

# REPORT

## **Barangaroo South Stage 1B Public Domain**

Seawalls / Over-Water Structures Impact Assessment

Client: Lend Lease  
Reference: PA1475\_R002.FD02  
Revision: 02/Final Draft  
Date: 24 January 2017

HASKONING AUSTRALIA PTY LTD.

Level 14  
56 Berry Street  
NSW 2060 North Sydney  
Australia  
Maritime & Aviation  
Trade register number: ACN153656252

+61 2 8854 5000 **T**  
+61 2 9929 0960 **F**  
project.admin.australia@rhdhv.com **E**  
royalhaskoningdhv.com **W**

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Revision: 02/Final Draft

Date: 24 January 2017

Project name: Barangaroo South Stage 1B Public Domain

Project number: PA1475

Author(s): Greg Britton

Drafted by: Greg Britton

Checked by: Greg Britton

Date / initials: 24/01/17, GWB

Approved by: Greg Britton

Date / initials: 24/01/17, GWB

Classification

Open



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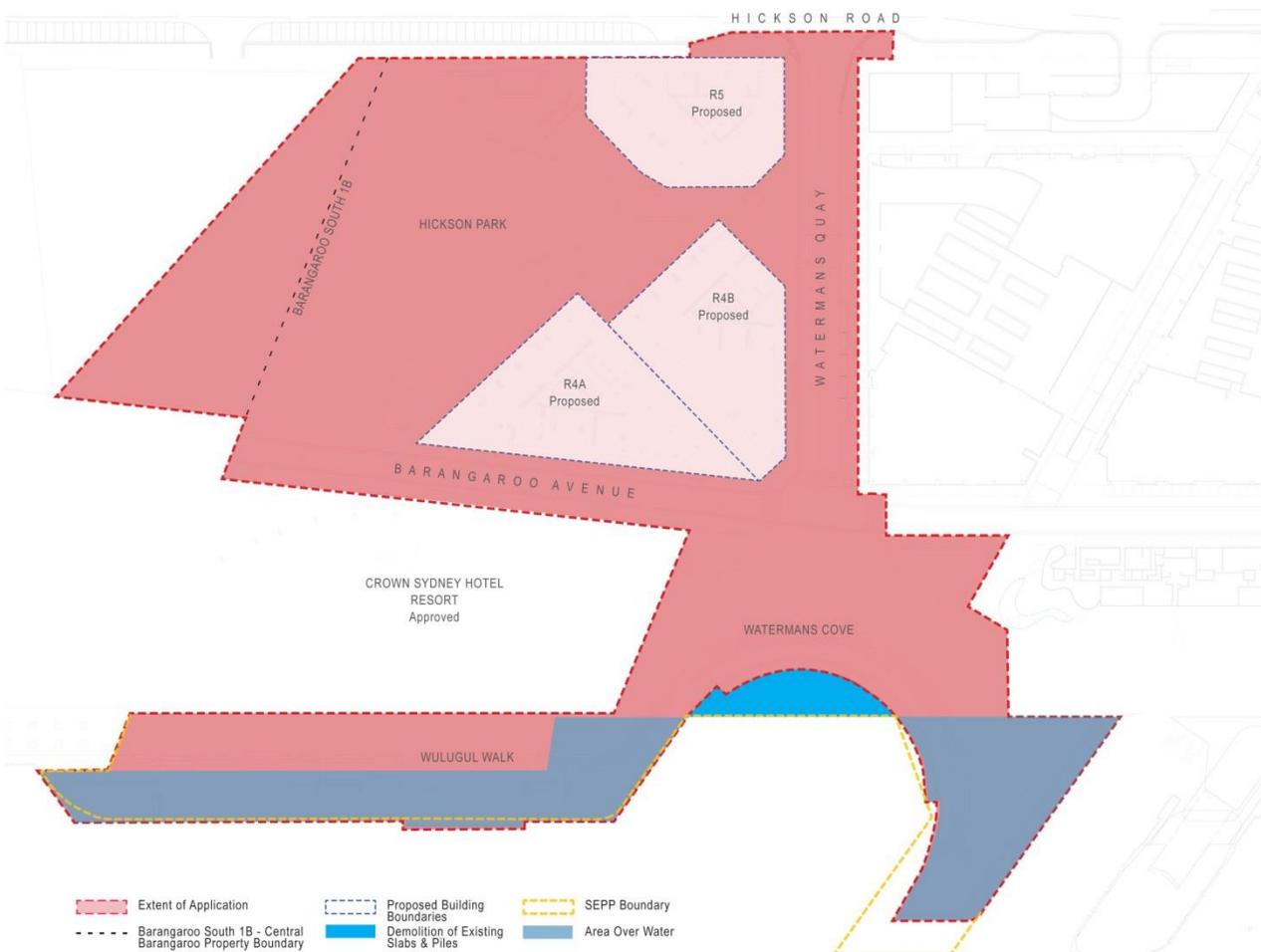
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# 1 INTRODUCTION

