as Dawes (1788), Lesueur (1802), Meehan (1807) and Harper (1823) and later engravers such as those working for Gibbs Shallard (1878) and the Illustrated Sydney News (1888). The area has a range of architectural styles that are both intact and excellent examples of their type, many of which are rare surviving shops and dwellings, with specific importance attributed to the Observatory, Fort Street School, Holy Trinity Church and Millers Point Post Office, as well as colonial housing, hotels, and commercial amenities. It demonstrates characteristic dramatic harbourside topography that has been modified for human purposes, and is regarded as a complete and cohesive area due to contributory materials, form and scale, with clear definition brought about through the location of the Sydney Harbour Bridge and Bradfield Highway, Walsh Bay and Darling Harbour. It demonstrates technical and creative excellence of the period 1820 to 1930, including, warehousing, civic facilities and landscaping, the observatory, hotels, public housing and its support facilities, colonial housing and the Garrison Church buildings. This is contrasted with modern apartment/warehouse style dwellings and the redeveloped wharves. The National Trust Centre (and associated buildings) are significant for their sequential development initially as a Military Hospital and then as an educational institution throughout the last half of the nineteenth century. They have aesthetic significance at a State and local level.

Criterion	Explanation
	The elevation of the Observatory site with its harbour and city views and vistas framed by the mature fig trees of the surrounding park, make it one of the most pleasant and spectacular locations. • The Observatory picturesque Italianate character and stylistic interest of the observatory and residence building, together with the high level of competence of the masonry (both stone and brick) of all major structures on the site, combine to create a precinct of unusual quality. (Kerr 1991: 39)
D – Social Significance	Millers Point is of state significance for its potential to yield information from its archaeological resources not readily available elsewhere including oviform drains, early kerb and guttering, woodblock or other features that remain extant in Millers Point. The changing domestic life of the residents has been documented in several excavations of residential sites; The area contains examples of buildings demonstrating each stage and every major component in the history of the suburb, the only exception being for the period 1788-1820. The building and archaeological fabric of the place has remained intact through community opposition to redevelopment, resulting in a large number of sites within the locale that remain comparatively or minimally undisturbed. The physical evidence of the area's history is complemented by the wealth of oral history contained within the existing resident population, which is a rare resource that allows a greater opportunity to understand the historic role of Millers Point and its social frameworks. The Sydney Observatory continues a tradition of astronomical research that began with the first observatory on Dawes Point in 1788. The changing defences of Sydney are also evident in the areas archaeological resources, notably at the site of Fort Phillip. Underlying this diverse potential for researching changing human occupation is also the potential for the peninsular landform itself, constantly shaped and re-shaped by human agency, to yield information on the abilities of the people of NSW to continue to craft cultural landscapes of strong aesthetic appeal. The surviving structures, both above and below ground, are themselves physical documentary evidence of 195 years of changes of use, technical development and ways of living. As such they are a continuing resource for investigation and public interpretation. (Kerr 1991:39) Millers Point layered fabric, both in terms of structures and archaeology, has had relatively little disturbance since intervention by the Sydney Harbour Trust and has the potential to provide valuable evidence about the place and its community.
E – Research Potential	Evidence from an archaeological excavation at Moore's Wharf when it was moved showed continuing indigenous occupation at least until the 1830s and it is possible other such sites exist. Millers Point is of state significance for its potential to yield information from its archaeological resources not readily available elsewhere including oviform drains, early kerb and guttering, woodblock or other features that remain extant in Millers Point. The changing domestic life of the residents has been documented in several excavations of residential sites; The area contains examples of buildings demonstrating each stage and every major component in the history of the suburb, the only exception being for the period 1788-1820. The building and archaeological fabric of the place has remained intact through community opposition to redevelopment, resulting in a large number of sites within the locale that remain comparatively or minimally undisturbed. The physical evidence of the area's history is complemented by the wealth of oral

Criterion	Explanation
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F - Rarity	Natural Heritage Millers Point is an important area in the Sydney City LGA, and its prominence is emphasised by its strong topography, particularly as viewed from the Harbour. Non indigenous Millers Point is of state significance as a rare, if not the only, example of a maritime harbourside precinct that contains evidence of over 200 years of human settlement and activity that spans all historical phases in Australia since 1788. While there are other historical maritime precincts in Australia that might show a comparable mix of historical and contemporary values, none are as old or so intimately associated with the spectrum of historical, social, aesthetic, technological and research values that have shaped Australian society since 1788. The area is one of a few unique sites in Australia because of a strong sense of cohesion facilitated by a range of complementary architectural, structural, physical and social elements. The maintenance of both original fabric in a more or less intact state, and the successive generations of Millers Point residents, allows for a degree of rarity and authenticity. Millers Point has significant structures, and has in close proximity a range of shipping and wharf structures that are believed to be of international significance. The area has a range of early buildings with specific functions that are rare within the Australian context, such as the Lord Nelson Hotel and the Observatory. Its unity, authenticity of fabric and community, and complexity of significant activities and events make it a significant historic urban place in Australia. The National Trust Centre (and associated buildings) are rare surviving example of modifications to an Old Colonial Georgian hospital building for use as a mid-nineteenth century school.
G – Representativeness	Millers Pont is of state significance for its ability to demonstrate the principle characteristics of 19th and 20th century Australian maritime harbourside or dockland precincts, such as a close proximity between workplace and work residence; the development of new methods for moving produce and passengers between land and water; interaction between natural elements such as water and wind and cultural elements such as wharves, boatyards and warehouses; and the constant remaking of the shoreline and its hinterland in response to changing economic, social, political and environmental factors in order for it to remain viable as a living, working place. The area typifies the nineteenth and twentieth century residential and maritime environments through the retention of a range of architectural styles and buildings. It contains good examples of both domestic and commercial Australian building forms,

Criterion	Explanation
	including a clearly discernible staged evolution of housing progression of housing from the Ark on Kent Street to early twentieth century Australian Edwardian terrace houses. The social and public nature of neighbourhood hotels and corner shops can be identified as typical of nineteenth century social spaces. The retention of such structures are demonstrative of the earlier 'everyday' environment of Millers Point, with the combination of formerly commonplace buildings within a distinct space making the representative nature of Millers Point of extremely high standard. The National Trust Centre (and associated buildings) are representative as fine examples of the Victorian Regency and Victorian Free Classical styles as used in public school buildings in the mid-nineteenth century

Bradfield Park (including northern section)

Table 12: Significance assessment for Bradfield Park (including northern section)

Criterion	Explanation
F – Rarity	This item is assessed as historically rare statewide. This item is assessed as aesthetically rare statewide. This item is assessed as socially rare statewide.
G – Representativeness	This item is assessed as historically representative regionally. This item is assessed as aesthetically representative locally. This item is assessed as socially representative locally.

North Sydney Olympic Pool

Table 13: Significance assessment for North Sydney Olympic Pool

Criterion	Explanation
F – Rarity	This item is assessed as historically rare statewide. This item is assessed as aesthetically rare statewide. This item is assessed as socially rare statewide.

Appendix B

DesignInc, December 2017. 'Sydney Harbour Bridge Arch Crane & Walkways Replacement: Urban Design Report including Landscape Character and Visual Impact Assessment'

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NSW Roads and Maritime Services

Sydney Harbour Bridge (SHB)
Arch Crane & Walkways Replacement
Urban Design Report including Landscape Character and Visual Impact Assessment (VIA)

Project	P17-112
Revision	B
Date	12 December 2017

Document Control Record

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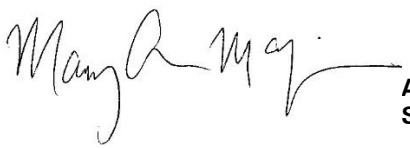
Document Control

Report Title	Sydney Harbour Bridge Crane VIA					
Project #	P17-112	**Document Name**	Visual Impact Assessment			
Client	NSW Roads and Maritime	**Client Contact**		Jonathan Donnelly		
Rev	**Date**	**Revision Details**	**Prepared By**	**Author**	**Verifier**	**Approver**
A	28 November 2017	DRAFT For Review	Mary Anne McGirr	Mary Anne McGirr	Ian Armstrong	Ian Armstrong
B	12 December 2017	FINAL	Mary Anne McGirr	Mary Anne McGirr		

Approval

Author Signature		**Approver Signature**	
Name	Mary Anne McGirr	**Name**	Ian Armstrong
Title	Principal	**Title**	Director

Contents

SHB Arch Crane & Walkways Replacement VIA

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SHB Arch Crane & Walkways Replacement VIA

1. Background

The Sydney Harbour Bridge is one of the most iconic landmarks of Sydney, servicing rail, cyclists, pedestrians and over 160,000 vehicles a day. The bridge connects almost a quarter of a million people a day to the northern and southern shores of Sydney Harbour. A program of works exists to ensure the value and character of the bridge is maintained as it adapts to changing needs and constraints.

…"The Sydney Harbour Bridge links Sydney's two major commercial centres and forms a daily orientation point for millions. It is a living landmark, a tourist experience and an essential transport line for Sydneysiders…It is a cultural landscape that people actively experience: driving, walking, sailing, flying, cycling, ferry and train commuting, as well as passively observe – from the foreshores, from a distance, as a distinctive landmark – or examine in detail as a marvel of engineering technology…"

Sydney Harbour Bridge Interpretation Plan, Draft Discussion Paper.
Report prepared for the Roads and Traffic Authority,
NSW September 2006 by Godden Mackay Logan Pty Ltd Heritage Consultants

Roads and Maritime Services (RMS) is proposing to replace four existing arch maintenance units (AMUs) on the Sydney Harbour Bridge with new bridge maintenance units. The new bridge maintenance units are needed to provide maintenance workers with safe and effective access to the full bridge arch, including the lateral members. The objectives of the proposal are to:

- Provide safe and efficient access for maintenance works to all steel members above the road deck.
- Provide a certified installation which is laid out in such a way that it maximises safety and ease of use for operators.
- Provide a system that minimises ongoing costs associated with the routine maintenance, component replacement and certification of the systems.
- Provide access systems which are located on the top chord members and maintains the heritage aspects of the bridge; through minimising visual impact, and providing a sympathetic visual appearance.
- Provide access systems that facilitate safe rescue procedures.

The proposal includes:

- Removal of existing arch maintenance units (AMUs).
- Removal of existing metal stairways on top chords of bridge arches, and relocation of stairs to outer section of the top chords.
- Installation of rail sections in the location of the current stair over the entire length of both top chords of bridge arches.
- Installation of two bridge maintenance units (each consisting of a gantry and two 'roof cars').

This proposal replaces an alternative proposal previously approved for slightly larger AMU structures under an exemption to the requirements of the Heritage Act (1977). This study takes into consideration this previous approval.

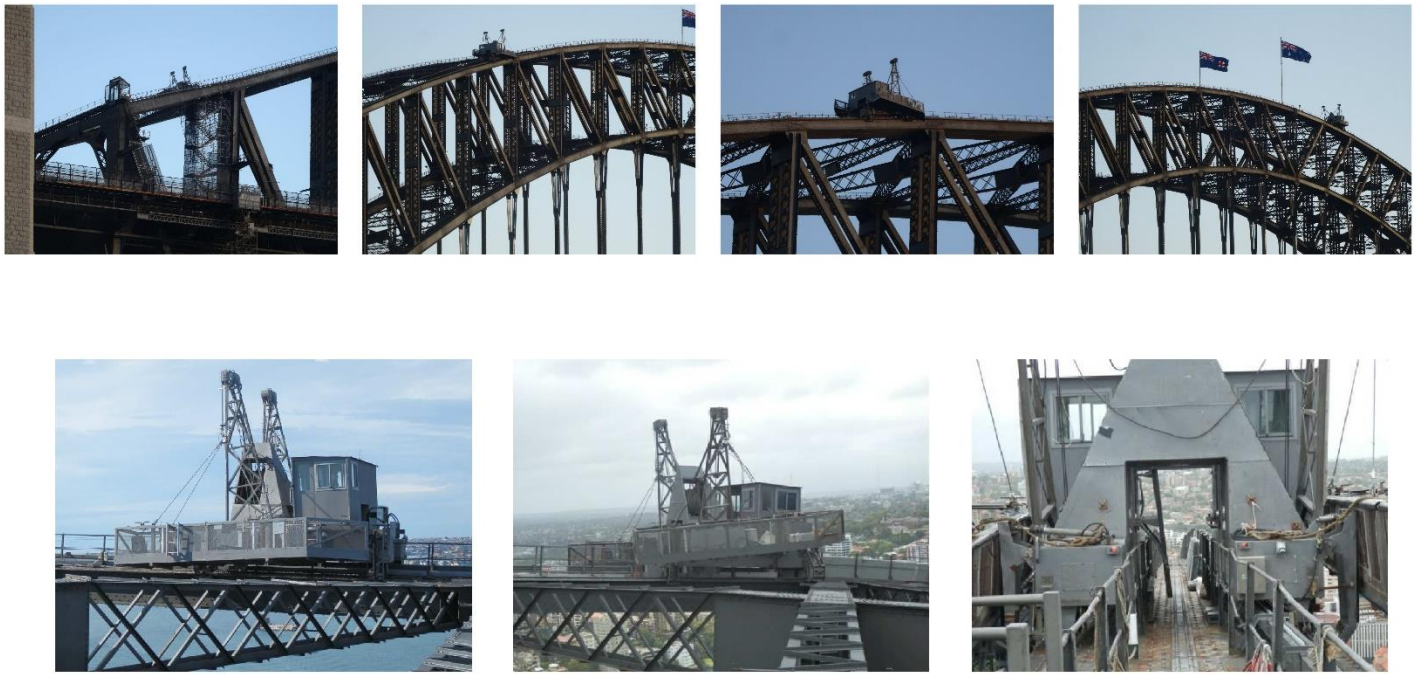

Figure 1 Existing arch maintenance units Image: ARUP

1.1 Purpose of this Report

This report presents a Landscape Character, Visual Impact Assessment and Urban Design Study for the replacement of the Sydney Harbour Bridge Arch Cranes and Walkways ('The Proposal'). It has been prepared for Roads and Maritime Services by DesignInc Sydney Pty Ltd. Separate to this Study, Artefact Pty Ltd has been engaged to prepare a Statement of Heritage Impact (SOHI) which along with this study will support the Review of Environmental Factors (REF) being prepared by RMS. The SOHI and the Landscape Character and Visual Impact Assessment have been undertaken iteratively to ensure a proposal with the greatest benefit and least impact.