## 1.1 Background

Barangaroo is located on the north-western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by CBD commercial tenants.

The Stage 1B Public Domain site is generally located to the north of the Stage 1A site, on land identified as public domain between and around Blocks 4A, 4B and Y in the approved Concept Plan (Mod 8), as shown in **Figure 1**. The majority of the site is legally described as Lot 212 in DP 1217691 but also includes an area of Darling Harbour. It is noted that an additional area of Darling Harbour was added to the site by the Planning Assessment Commission in their determination of Concept Plan MOD 8. This additional area is reflected in the site area identified in **Figure 1**.



**Figure 1** Site plan

## 1.2 Scope of Work

This report principally addresses Key Issue 9 Seawalls/Over-Water Structures in the Secretary's environmental assessment requirements (SEARs) which states:

- The EIS should address whether modifications to the estuarine foreshore comply with the recommendations of *Environmentally Friendly Seawalls – A Guide to Improving the Environmental Value of Seawalls and Seawall-lined Foreshores in Estuaries (DECC, 2009)*.
- The EIS should detail plans for any proposed environmentally friendly seawall works or aquatic eco-engineering works to improve bio-diversity.
- Where structures are proposed to be built over water they should have regard to the *Policy & Guidelines for fish habitat conservation and management (2013)*, and identify construction methods and techniques that minimise the impact on aquatic biodiversity.

In addition, this report also addresses one aspect of Key Issue 6 Water Quality and Contamination in relation to contaminated sediments, which states:

- Assess the geotechnical and contamination issues (including Acid Sulphate Soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works.

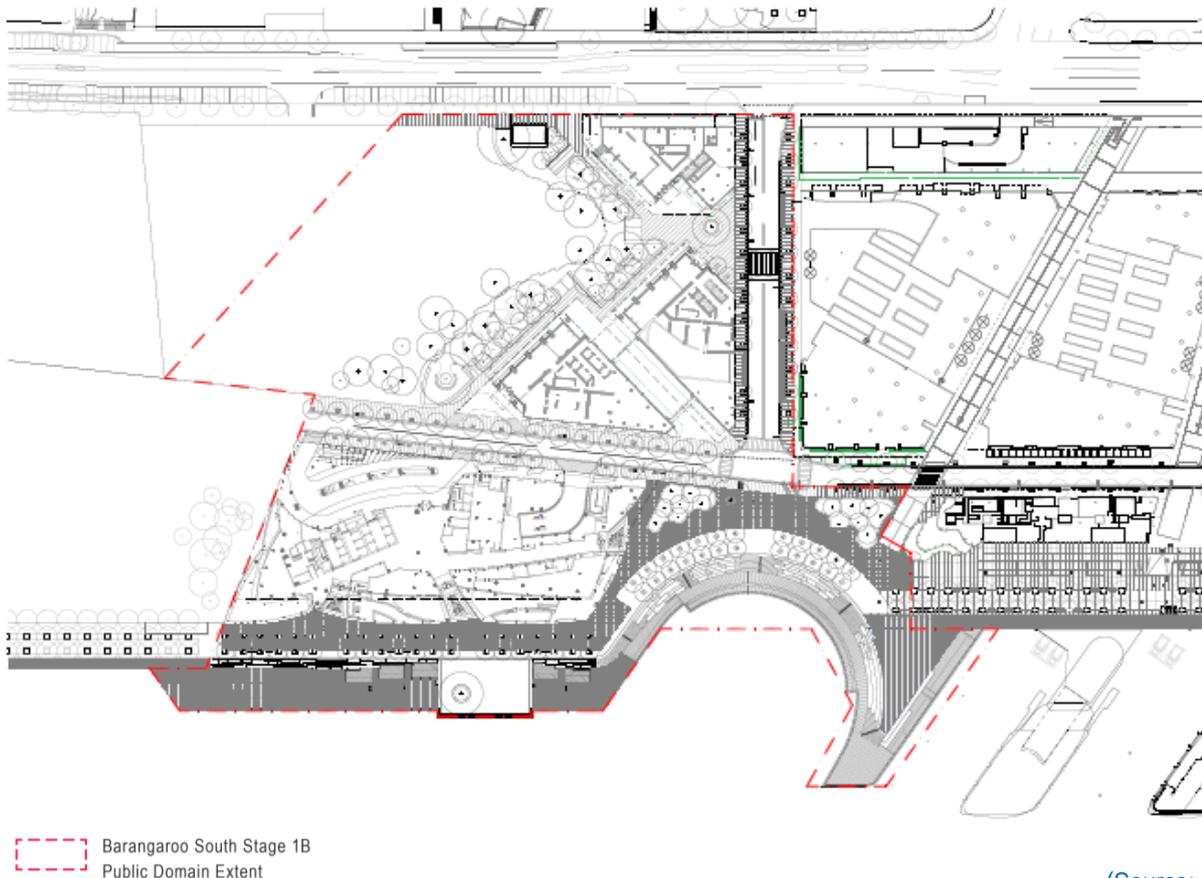
## 2 DESCRIPTION OF PROPOSED DEVELOPMENT

### 2.1 General

The State Significant Development (SSD) application will seek consent for all public domain works within 'Stage 1B' of the Barangaroo South Site. The extent of public domain works is illustrated on the site plan prepared by Lend Lease in **Figure 1**, and the preliminary indicative design drawing in **Figure 2**.

The public domain works include the construction of Waterman's Cove and public pier along the foreshore, the provision for a potential building on the public pier, public domain works associated with Hickson Park as well as all typical public domain features such as trees and other landscape features, walkways, street paving, street furniture, lighting, roads and planting. Various services and infrastructure such as power and water with Landowner consent will also be included in the public domain to enable it to be used for a range of different activities. Opportunity for boat set down/pick up (i.e. no berthing), including the potential for water taxi drop off and pick up is also included in the design.

Staging of the proposed public domain works will be a key component in order to accommodate the efficient and timely construction of the works and to integrate with the construction of the residential buildings R4A, R4B and R5 located within the Stage 1B Site and The Crown Sydney Hotel Resort.



(Source: JBA)

**Figure 2** Preliminary indicative design

The particular waterfront elements of the Barangaroo South Stage 1B Public Domain that are relevant to this report are listed below and described in the following sections. The description includes an outline of the expected construction methodology.

- Wulugul Boardwalk and Pontoon;
- Watermans Cove and Public Pier.

## 2.2 Wulugul Boardwalk and Pontoon

### 2.2.1 Proposed Structure

The proposed Wulugul Boardwalk and Pontoon, showing key levels, are shown in **Figure 3**. The structure comprises a fixed boardwalk over the majority of its length with a floating pontoon and hinged gangway at the northern end. The structure extends approximately 14m into Darling Harbour beyond the face of the existing vertical caisson wall. The fixed boardwalk level steps down from 2.50m AHD in the south to a minimum of 2.0m AHD in the north at the top of the gangway leading to the pontoon.

A typical section through the fixed boardwalk near the northern end (deck level 2.0m AHD) is shown in **Figure 4**. A view of the boardwalk and pontoon looking south, drawn at Lowest Astronomical Tide (-0.925m AHD), is shown in **Figure 5**.