The objectives of the study are to:

- Develop and present an integrated engineering and urban design outcome that:
  - » Fits sensitively into the built, natural and community environments in which it sits, is well designed and contributes to the character and functioning of the area.
  - » Contributes to the overall quality of the public domain for the community and all road users.
- Carry out a succinct landscape character and visual impact assessment, the results of which are iteratively fed into the concept development process and environmental assessment.
- Develop and report on improvements to the concept design for the project being developed concurrently by the engineering contractor, giving guidance to the project team about ways to integrate the proposal into its setting and minimise visual impact.

1.2 Study Methodology

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

1. Contextual Analysis.
2. Landscape Character Assessment.
3. Visual Impact Assessment.
4. Proposed Urban Design Objectives and Principles and Concept Design Development.
5. Mitigation Recommendations.

The methodology used in this Landscape Character and Visual Impact Assessment is based on the Roads and Maritime Service EIA Practice Note EIA-N04: Guidelines for landscape character and visual impact assessment. The methodology in the guidance note has been modified to suit the characteristics and requirements of this particular proposal.

1.2.1 Contextual Analysis

A succinct summary is provided of the contextual analysis of the built, natural and community character, structure and functioning of the study area, identifying landscape character zones and issues/ opportunities. The analysis includes brief descriptions, photographs and expert analysis as appropriate. It is noted that it was determined by the Project Team that there would be only one landscape character zone to consider.

1.2.2 Landscape Character Assessment

This task involves photographing, understanding, mapping and describing the identified landscape character zone and determining and describing the capacity of this zone to visually absorb the Proposal. The Landscape Character Zone identified for the Study is mapped and described in Section 2.

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

– 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 Service Environmental Impact Assessment Guidance Note 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 Service, 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 Service, EIA-N04, p.9).

In this instance, the capacity to absorb change is primarily dependent on landform, existing structures and cultural significance. The more culturally or heritage significant the landscape zone, the greater the consequence of introducing new development and therefore the higher the sensitivity of the zone. A precinct with a coherent character, for example the Sydney Harbour Bridge, would be more visually sensitive to new development than a precinct whose topography and natural and/or built character has greater variety.

The magnitude of a proposal in a landscape character zone depends firstly on the scope of that proposal. Replacement of existing structures would typically have a lesser magnitude than insertion of new elements. The location of the proposal in relation to the character zone also influences magnitude. Four 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	High - Moderate	Moderate	Negligible
Moderate	High - Moderate	Moderate	Moderate - Low	Negligible
Low	Moderate	Moderate - Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 1 Landscape Character and Visual Impact Grading Matrix, Roads and Maritime Service, (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 of character would be felt and understood even when one is not physically present in the Study Area.

1.2.3 Visual Impact Assessment

To assess the likely impact of the proposal, the following tasks were undertaken:

- A desktop analysis to ascertain the visual catchment of the Proposal within the area from which the new bridge maintenance units; platforms and walkways may be visible, and potential receptors of the visual impact determined through topographic analysis and Google Maps. This provides the basis for the establishment of the Visual Envelope Map (VEM), view corridors, and key viewpoints. Locate on a map the seven key public domain locations (viewpoints – seven only) within the VEM.
- The sensitivity of each viewpoint takes into account the sensitivity ranking of the landscape character zone in which it is located.
- The magnitude of the proposal is the degree of change the view undergoes as a result of the Proposal. Relative to the existing condition, magnitude is ranked on a four 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 in the matrix in Table 1.

1.2.4 Urban Design Principles and Concept Design Development

Urban design objectives and principles to govern further development of the concept design and address the landscape character zone and visual impacts were identified. A Concept Design was developed with the Project Team and the construction engineers Manntech.

1.2.5 Mitigation Recommendations

Recommendations are made for possible feasible mitigation measures to assist in the on-going development of the detailed design and the avoidance or minimisation of impacts.

2. Contextual Analysis

2.1 Study Area, Context and Heritage

The Project Proposal is located along the top chord arch of the iconic monumental landmark, the Sydney Harbour Bridge (SHB). The bridge is an internationally recognisable symbol of both Sydney and Australia. The SHB forms an integral part of the broader setting of Sydney Harbour, incorporating the Opera House, Circular Quay and the iconic sandstone headlands and inlets fringed with parklands, vegetation and residential, commercial and industrial development. The SHB is located within the Sydney Harbour Bridge curtilage as shown on the National Heritage Register, and within the curtilage of the Sydney Harbour Bridge as per the NSW State Heritage Register. The location of the Proposal is highly visible from many key viewpoints including other landmarks such as the Opera House and Circular Quay (refer Figure 2 Study Area, Context and Heritage).

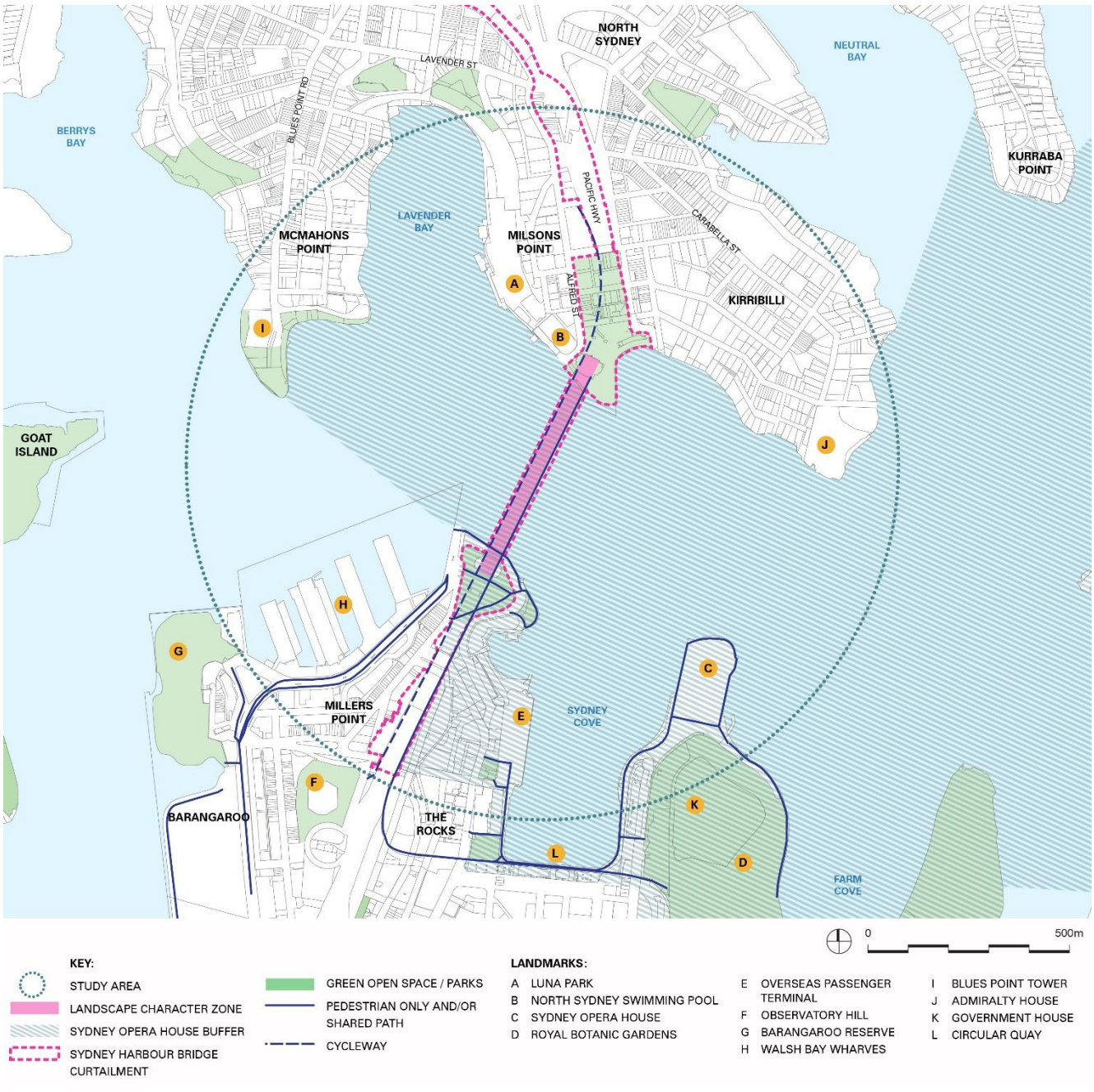

Figure 2 Study Area, Context and Heritage

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The Sydney Harbour Bridge is a steel arch truss structure, with the steel arch trusses transferring the structural loads to the concrete abutments located at the foot of the pylons. The road deck is hung from the arch trusses. The visual effect of the steel truss arch is of a lightweight web-like lattice that is very transparent. The steel is silicon steel, a form of structural steel and painted dark grey. The Sydney Harbour Bridge requires constant inspections and other maintenance work to keep it safe for the public, and to protect it from corrosion. The maintenance crane and gantries are therefore an intrinsic working element of the Sydney Harbour Bridge and part of its daily life and care. They are visible on the top chord of the steel arch trusses, from many locations, but particularly when the Arch is seen in elevation.

Since 1998, BridgeClimb has made it possible for tourists to legally climb to the top of the bridge along the top chord of the arch truss and more recently within the bottom chord truss.

View from Kirribilli Wharf

View from Milson Point

View from the Opera House

View heading south from the bridge carriageway

View heading north from the bridge carriageway

View from Pier 2/3 Dawes Point

3. Landscape Character Assessment

An analysis of the existing character of the Sydney Harbor Bridge Study Area was carried out to provide a baseline to assess the significance of likely changes resulting from the Proposal. The analysis involved identification of a landscape character zones (LCZ). The landscape character zones are areas that are relatively consistent in terms of their combination of landform, vegetation and land uses, while containing a degree of variation in visual landscape character.

For this Study, only one primary landscape character zone has been identified. This is mapped in Figure 2 Study Area, Context and Heritage. The following text, table and photos describe the landscape character zone and its sensitivity to change.

3.1 Landscape Character Zone 1

This zone is primarily characterised by the monumental landmark structure of the Sydney Harbour Bridge which dominates the view. The bridge spans the equally significant waterbody of Sydney Harbour and lands on the northern foreshore at Milson Point and the southern foreshore at The Rocks. Both foreshores comprise parkland and walking/ cycling paths providing panoramic views of the Harbour, SHB and the Opera House. There is minimal vegetation with man-made structures dominating the view. The Bridge itself is a skeletal weblike steel arch structure painted dark grey. Two existing crane gantries are located on both top chords of the arches. Walkways are also located along each top chord.

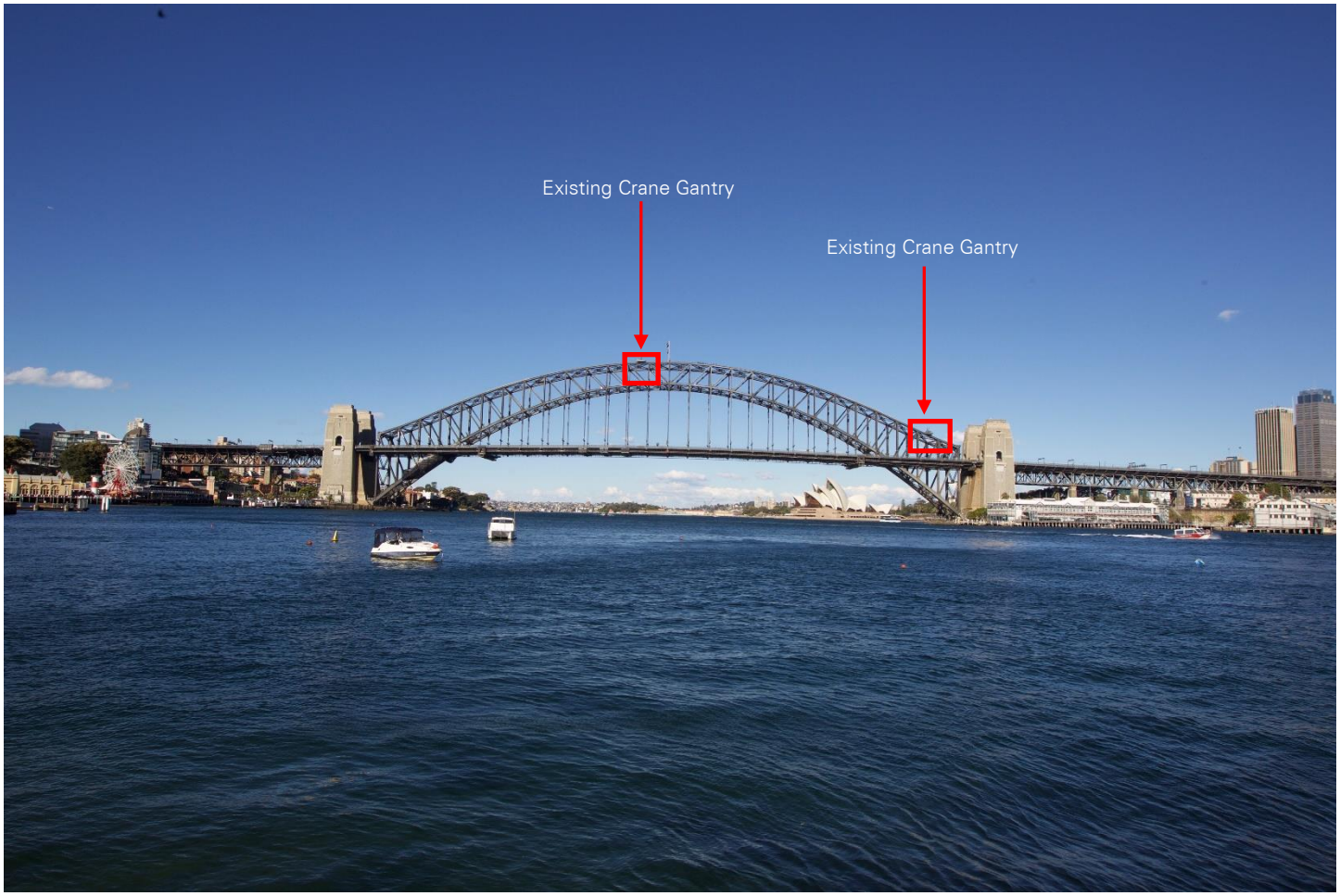

Figure 3 Sydney Harbour Bridge - A large iconic bridge structure with distinctive form and scale within a harbour setting