The proposed fixed boardwalk is supported by tubular steel piles (refer **Figure 4**). Situated above the piles would be precast concrete headstocks, timber or precast concrete girders and timber decking. The floating place is restrained in place by a series of steel tubular piles along the landward side (refer **Figure 5**). The pontoon is likely to be fabricated from steel or precast concrete with timber board decking.

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(Source: Grant Associates)

Figure 3 Wulugul Boardwalk and Pontoon showing key levels

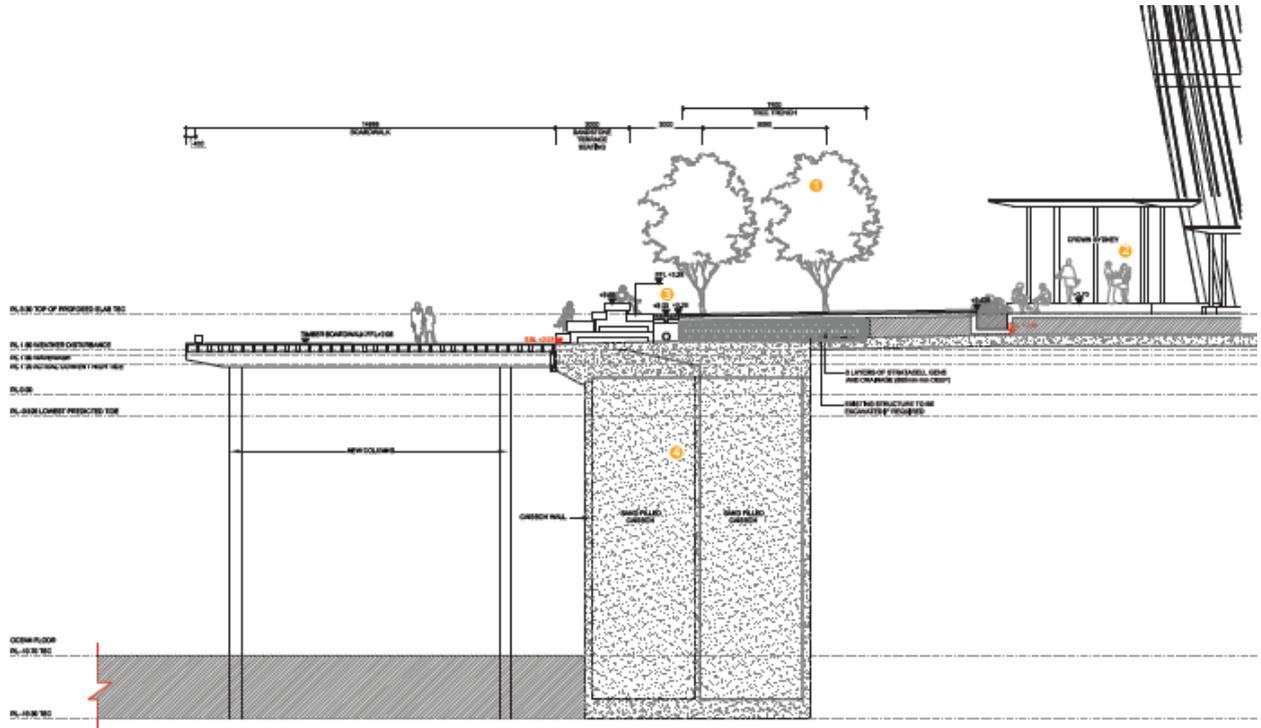


Figure 4 Wulugul Boardwalk – section

(Source: Grant Associates)



Figure 5 Wulugul Boardwalk and Pontoon – view looking south

(Source: Grant Associates)

### 2.2.2 Construction Methodology

The proposed construction methodology would involve a combination of water based and land based plant.

Water based plant would be utilised for installation of piling and precast headstocks for the fixed boardwalk. The barge involved in these works would be approximately 54m long and 24m wide. It would be oriented primarily north/south during piling operations (approximately 75% of the time).

Land based plant and equipment would be primarily utilised for installation of the girders and decking for the boardwalk. Some movements by small work boats would also take place.

The pontoon would be fabricated off site, transported to a suitable offloading point in the Harbour elsewhere, and towed into position.

The total duration of the water based component of the works, involving the barge, is estimated to be approximately 4 months.