SHB Arch Crane & Walkways Replacement VIA

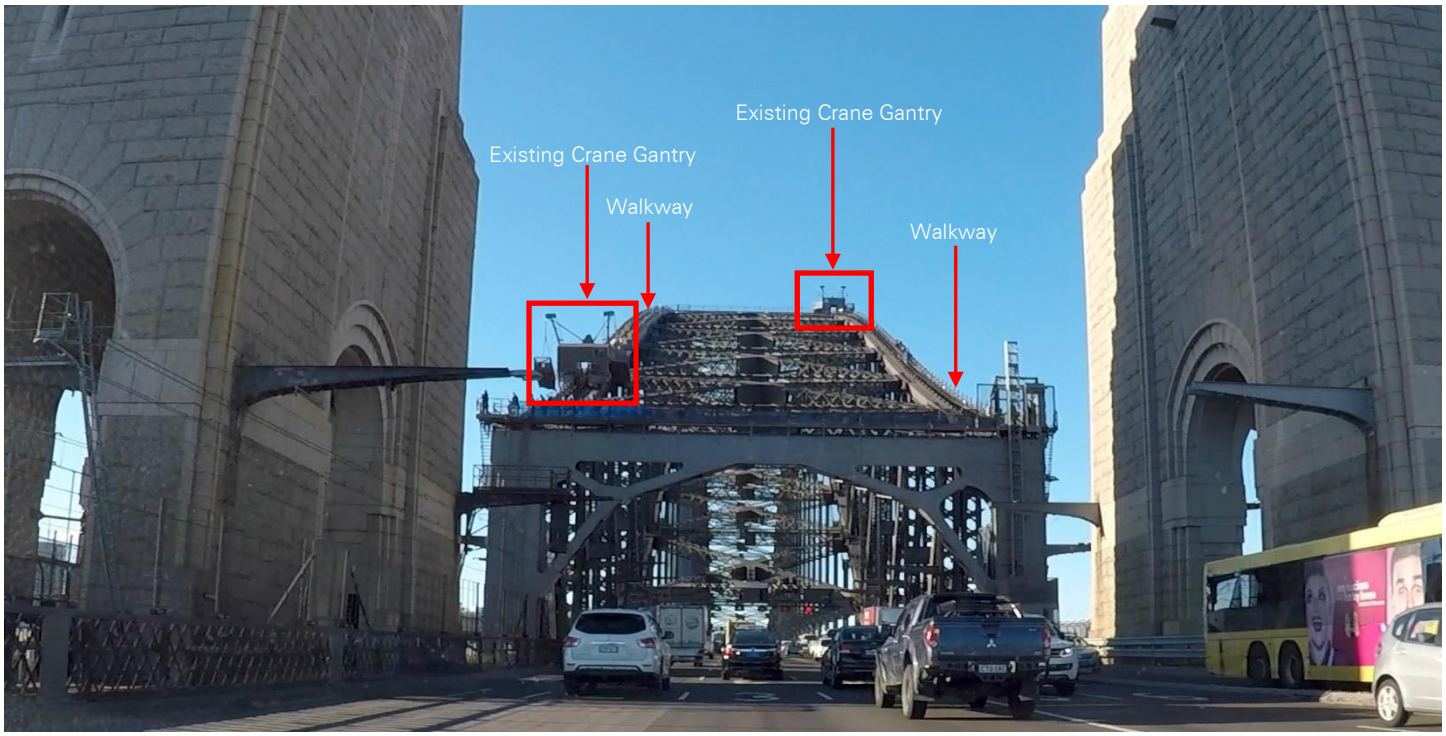

Figure 4 View northbound from Bradfield Highway showing the weblike steel truss structure and the existing cranes traversing the arch chords.

Figure 5 View southbound from the pedestrian walkway

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The extent of proposed works associated with the Proposal includes:

– Two new consolidated Crane and Gantry structures are proposed that will replace the existing cranes. They will provide platforms linking across the arches for safer maintenance access. Removal of the existing metal stairways on the top chords of the bridge arches (also used for the BridgeClimb) and provision of new stairs re-located to the outer section of the top chords. Refer Section 4.2 for a visual description of the design.

Character Zone Description	
Landform	A bridge spanning the major waterbody of Sydney Harbour, landing on the north and south foreshores with flat topography at the bridge abutments rising up either side to meet the approach carriageways.
Vegetation	No vegetation at bridge deck and arch level. Some trees and grass below the bridge at the foreshore level.
Hydrology	The SHB traverses Sydney Harbour a major water body that visually dominates most of the character zone.
Land Uses	Major infrastructure - Public roadway, Walkway and Cycleway, Public transport; Public recreation, BridgeClimb
Built Form	Sydney Harbour Bridge is the dominant built form comprising a steel arch truss structure painted dark grey. Known colloquially as "The Coathanger" it is a distinctive and dramatic landmark for Sydney and a major Harbour and City Gateway. The web-like trusses create a visual transparency that belies the large structural members.
Spatial	A large iconic bridge structure with distinctive form and scale within a harbour setting.

.

Sensitivity: HIGH

The SHB is a major element of one of the most internationally recognised views of Australia and the city of Sydney, which also comprises the Sydney Opera House, Sydney Harbour and its foreshores and the city skyline. It is highly visible from all these vantage points.

Magnitude: MODERATE

– Replacement of existing cranes.
– New platform structure spanning between arch trusses for the new cranes to be located on.
– Replacement of walkways along arch truss top chords.

Landscape Character Impact: MODERATE-HIGH

The landscape character impact is moderate to high. Whilst the sensitivity is high the degree of change is moderate as the crane and walkways already exist and it is the platform only that is a new additional element.

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4. Urban Design Principles and Concept Design Development

4.1 Urban Design Objectives and Principles

The overarching Urban Design Objectives are to:

- Respect the heritage importance and integrity of the Sydney Harbour Bridge and its approaches.
- Protect and where possible enhance, views to and from the Sydney Harbour Bridge, particularly from the Opera House, Sydney Harbour Bridge Climb, aerial views, northern and southern carriageway approaches and Sydney Harbour views.
- Ensure elements and materials are visually sympathetic with the Sydney Harbour Bridge.

Key principles for the Concept design are to:

- Minimise bulk and massing of new elements by minimising height and maximising slenderness of structural elements. For the walkways, investigate the use of different materials and how they maximise transparency and minimise bulk of structure – steel versus aluminium vs hybrid steel/ aluminium.
- Maximise transparency – utilise structural designs that maximise views through the structure and provide a web-like transparency sympathetic to the existing Sydney Harbour Bridge structure.
- Conceal any services/ pipes in the structure.
- Consider maintenance issues such as painting and galvanising.

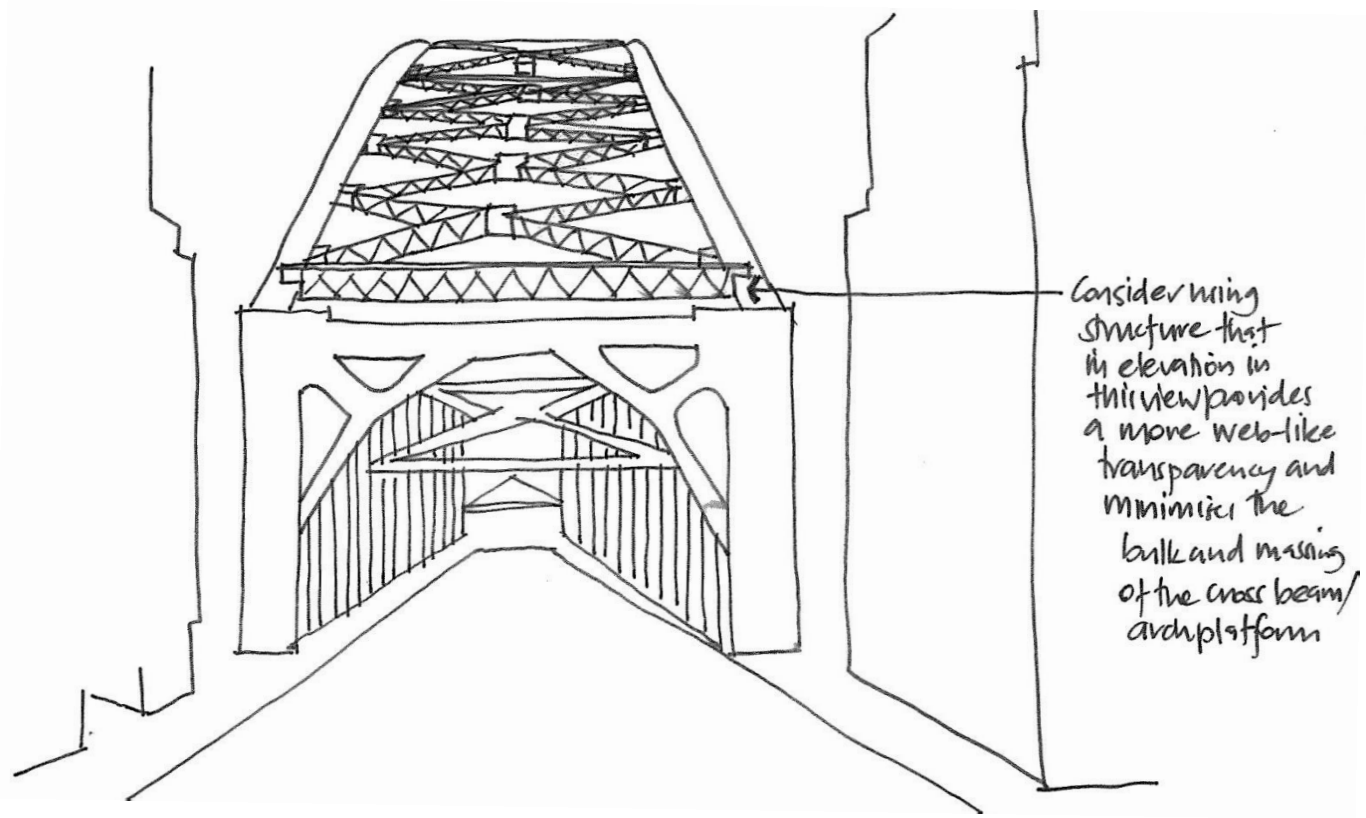

Figure 6 Utilise structural designs that maximise views through the web like structure

4.2 Concept Design Development

The Concept design has been an iterative process that has incorporated urban design objectives and principles.

Tender Design

The original tender design replaced the existing AMUs and walkways only (refer Figures 7 and 8).

Figure 7 BMU Tender Design: Option 1: Knuckle JIB Images: ARUP

Figure 8 BMU Tender Design: Option 2: Telescopic JIB Images: ARUP

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Alternative Tender Design

Subsequent to the tender, an AMU system spanning across the bridge with two smaller cranes (refer Figure 9) was proposed as it offered improved safety and maintenance access outcomes. There were two options considered. The first was an enclosed box gantry design - Option 1 (refer Figures 10 and 11), and the second was a truss gantry – Option 2 (refer Figures 14 and 15). Advantages and disadvantages were evaluated by the Project Team as well as possible solutions to any disadvantages. All options provided reduced safety risk and improved efficiency. Photomontages were developed for the two options from the critical views where the platform would be most visible from the Bradfield Highway to compare and contrast.

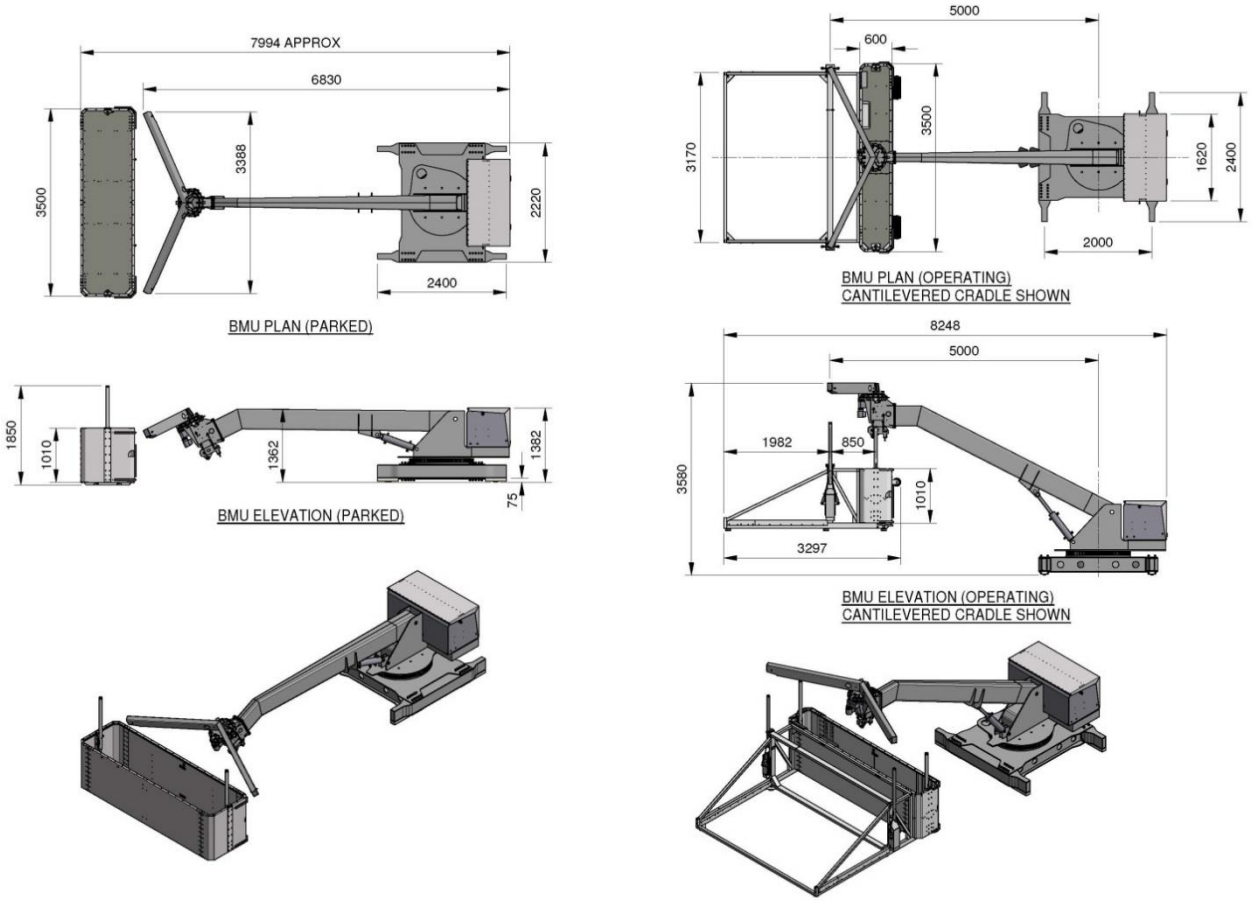


Figure 9 Proposed Smaller Crane Design – Images: Manntech

SHB Arch Crane & Walkways Replacement VIA

Option 1: Enclosed Box Gantry – Refer Figure 10.