## 2.3 Watermans Cove and Public Pier

### 2.3.1 Proposed Structure

The proposed Watermans Cove and Public Pier are shown in **Figure 6**.

The Cove is framed by the Public Pier in the south and Wulugul Boardwalk in the north. A small section of existing suspended wharf structure and piling would be demolished to complete the shape of the Cove (refer **Figure 1**). No berthing facilities are proposed within the Cove.

The levels around the Cove step down from an upper concourse level of 3.5m AHD to a minimum level near the waters edge of 1.50m AHD. A typical section through the Cove is shown in **Figure 7**. A view of the Cove foreshore looking north west is shown in **Figure 8**. The main boardwalk and lower boardwalk would be timber structure with timber decking boards.

Approximately 20 existing piles would need to be removed to create the inner shape of the Cove. It would be normal practice to cut the piles off at or below seabed level so they do not form a hazard to navigation. In this case, however, it is proposed to restrict navigation to the inner portion of the Cove, accordingly cutting off the piles at or below the seabed is not required for navigation purposes. It is proposed to retain a portion of the piling and include them in aquatic eco-engineering works to improve bio-diversity, as discussed further below. The depth below low water mark at which the piles would be cut off will be influenced by a future risk assessment at Design Development stage that investigates the potential for injury from a fall into the water.

Wherever possible, other existing piles would be retained and utilised to support the new boardwalks and steps of the Cove. Where new piles are required due to the required geometry of the Cove, tubular steel piles would be installed.

The Public Pier would extend into Darling Harbour by a distance of approximately 50m measured from the face of the existing vertical caisson wall. The proposed level of the timber boardwalk around the perimeter of the Pier is 1.80m AHD.

The Public Pier would be supported on steel tubular piles. Situated above the piles would be precast concrete headstocks then either timber girders and decking (perimeter boardwalk) or precast concrete deck planks (below future building structure).

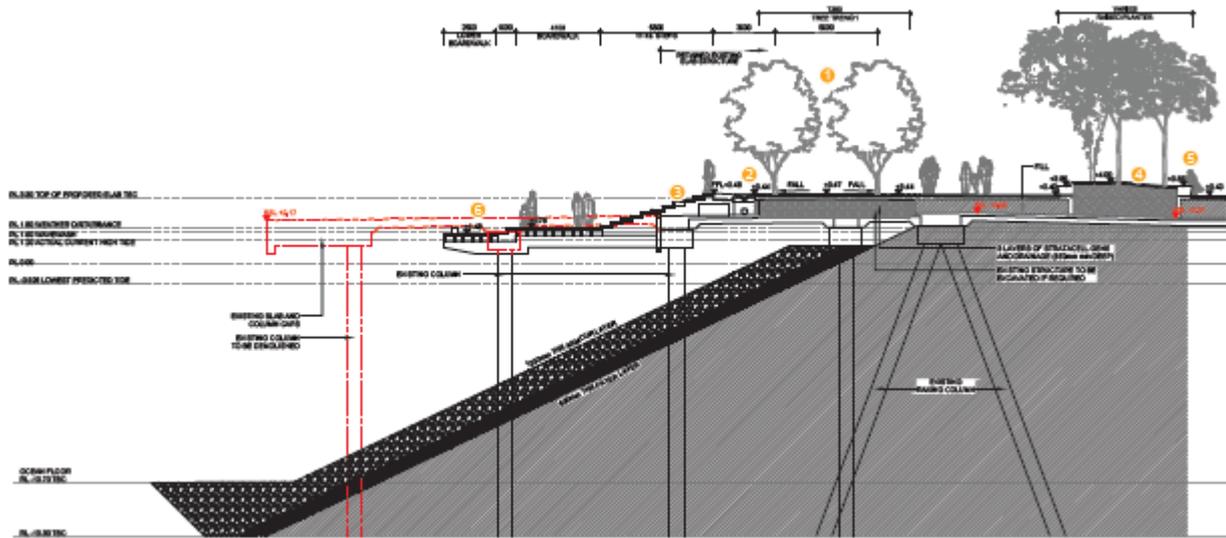
As noted above, it is proposed to include aquatic eco-engineering works to improve bio-diversity in the inner area of Cove where piles are to be cut off. In principle the proposal is to cut off the approximately 20 piles at a suitable level below low water having regard to public safety (refer above) and attach structure complexity to the piles in this subtidal area in the form of concrete reef balls and steel plates and the like to promote aquatic colonisation and recruitment, and improve bio-diversity.

It is intended that detailed design of the subtidal structure would be undertaken in consultation with the NSW Department of Primary Industries and the University of New South Wales Sydney Institute of Marine Science (SIMS). The development and monitoring of the aquatic eco-engineering works could form part of the SIMS Sydney Harbour Research Program.



(Source: Grant Associates)

**Figure 6** Watermans Cove and Public Pier



(Source: Grant Associates)

Figure 7 Watermans Cove – typical section



(Source: Grant Associates)

Figure 8 Watermans Cove – view looking north west

### 2.3.2 Construction Methodology

The proposed construction methodology would involve a combination of water based and land based plant.

Water based plant would be utilised for installation of piling and precast headstocks. The barge involved in these works would be approximately 54m long and 24m wide. It would be oriented primarily north/south for the Public Pier works and primarily east/west for the Watermans Cove works.

Land based plant and equipment would be primarily used for installation of the girders, decking and precast deck planks. Some movements by small work boats would also take place.

The total duration of the water based component of the works, involving the barge, is estimated to be approximately 4 months each for Watermans Cove and the Public Pier.

### 3 ASSESSMENT OF ISSUES

#### 3.1 General

As outlined in Section 1.2, there are four issues or matters to be addressed:

- The EIS should address whether modifications to the estuarine foreshore comply with the recommendations of *Environmentally Friendly Seawalls – A Guide to Improving the Environmental Value of Seawalls and Seawall-lined Foreshores in Estuaries (DECC, 2009)*.
- The EIS should detail plans for any proposed environmentally friendly seawall works or aquatic eco-engineering works to improve bio-diversity.
- Where structures are proposed to be built over water they should have regard to the *Policy & Guidelines for fish habitat conservation and management (2013)*, and identify construction methods and techniques that minimise the impact on aquatic biodiversity.
- Assess the geotechnical and contamination issues (including Acid Sulphate Soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works.

Each of the above four matters are considered in the following sections.

#### 3.2 Compliance of Modifications to the Estuarine Foreshore with Environmentally Friendly Seawalls (DECC, 2009)

##### 3.2.1 DECC (2009)

DECC (2009) sets out a range of techniques to increase the environmental and habitat values of both existing and new seawalls, while minimising disruption to natural processes. It advocates use of natural materials such as rock and emphasises three key principles:

- maximise the use of native foreshore and estuarine vegetation:
  - include estuarine vegetation such as saltmarsh in the seawall,
  - plant native foreshore vegetation behind the seawall and in the gaps of rock seawalls,
  - establish mangroves in front of the seawall,
- maximise habitat diversity and complexity:
  - create walls of boulders of varying sizes and shapes, or irregularly shaped and weathered blocks,
  - include pool or crevice areas that retain water at low tide, and create seawalls with blocks that extend outwards,
  - use blocks cut from rock without cement between them to provide gaps and crevices,
- create low-sloping seawalls or include changes of slope:
  - build seawall with a gentle slope using boulders,
  - use benches or steps to break up and vary the slope,
  - do not build vertical seawalls.

Importantly, the Environmentally Friendly Seawalls document deals with structures situated within the intertidal zone, ie. from Lowest Astronomical Tide (LAT) to Highest Astronomical Tide (HAT) or, currently, in terms of AHD, from -0.93m AHD (approximately LAT) to 1.08m AHD (approximately HAT).

### 3.2.2 Proposed Modifications to Estuarine Foreshore and Assessment

The existing foreshore along the Stage 1B Public Domain comprises a vertical faced reinforced concrete caisson north and south of Watermans Cove, and a sloping rock revetment within the area of Watermans Cove.