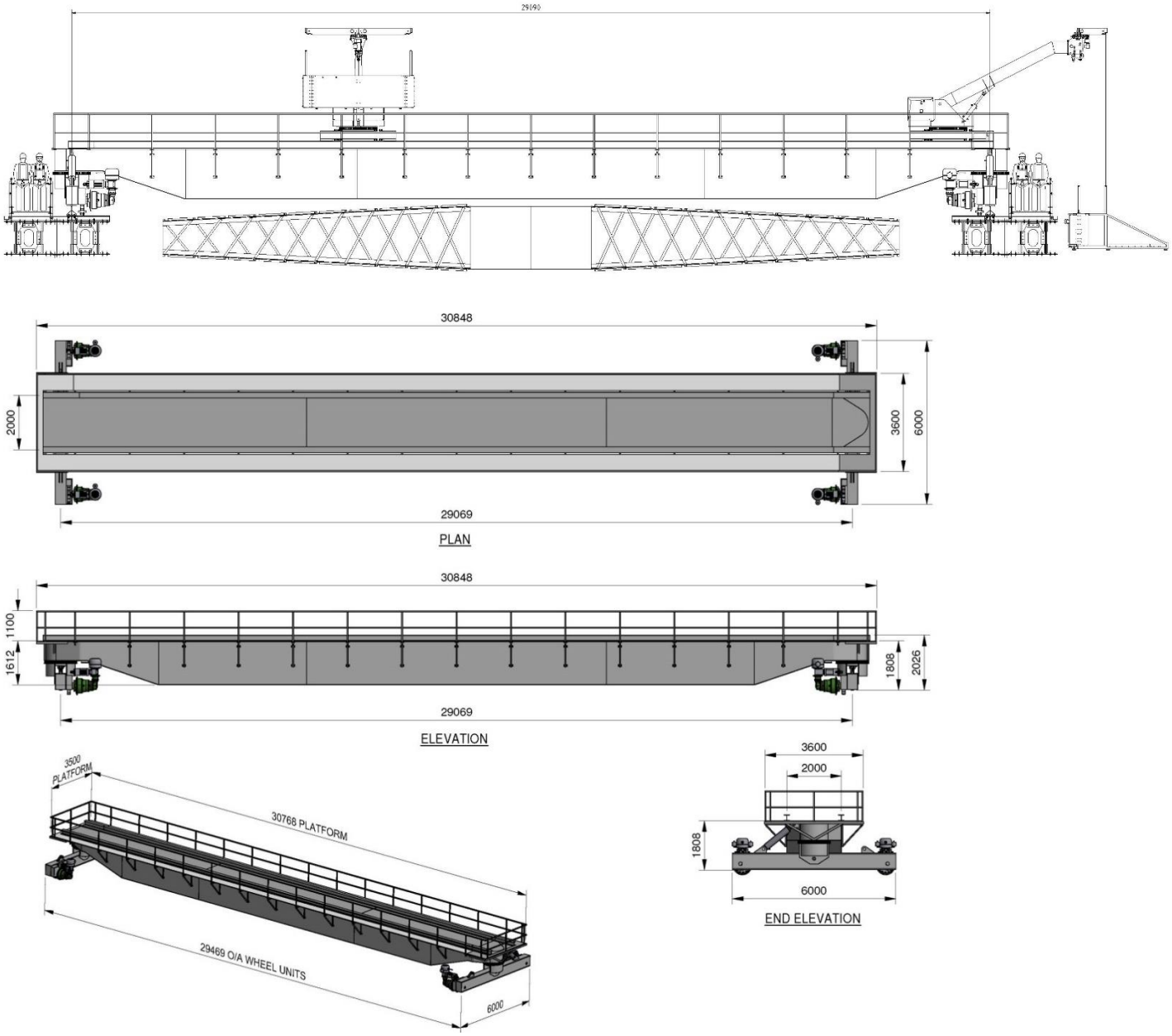


Figure 10 Box Design – Images: Manntech

SHB Arch Crane & Walkways Replacement VIA

Advantages

- Minimises overall height of structure with handrails and lower than existing AMUs.
- Easier to inspect structure.
- Can store maintenance equipment out of sight.
- Easier to conceal services in box section.
- Easier to galvanise achieving a high quality finish and therefore providing a structure less susceptible to corrosion.
- Decrease in design time, manufacture, assembly as a less complex structure to a truss.

Disadvantages

- Visually appears bulky, opaque and unsympathetic to the existing web-like Sydney Harbour Bridge structure.
- Greater surface area for corrosion to occur over.
- Higher wind loading.
- Openings to access storage small.

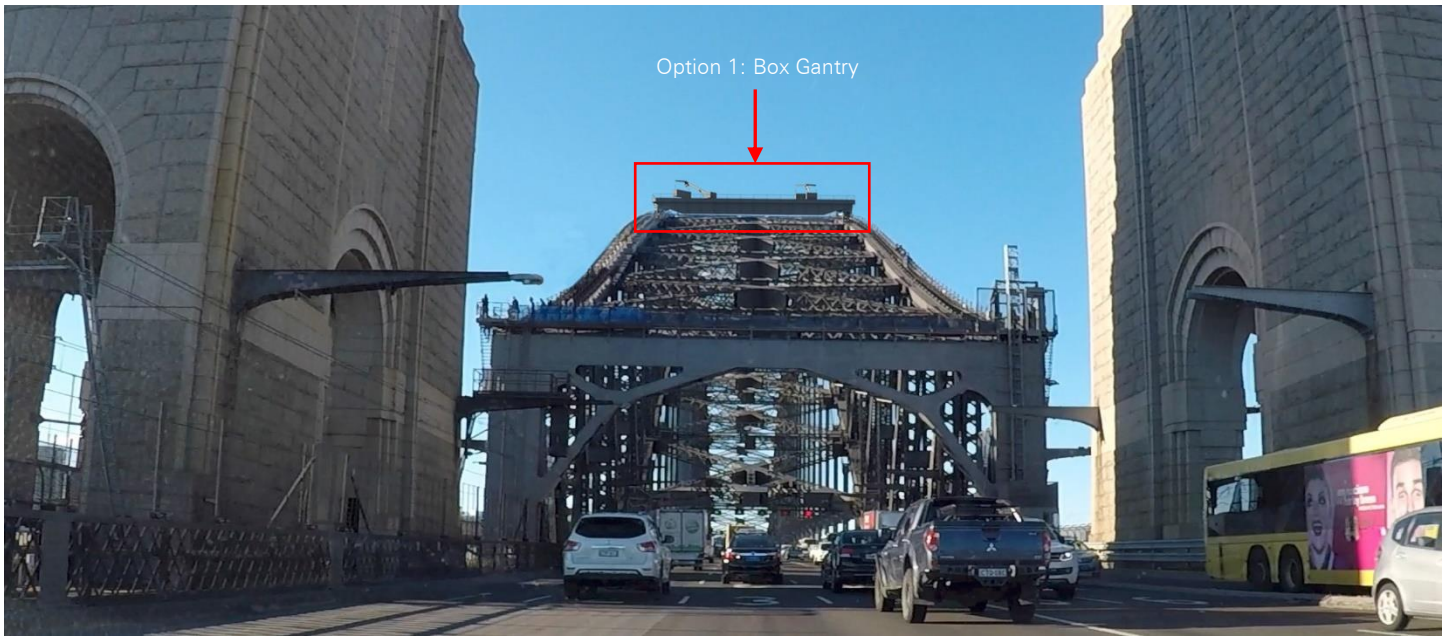


Figure 11 Box Gantry Design in operation - view from Bradfield Highway heading north

SHB Arch Crane & Walkways Replacement VIA

Refined Box Gantry Design

Further work was done on the Box Gantry design to see whether it could be improved visually. The section shown in Figure 12 describes the additional refinement and Figure 13 is a photomontage of the refined box design. Although still quite solid, visually it is more sympathetic to the overall look and design of the heritage bridge structure with the play of light and dark contrasts of the visible truss and stiffening elements adding more visual variety and casting various shadows throughout the day.