#### Existing Caissons

The proposed modification in the area of the existing concrete caissons involves an increase in crest level from around 2.2m AHD, up to typically 3.5m AHD. As such, the proposed modification is situated well above the current intertidal zone (-0.93m AHD to 1.08m AHD as noted above) and, accordingly, the Environmentally Friendly Seawalls Guideline document is strictly not a relevant consideration for the modification, at present day.

Should a rise in mean sea level occur into the future associated with climate change the position of the intertidal zone relative to current AHD will also rise. The tidal range itself (LAT to HAT) would not change as this is related to the effects (mainly) of the sun and the moon.

Arup (2013) has set out a summary of sea level rise policy benchmarks and projections to the year 2100 as part of their climate change and sea level rise report for the Public Domain (Stage 1A). In order for the proposed modification section to become intertidal at some point into the future it would be necessary for sea level to rise a minimum of approximately 1.0m.

A sea level rise of 1m is near the upper limit of estimates to the year 2100. It is in excess of the NSW Government's sea level rise planning benchmark value to 2100 of 0.9m included in the then NSW Sea Level Rise Policy Statement, November 2009<sup>1</sup>.

Based on the above it is considered very unlikely that the section of modification of the estuarine foreshore would become intertidal over the life of the project, and thus very unlikely over time to fall within the scope of recommendations set out in Environmentally Friendly Seawalls (DECC, 2009). In any case, should this occur within the life of the project, adaption measures could be readily applied to that section which becomes intertidal. Of the recommendations included in DECC (2009), such adaption measures would likely comprise pooling or crevice elements installed on the face of the foreshore, since use of vegetation or creation of low-sloping elements would not be feasible due to water depth and geometrical/spatial constraints.

#### Sloping Rock Revetment

There are no required or proposed modifications to the existing sloping rock revetment. Accordingly, a check on compliance with DECC (2009) does not arise. However, it is worth noting that the removal of a section of existing overwater deck structure to create the Cove (refer **Figure 1**) would remove some

<sup>1</sup> Note that the 2009 NSW Sea Level Rise Policy Statement is no longer NSW Government Policy. Any reference to the 'NSW sea level rise planning benchmarks' in various guidelines and documents should now be taken as meaning 'council's adopted sea level rise projections' where available. The City of Sydney has not produced a local council sea level rise policy (Arup, 2013). A sea level rise planning benchmark value to 2100 of 0.9m remains reasonable in the opinion of the writer and has been adopted as a planning value by numerous NSW coastal Councils.

overshadowing of the rock revetment which is beneficial, albeit in relatively deep water (approximately -6m AHD and deeper).

### **3.3 Environmentally Friendly Seawall Works or Aquatic Eco-Engineering Works**

No specific environmentally friendly seawall works are proposed to the face of the existing vertical concrete caissons or to the existing sloping rock revetment.

Aquatic eco-engineering works are proposed in conjunction with partial demolition of the existing over-water deck and retention of some 20 cut-down piles, as outlined in Section 2.3.1. This will have a positive benefit for bio-diversity.

### **3.4 Over-water Structures and Policy & Guidelines for Habitat Conservation and Management (DPI, 2013)**

The Wulugul Boardwalk and Pontoon are proposed over-water structures that would extend some 14m into Darling Harbour beyond the face of the existing vertical caisson wall. The Public Pier also extends over water into Darling Harbour by approximately 50m.

The relevant considerations in the *Policy & Guidelines for Habitat Conservation and Management (2013)* are those that relate to foreshore works and waterfront development (Section 5 of the document). It can be demonstrated that the general policies for foreshore structures and the more specific policies for jetties, wharves and pontoons would not have a significant influence on the proposed over-water structures in the Stage 1B Public Domain since:

- the waterway is not TYPE 1 – Highly Sensitive Key Fish Habitat (refer below);
- the proposed structures would not restrict fish passage (being open piled structures);
- the structures would not shade seagrass, as no seagrass exists at the site (refer below).

TYPE 1 – Highly Sensitive Key Fish Habitat is defined in Table 1 of DPI (2013). It includes habitats such as *Posidonia australis*, coastal saltmarsh, coral communities and SEPP 14 coastal wetlands. Marine ecology studies at Barangaroo completed by WorleyParsons (2010) including observations by divers and underwater video transects, and mapping by DPI, indicates the absence of highly sensitive key fish habitat including seagrass. The water depth at the site (greater than 10m) and associated limited light penetration at such depths in Sydney Harbour would restrict the growth of seagrasses in the footprint of the proposed over-water structures.

It follows that no specific consideration of construction methods and techniques that minimise the impact on aquatic bio-diversity is considered necessary for the proposed over-water structures in the Stage 1B Public Domain. Having said that, purpose-designed works to improve bio-diversity at the site (Watermans Cove) form part of the project proposal as discussed earlier.

## 3.5 Geotechnical and Contamination Issues

### 3.5.1 Geotechnical

The geotechnical conditions at the site comprise very soft organic sandy silty clay overlying compact/firm/stiff/very stiff silty sands and silty clays, overlying sandstone. Piles carrying significant vertical loads would be installed to bedrock. Piles restraining the proposed pontoon structure, which are subject to lateral loading only, may be founded in the silty sands and silty clays above bedrock subject to detailed design.

Piles can be readily installed into the seabed at the site with the appropriate pile driving equipment as evidenced by the existing piled structures at Watermans Cove. Accordingly, geotechnical conditions at the site are not an issue for completion of the project.

### 3.5.2 Contamination

Acid sulfate soils are incorrectly referred to as contaminated materials in the SEARs, they are in fact a naturally occurring material. In any case, it is not proposed to remove sediments from the seabed and place them in an environment where they may oxidise, such as could occur otherwise with dredging and on land disposal. Accordingly, acid sulfate soils is not an issue.

The contamination status of the sediments at the site were studied by ERM (2008) as reported in WorleyParsons (2010). WorleyParsons (2010) also collected surface sediment samples in the Barangaroo Stage 1 area which were analysed for particle size distribution. No testing of heavy metals or other contaminants was undertaken, as the results from ERM (2008) were relied upon.

In summary, the significant findings were as follows:

- the surface sediments comprise sandy clayey silt, the mean percentages by weight for each sediment fraction based on four samples was sand 23%, silt 40% and clay 37%;
- anthropogenic debris was observed on the seabed including rocks, chains, bricks, steel and old fencing;
- concentrations of metals exceeded screening levels<sup>2</sup> across the majority of the area sampled;
- concentrations of polycyclic aromatic hydrocarbons (PAHs) exceeded screening values across the majority of the area sampled;
- concentrations of tributyl tin (TBT) exceeded screening values across the majority of the area sampled.

Elevated concentrations of contaminants in sediments in Sydney Harbour is common due to the long history of urban and industrial activity. Heavy metal contamination would be linked to diffuse source and concentrated source stormwater runoff to the Harbour. Elevated PAH concentrations would be associated with the former gasworks operations nearby. The likely source of elevated TBT would be anti-fouling agents on ships hulls using Darling Harbour.

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<sup>2</sup> The screening levels adopted in ERM (2008) were the Interim Sediment Quality Guidelines (ISQG) – Low concentration/set out in ANZECC/ARMCANZ (2000).

While the existence of elevated concentrations of contaminants in sediments has the potential to impact on water quality and aquatic ecology, in practice any impacts would be negligible, for the following reasons:

- disturbance during construction activity would be minimal, limited to minor localised movement of surface sediments during piling;
- any disturbed sediments would locally re-settle and remain in the same physico-chemical environment;
- piling operations would be intermittent and temporary in duration;
- once constructed the proposed over-water structures would not lead to any significant alteration of existing low tidal velocities near the seabed given the large cross sectional area of the Darling Harbour waterway and limited 'blockage' caused by the isolated pile foundations.

Notwithstanding the above, it is recommended that a number of mitigation measures be introduced during construction, as follows:

- installation of a silt curtain, unless it can be shown by monitoring of similar construction activities at the site, eg. construction of the adjacent ferry hub, that installation of silt curtains is not required to ensure satisfactory water quality;
- water quality monitoring;
- availability of site spillage equipment to absorb any spills that may enter the water from a piling barge or the like;
- preparation and implementation of a Construction Environmental Management Plan (CEMP).

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