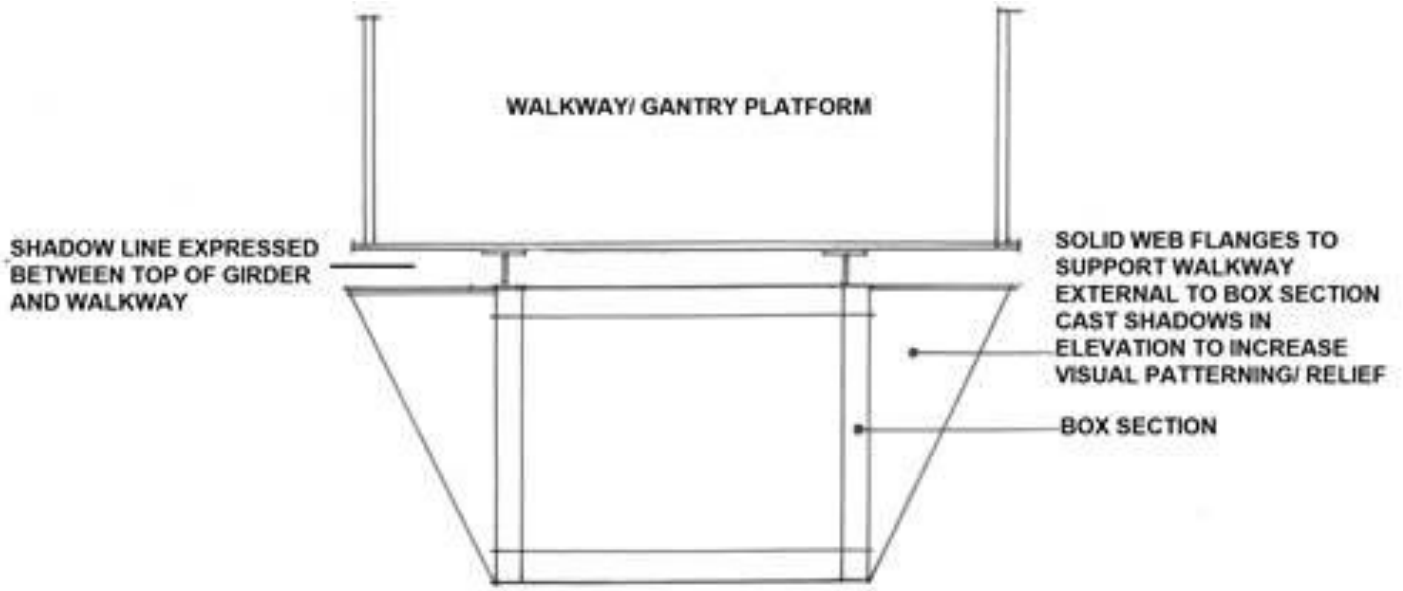


Figure 12 Rectangular Box Section Refinements

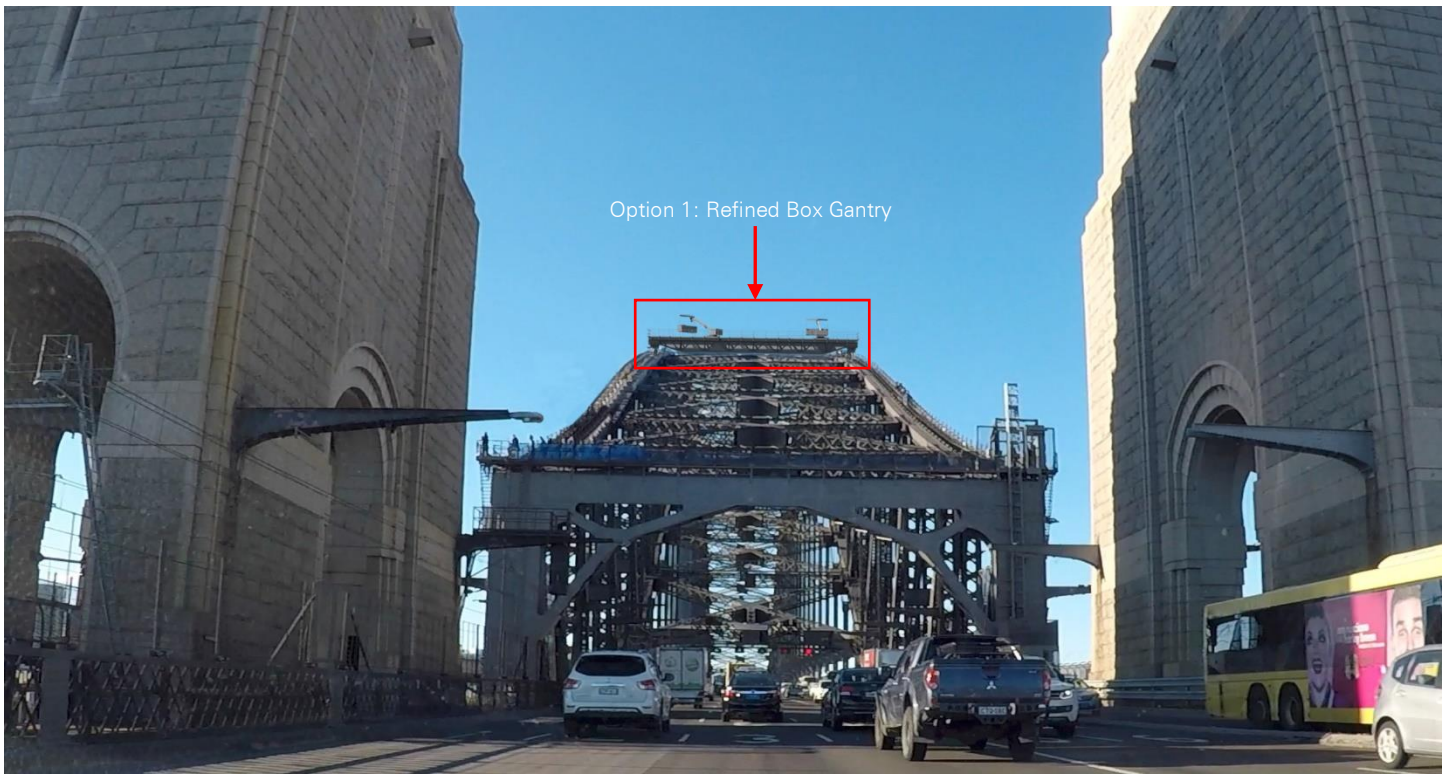


Figure 13 Refined Box Gantry Design

SHB Arch Crane & Walkways Replacement VIA

Option 2: Truss Gantry – Refer Figure 14

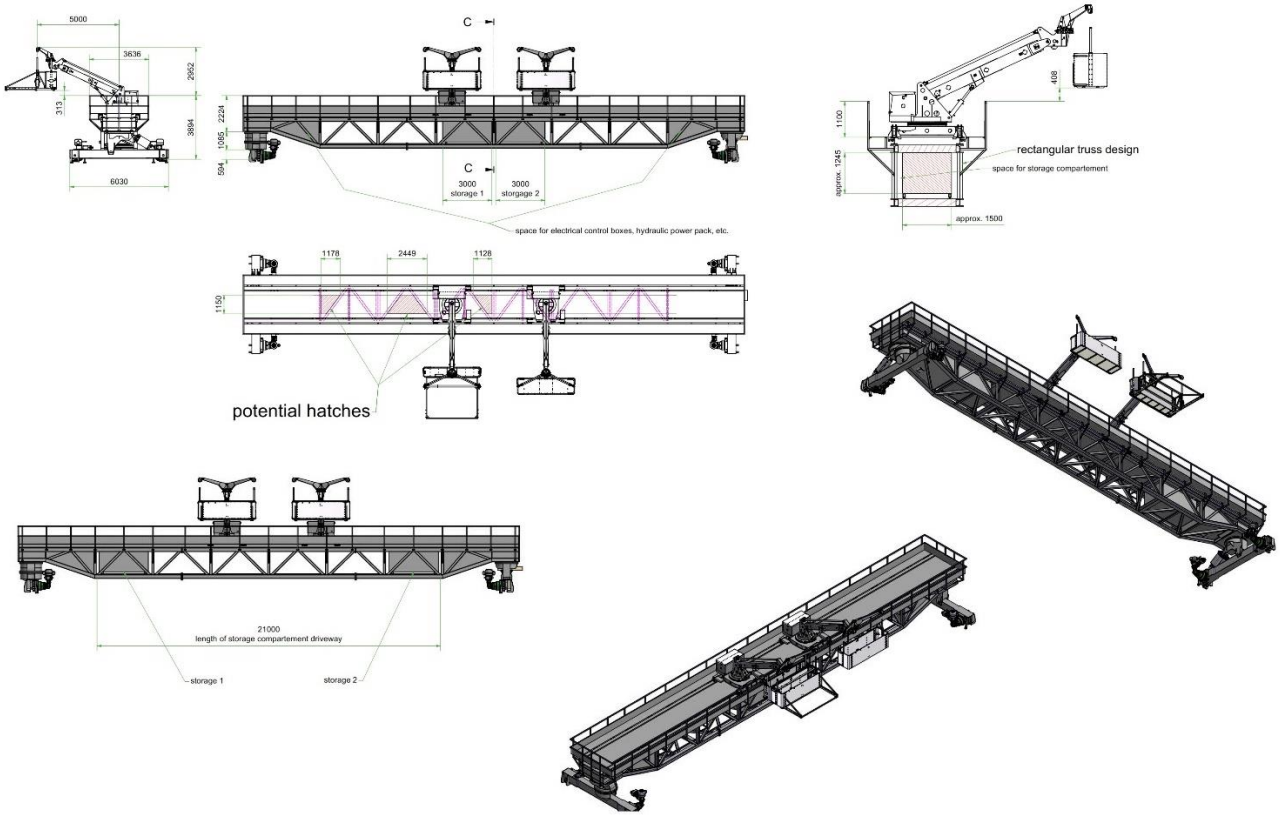


Figure 14 Truss Gantry Design – Images: Manntech

Advantages

- Increased transparency which is more sympathetic to the existing web-like Sydney Harbour Bridge structure, minimising any adverse visual impacts on the Sydney Harbour Bridge.
- Consistency of elements and materials with other gantries on the Sydney Harbour Bridge.
- Smaller surface area for corrosion to occur over.
- Lighter weight to overall structure.

Disadvantages

- Structure is higher in overall height.
- More complex design increases design time, manufacture, assembly.
- Structure cannot be easily hot dipped galvanised.
- The open structure will be occupied with additional components (control boxes, hydraulic systems etc.) which will take away from some of the transparency. Services will need to be carefully placed to minimise visibility and ensure maintainability.

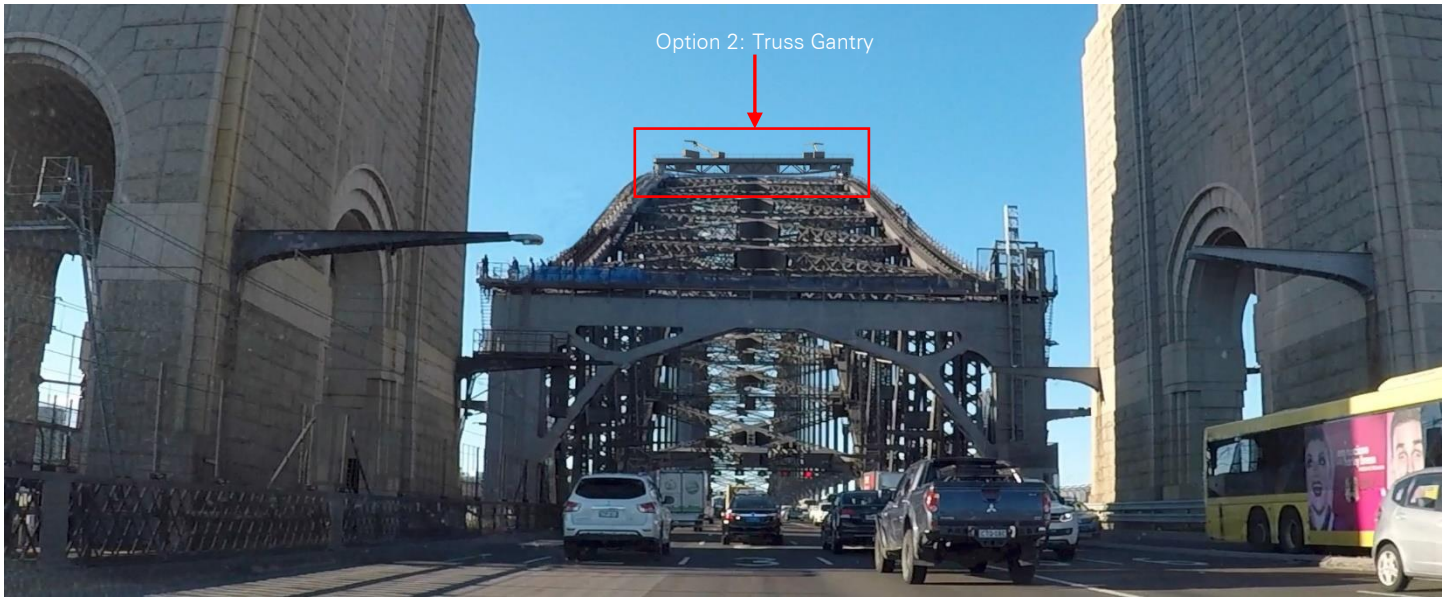


Figure 15 Truss Gantry Design in operation – view from Bradfield Highway heading north

Design Optioneering Conclusion

Upon further refinement of the functional requirements and how the gantry would be operated, coupled with the visual advantages of the truss, Option 2 was determined to be the preferred option to be carried forward into the REF.

Maintenance/ BridgeClimb Walkway Design Refer Figure 17.

To meet current safety Australian Safety standards, the walkway design will require a new design that has:

– A railing design with an increased height and additional vertical railing supports than the existing walkway.

Currently the walkway is located down the centre of the truss top chord. In plan the walkway will be located closer to the outer edge of the top chord of the truss to accommodate the new gantry and platform system.

The walkway design considered an "off the shelf" aluminium product. This was deemed unsuitable based on a number or reasons including: the design being not visually suitable for the Sydney Harbour Bridge aesthetic; the aluminium section being more visually bulky as it needed to be higher/deeper; and that the material should be sympathetic with the existing steel bridge structure. Refer Section 6.0 for design considerations to be addressed in detailed design.

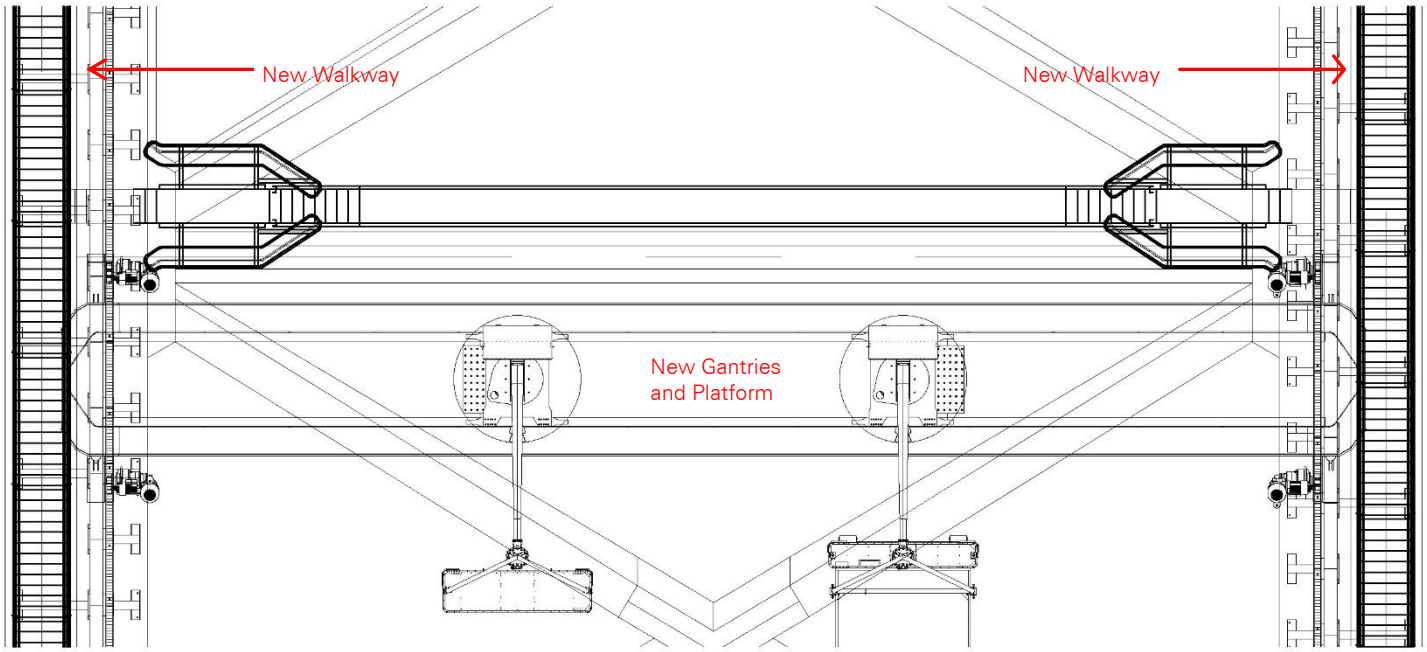


Figure 16 Walkway Location Plan – Plan Images: Manntech

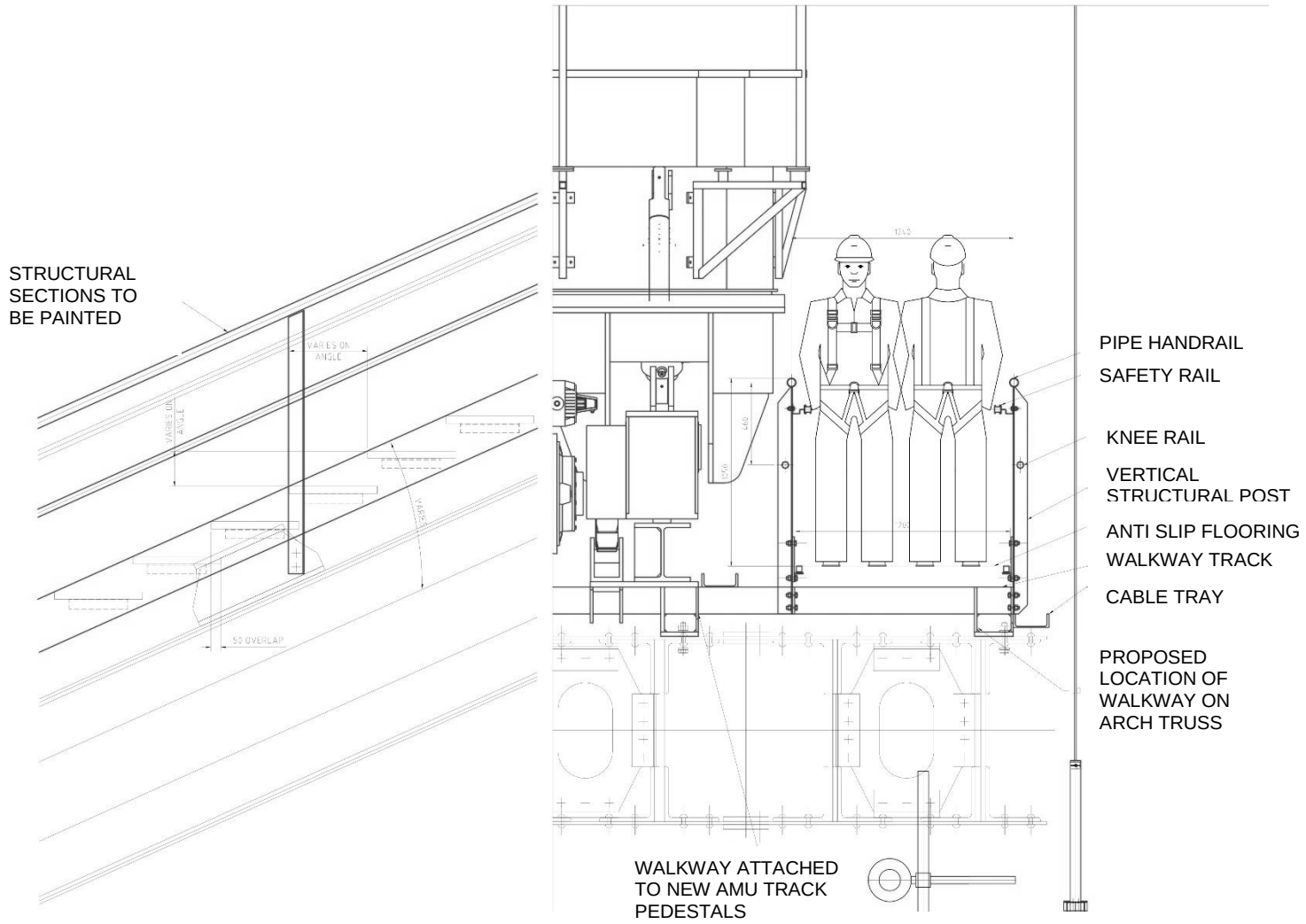


Figure 17 Walkway Location and Design (Aluminium Option) – Stair Section and Cross Section Images: Manntech

5. Visual Impact Assessment

5.1 Visual Envelope

The visual envelope illustrates the likely visual catchment of the Proposal. It generally describes the extent of the views possible from any given place within the Proposal site. 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 any screening of views. Key viewpoints from which potential visual impacts are assessed are located on the Visual Envelope Map. It is noted that whilst the Sydney Harbour Bridge is visible from more distant viewpoints, given the scale of the proposed elements, they would not be visible beyond the extents shown. These locations were determined on desktop analysis and a site visit (refer Figure 18 Visual Envelope and Viewpoints Map).

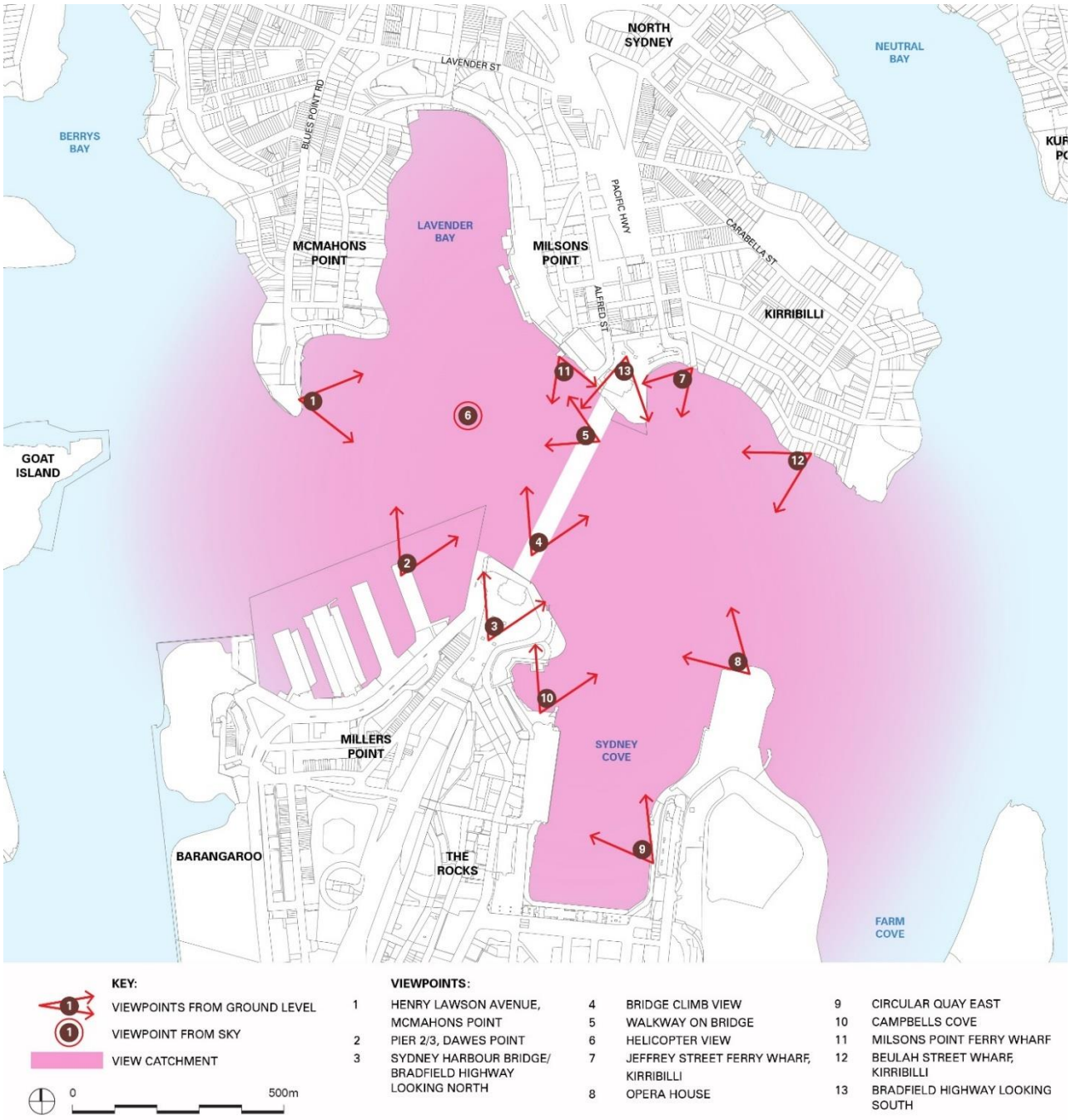


Figure 18 Visual Envelope and Viewpoints Map

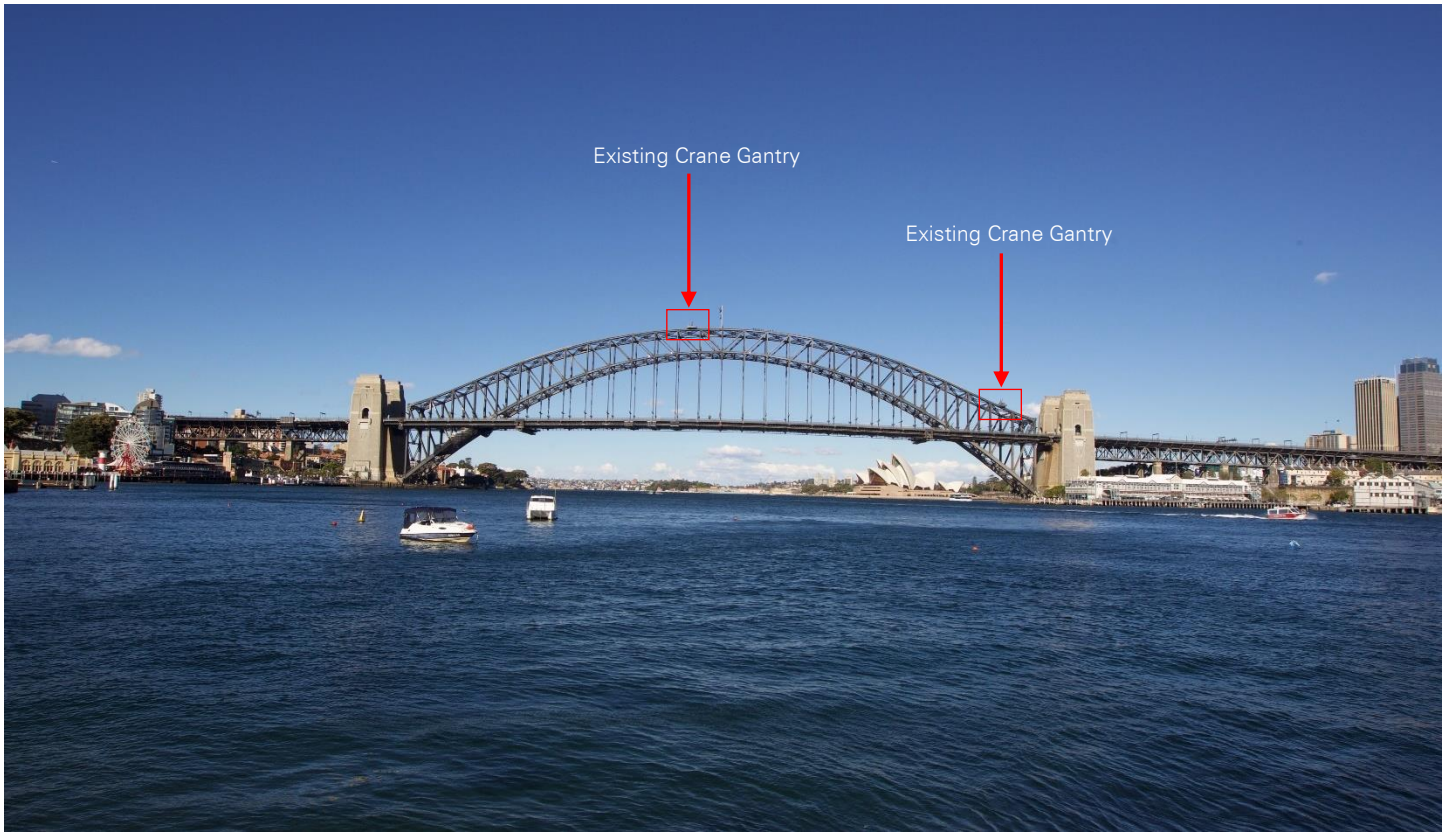
SHB Arch Crane & Walkways Replacement VIA

The Visual Impact Assessment has taken account of the following:

- Viewpoints have been assessed based on a static crane position.
- It is noted that the crane/ walkway will move over time and not remain fixed in position. A position for the crane could be agreed upon that minimised the impact from most viewing scenarios.

The following documents the visual impact assessment by viewpoint.

Viewpoint 1: Henry Lawson Avenue, McMahons Point



View from Henry Lawson Avenue, McMahons Point – Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Negligible
Overall Visual Impact Rating	Low
Elements of Proposal Visible	**Comment**
Only the crane will be visible from this location. The platform and the maintenance/ BridgeClimb walkway are not distinguishable from this distance.	The visual sensitivity is high but the distance of the viewer from the crane and the percentage of the view the crane occupies in the overall SHB elevation composition means the magnitude of visual effect is negligible. The overall visual impact is therefore low.

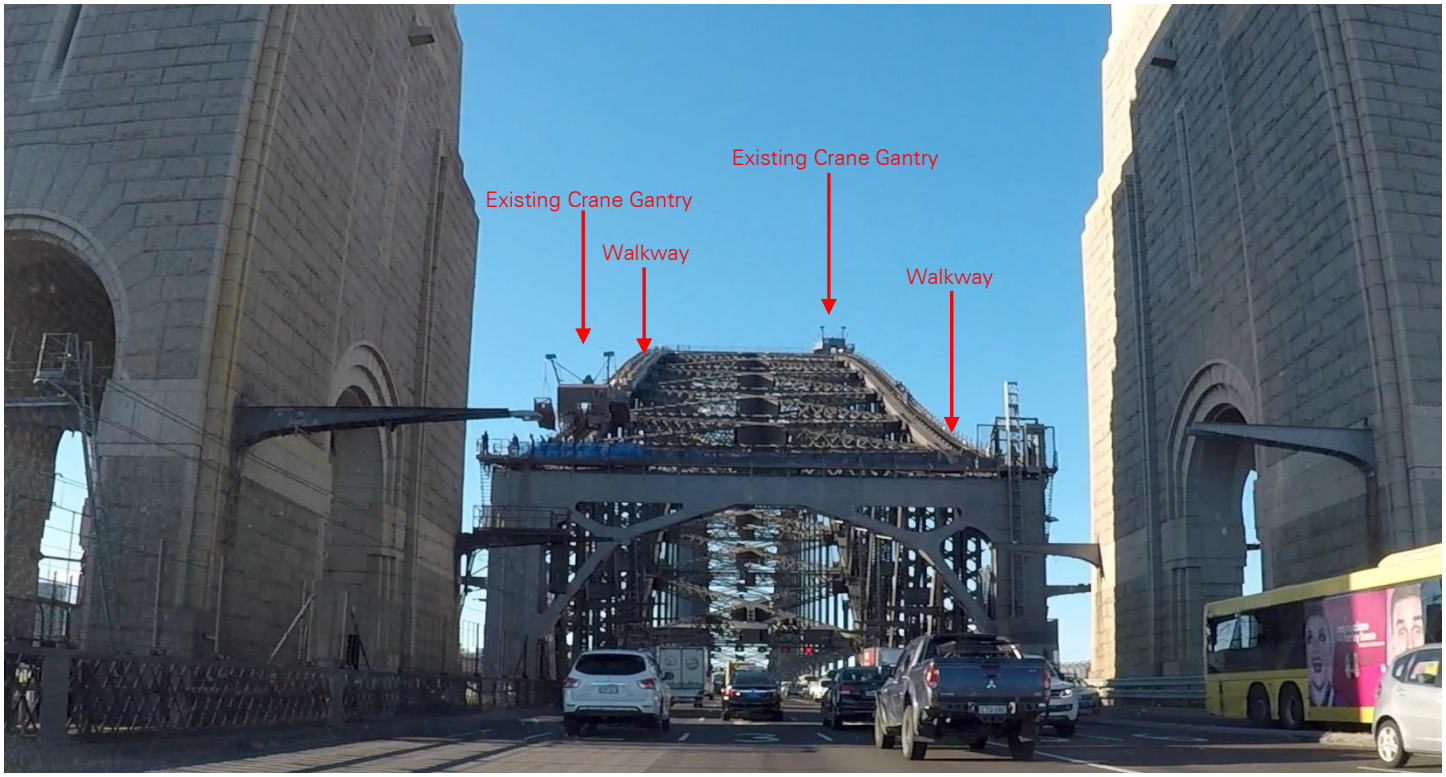
Viewpoint 2: Pier 2/3 view, Dawes Point

View from Pier 2/3 view, Dawes Point – Existing View

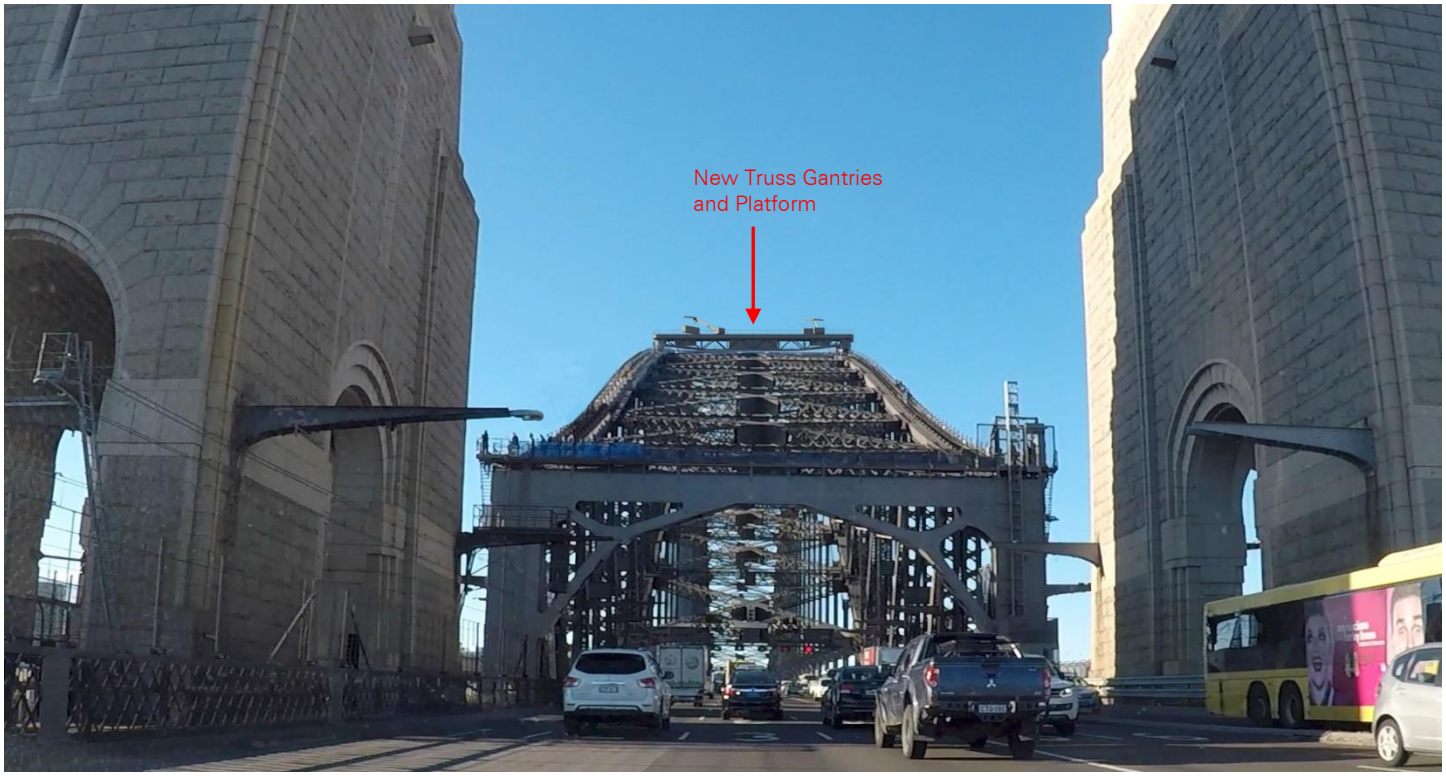
Visual Sensitivity	High
Magnitude of Visual Effect	Low
Overall Visual Impact Rating	Moderate
Elements of Proposal Visible	**Comment**
The new crane and platform are visible from this location. The maintenance/ BridgeClimb walkway is not visually distinguishable from this location.  Artist Impression showing new platform contrasted with old gantry	The visual sensitivity is high. The Magnitude of Visual Effect is low as the new crane will be smaller in appearance than the existing cranes and located further inwards from the edge of the truss arch. The platform will add a new element more prominent in this view however the truss will minimise its bulk to some extent through its transparancy. The overall visual impact is therefore moderate.

SHB Arch Crane & Walkways Replacement VIA

Viewpoint 3: Sydney Harbour Bridge/ Bradfield Highway heading north



Sydney Harbour Bridge/ Bradfield Highway heading north – Existing View

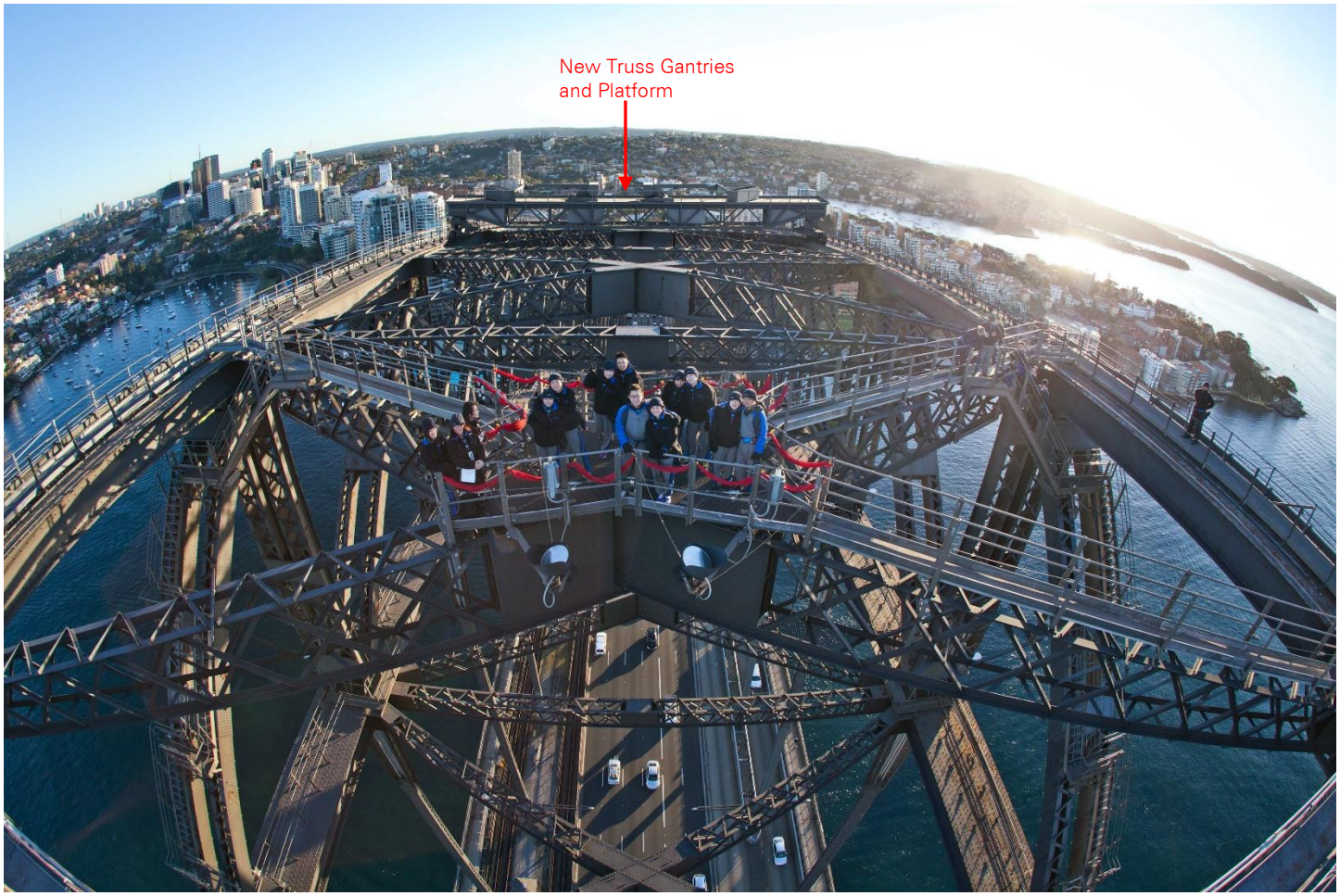


Sydney Harbour Bridge/ Bradfield Highway heading north – Proposed View

Visual Sensitivity	High
Magnitude of Visual Effect	Moderate
Overall Visual Impact Rating	Moderate-High
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be visible from this location. The walkway is less distinguishable visually than the new crane and platform.	The visual sensitivity is high. The Magnitude of Visual Effect is moderate as whilst the new crane will be smaller in appearance than the existing cranes, the platform will add a new element more prominent in this view. The truss will minimise its bulk by providing glimpses through to the skyline as the current SHB web-like structure provides. It is noted that the crane will ultimately not be fixed into this position permanently. The overall visual impact is therefore moderate-high.

SHB Arch Crane & Walkways Replacement VIA

Viewpoint 4: BridgeClimb/ Aerial View



BridgeClimb Aerial View– Proposed View

Visual Sensitivity	High
Magnitude of Visual Effect	Moderate
Overall Visual Impact Rating	Moderate-High
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be very visible from this location.	The visual sensitivity is high. The Magnitude of Visual Effect is moderate as whilst the new crane will be smaller in appearance than the existing cranes, the platform will add a new element to the bridge arch horizon that is more prominent in this view. The truss design helps to minimise its overall bulk. The overall visual impact is therefore moderate-high.

Viewpoint 5: Pedestrian Walkway on SHB heading south

Pedestrian Walkway on SHB heading south– Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Moderate
Overall Visual Impact Rating	Moderate-High
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be visible from this location. The maintenance/ BridgeClimb walkway will be less distinguishable visually than the new crane and platform in the overall view.	The visual sensitivity is high. The Magnitude of Visual Effect is moderate as whilst the new crane will be smaller in appearance than the existing crane, the platform will add a new element more prominent in this view. The truss design will minimise its bulk by providing glimpses to the sky. When the platform/crane is at the top of the arch it may partially obscure the view to the flag. The overall visual impact is therefore moderate-high.

Viewpoint 6: Helicopter View

Helicopter Panorama – Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Low
Overall Visual Impact Rating	Moderate
Elements of Proposal Visible	**Comment**
The new crane and platform will be visible from this location. The maintenance/ BridgeClimb walkway is not distinguishable visually from this location.	The visual sensitivity is high. The Magnitude of Visual Effect is low, as whilst the new crane will be smaller in appearance, the platform will add a more solid element perpendicular to the arch chord which contrasts the more transparent cross patterning of existing structure between the arch chords. The distance of the view however lowers the visual effect from high. The overall visual impact is therefore moderate.

SHB Arch Crane & Walkways Replacement VIA

Viewpoint 7: Jeffrey St Ferry Wharf, Kirribilli

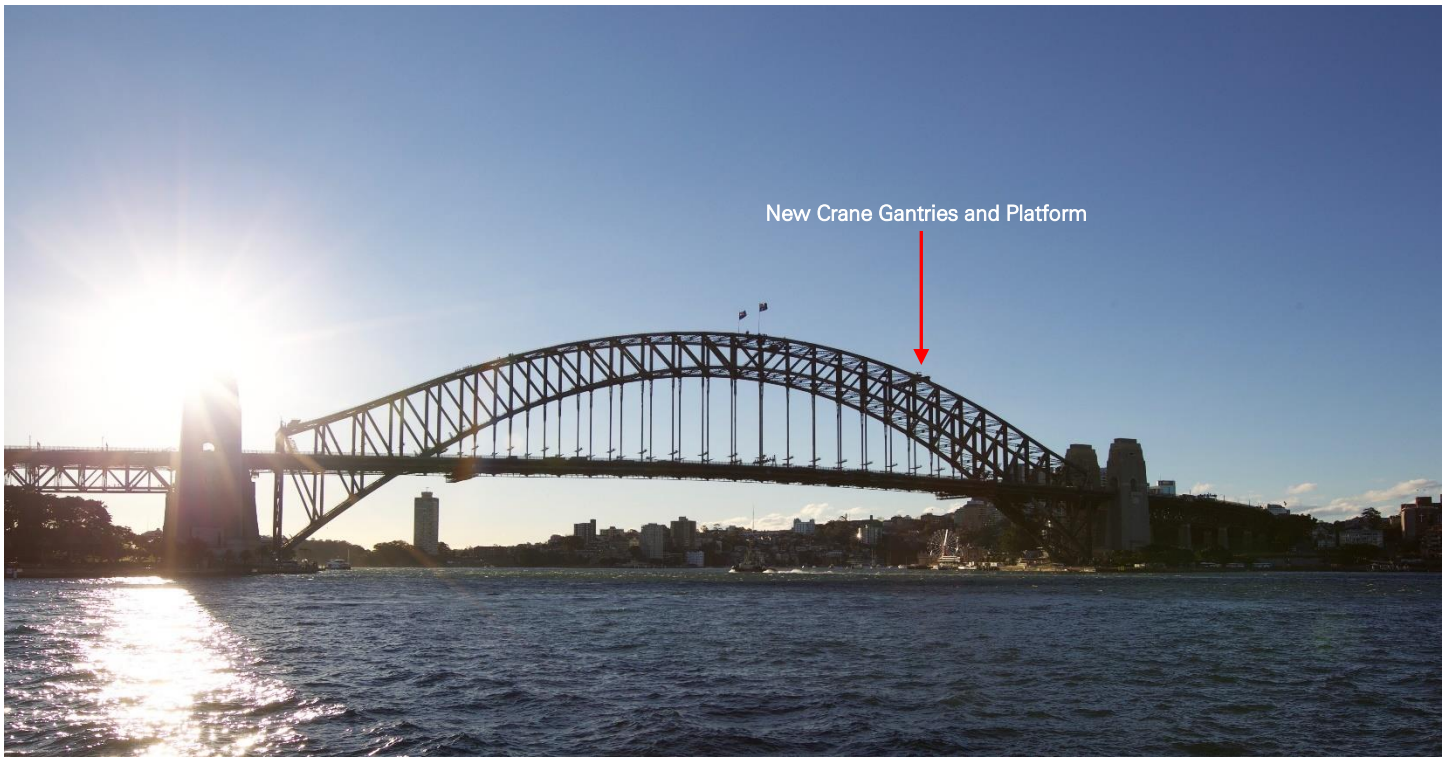
Jeffrey St Ferry Wharf, Kirribilli– Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Negligible
Overall Visual Impact Rating	Low
Elements of Proposal Visible	**Comment**
The new crane and some of the platform will be visible from this location. The maintenance/ BridgeClimb walkway is not distinguishable visually from this location.	The visual sensitivity is high. The Magnitude of Visual Effect is negligible, as the crane structure from this angle is reduced in size compared to the existing crane. There will be a view of the platform through the existing web of structure but the truss will maximise the transparency. The overall visual impact is therefore low.

SHB Arch Crane & Walkways Replacement VIA

Viewpoint 8: Opera House

Opera House– Existing View



Opera House– Proposed View

Visual Sensitivity	High
Magnitude of Visual Effect	Negligible
Overall Visual Impact Rating	Low
Elements of Proposal Visible	**Comment**
The new crane and platform will be visible from this location. The maintenance/ BridgeClimb walkway will not be not visually distinguishable from this distance.	The visual sensitivity is high. The Magnitude of Visual Effect is negligible, as the crane structure from this angle will reduce the visual bulk on the top chord skyline view compared to the existing crane structure. There will be some additional bulk where the platform crosses over the two arches although this will be negligible from this distance. The overall visual impact is therefore low.

Viewpoint 9: Circular Quay East

Circular Quay East– Proposed View

Visual Sensitivity	High
Magnitude of Visual Effect	Negligible
Overall Visual Impact Rating	Low
Elements of Proposal Visible	**Comment**
The new crane and platform will be visible from this location. The maintenance/ BridgeClimb walkway will not be not distinguishable visually from this distance.	The visual sensitivity is high. The Magnitude of Visual Effect is negligible, as the crane structure from this angle will reduce the visual bulk on the top chord skyline view compared to the existing crane structure. There will be some additional bulk where the platform crosses over although this will be negligible from this distance. The overall visual impact is therefore low.

Viewpoint 10: Campbell's Cove View

Campbell's Cove – Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Low
Overall Visual Impact Rating	Moderate
Elements of Proposal Visible	**Comment**
The new crane, platform are visible from this location. The maintenance/ BridgeClimb walkway is not visually distinguishable from this location.	The visual sensitivity is high. The Magnitude of Visual Effect is low as whilst the new crane will be smaller in appearance than the existing crane and located further inwards from the edge of the truss arch, the platform will add a new element more prominent in this view with some additional shadow where the platform crosses over.The truss design will however minimise its bulk to some extent. The overall visual impact is therefore moderate.

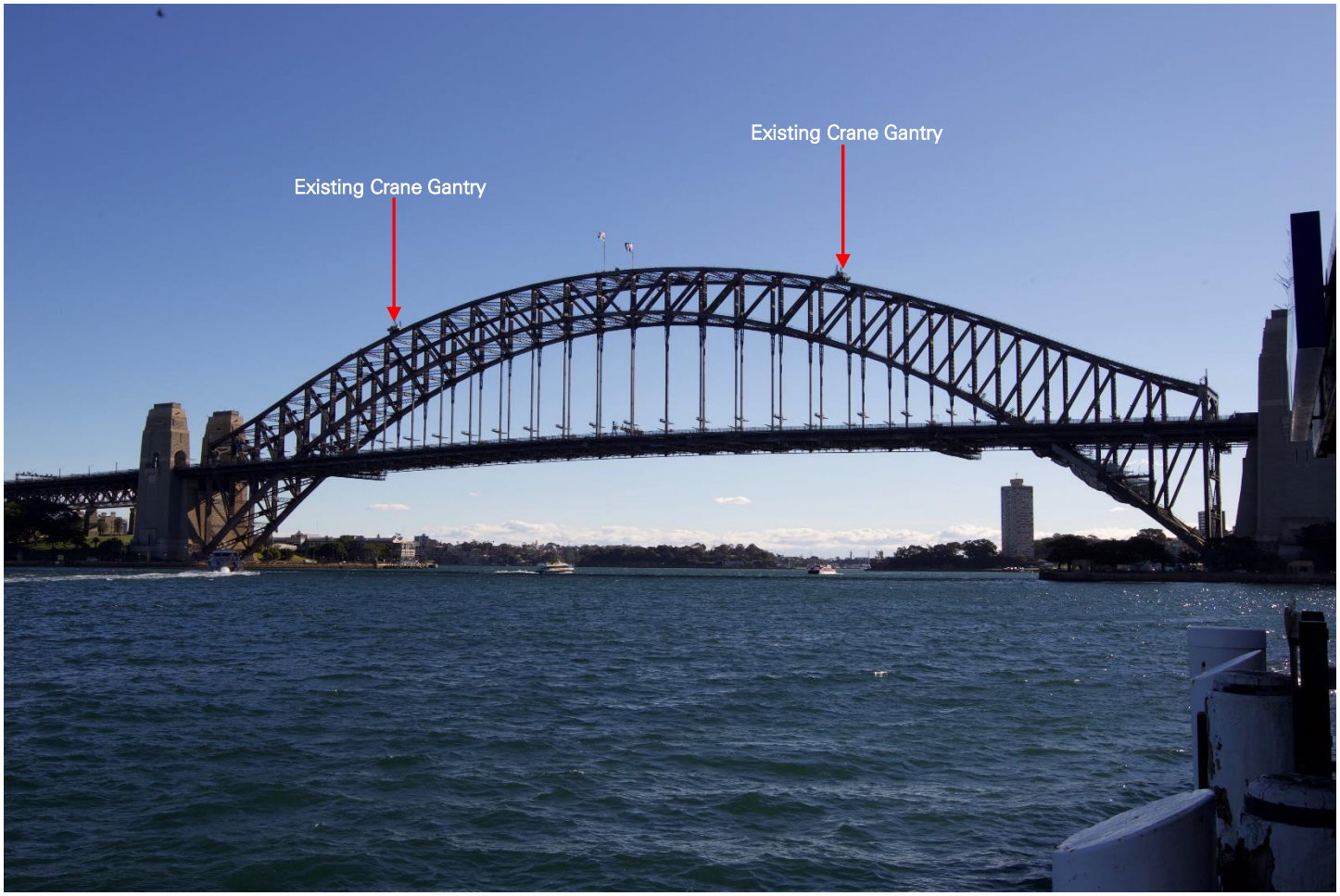
SHB Arch Crane & Walkways Replacement VIA

Viewpoint 11: Milsons Point Ferry Wharf

Milsons Point Ferry Wharf – Proposed View

Visual Sensitivity	High
Magnitude of Visual Effect	Moderate
Overall Visual Impact Rating	Moderate-High
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be visible from this location. The maintenance/ BridgeClimb walkway will be less distinguishable visually than the new crane and platform.	The visual sensitivity is high. The Magnitude of Visual Effect is moderate as whilst the new crane will be smaller in appearance than the existing crane, the platform will add a new element more prominent in this view. The truss design will minimise its bulk by providing glimpses through to the skyline as the current SHB web-like structure provides. The overall visual impact is therefore moderate-high.

Viewpoint 12: Beulah St Wharf, Kirribilli

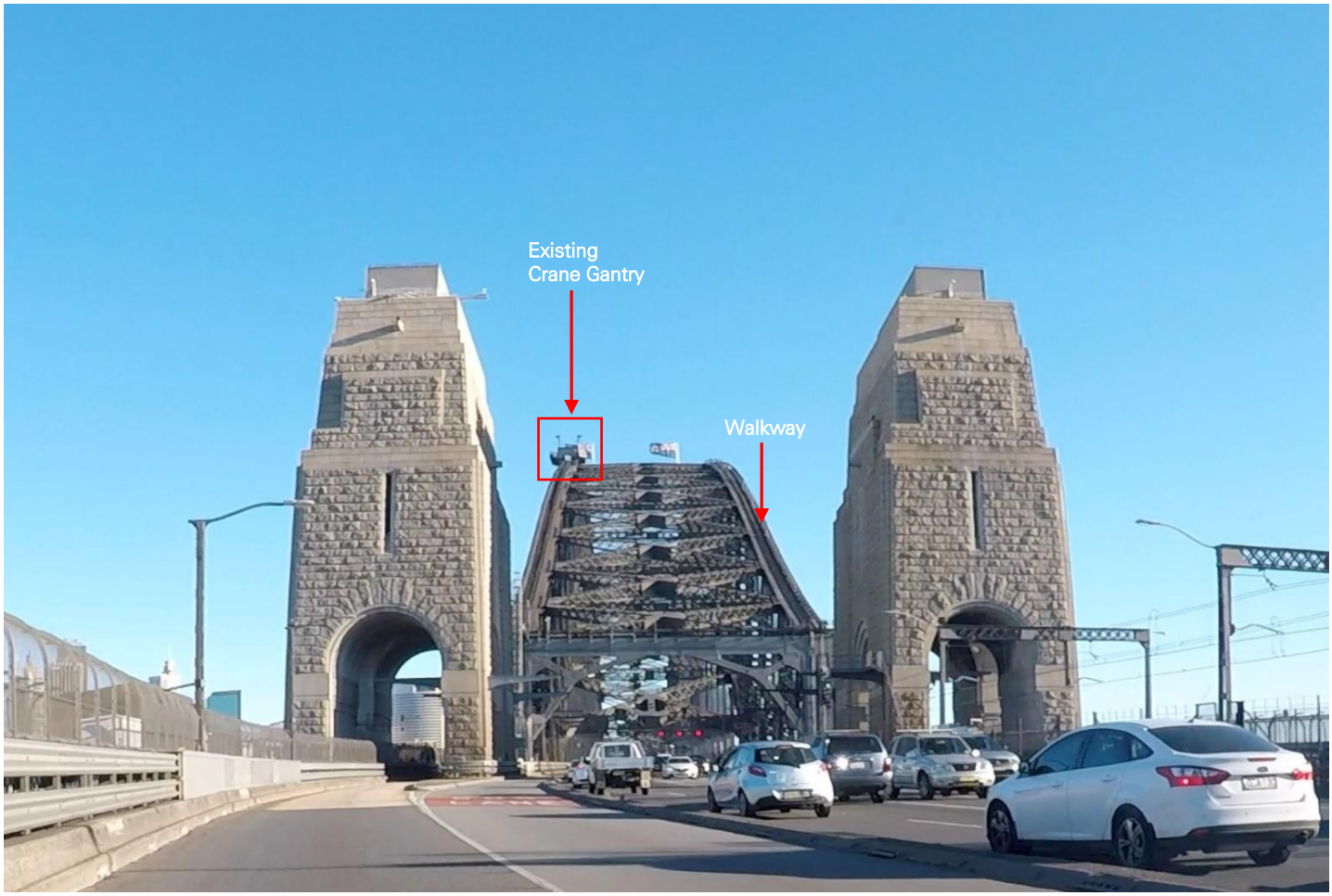


Beulah St Wharf, Kirribilli - Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Low
Overall Visual Impact Rating	Moderate
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be visible from this location. The maintenance/ BridgeClimb walkway will be less distinguishable visually than the new crane and platform.	The visual sensitivity is high. The Magnitude of Visual Effect is low as whilst the new crane will be smaller in appearance than the existing, the platform will add a new element in this view. The truss design will minimise its bulk to some degree. The overall visual impact is therefore moderate.

SHB Arch Crane & Walkways Replacement VIA

Viewpoint 13: Sydney Harbour Bridge/ Bradfield Highway heading south



Sydney Harbour Bridge/ Bradfield Highway heading south - Existing View

Visual Sensitivity	High
Magnitude of Visual Effect	Moderate
Overall Visual Impact Rating	Moderate-High
Elements of Proposal Visible	**Comment**
The new crane, platform and walkway will be visible from this location. The maintenance/ BridgeClimb walkway is less distinguishable visually than the new crane and platform.	The visual sensitivity is high. The Magnitude of Visual Effect is moderate as whilst the new crane will be smaller in appearance than the existing crane, the platform will add a new element more prominent in this view. The truss design will minimise its bulk to some degree by providing glimpses through to the skyline as the current SHB web-like structure does. The overall visual impact is therefore moderate-high.

Conclusion

In general, views from further away and with the arch truss in elevation, are improved by the smaller crane structure. The truss platform design, to some degree, helps to minimise the visual bulk between the top arches. However, the solid platform deck, from some of these angles, is noticeable against the more transparent web structure. Mitigation measures should look to further maximise the deck transparency. Refer Section 6.

For views closer up, either from the bridge itself or directly adjacent such as the pedestrian pathways or road carriageways, where the arch is not seen in elevation, the impact is greater as the platform element becomes more visible. The truss platform design maximises the transparency and minimises the bulk in these instances. Further refinement of the platform design could further enhance transparency.

The new walkway structure is most visible from the Bridgeclimb view. Careful design of the structure is required to minimise impact. Refer Section 6.

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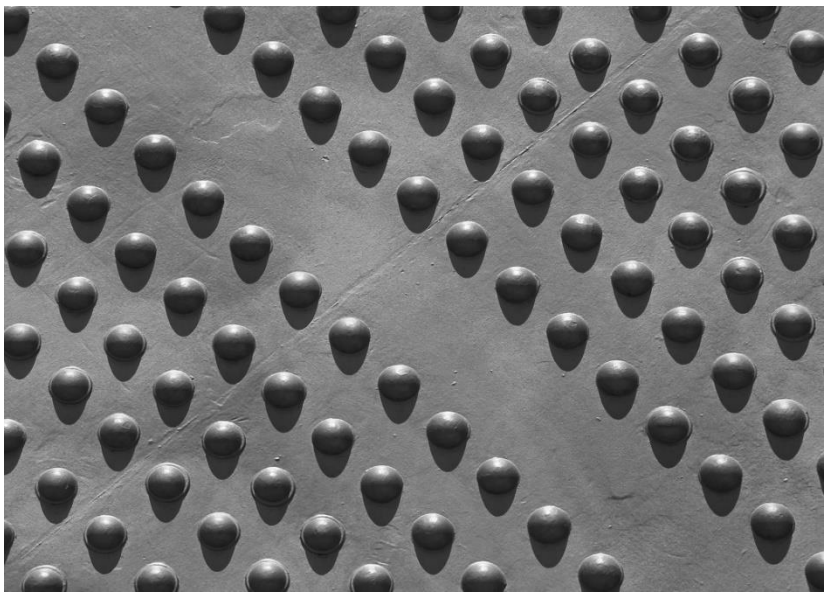
6. Mitigation Recommendations

During the concept design process design modifications to mitigate visual impacts to achieve urban design objectives. These modifications included the adoption of the truss gantry design for the platform over the box gantry structure.

Strategies to further reduce the perceived bulk of the platform structure and increase transparency, which will be investigated during the detailed design phase, include:

- Continuation of the integrated engineering and urban design process that has developed the concept design in detailed design development.
- Investigation of the use of more transparent materials such as expanded or perforated mesh or clear materials on the platform deck.
- For any boxed machinery elements, as far as practicable given corrosion issues, investigate the use of expanded or perforated mesh to reduce visual bulk.
- Investigation of whether additional voids could be created through the platform to increase visual transparency.
- All new elements should be painted the same dark grey to match all other elements on the bridge.
- Conceal all services pipes, wiring or cable trays in the structure.
- The walkway along the arch top chord should be designed so that there is a separation/ shadow line expressed between the arch top chord and the supporting structure/ beam for the walkway to distinguish the new structure from the old bridge structure.
- The walkway railing design should minimise width of structural elements and be in keeping with the steel materials used in the existing structure. Detailing should be carefully considered and integrate tethering for bridge climbers if possible.
- All bolt fixings to be capped and painted to match existing, subject to structural and maintenance requirements. Refer image below.



- Determining a preferred parking location for the crane platform when it is not in use. The crane positioned along the arch seems to be a more appropriate place than at the ends where the line of the arch is interrupted, the crane being integral/ intrinsic to the working life of the Bridge.

7. References

1. PS281 Urban Design for Concept Design and Environmental Assessment, Version for Sydney Harbour Bridge Replacement of Arch Maintenance Units, RMS, July 2017
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3. ARUP, Sydney Harbour Bridge Heritage Considerations, June 2015
4. http://sydney-harbour-bridge.nesa.nsw.edu.au/
5. https://en.wikipedia.org/wiki/Sydney_Harbour_Bridge
6. Godden Mackay Logan for RMS, Sydney Harbour Bridge Conservation Management Plan, Sydney, 2007.

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