



Non-Technical Summary

Kendall Bay Sediment Remediation Project Environmental Impact Statement

Preface

This Non-Technical Summary (NTS) accompanies the Environmental Impact Statement (EIS) for the Kendall Bay Sediment Remediation Project (the Project) being undertaken by Jemena Limited (Jemena). The NTS has been provided to summarise the proposed remediation works and key impacts (both positive and negative) of the Project that have been assessed as part of the EIS.



Introduction

Who is Jemena?

Jemena is an Australian infrastructure company which builds, owns and operates a diverse portfolio of major electricity, gas and water assets across eastern and northern Australia. Jemena was formed following the acquisition of assets and businesses from Alinta Limited, as well as The Australian Gas Light Company's (AGL) gas distribution business.

AGL formerly operated the Mortlake Gasworks located adjacent to Kendall Bay on the Parramatta River.

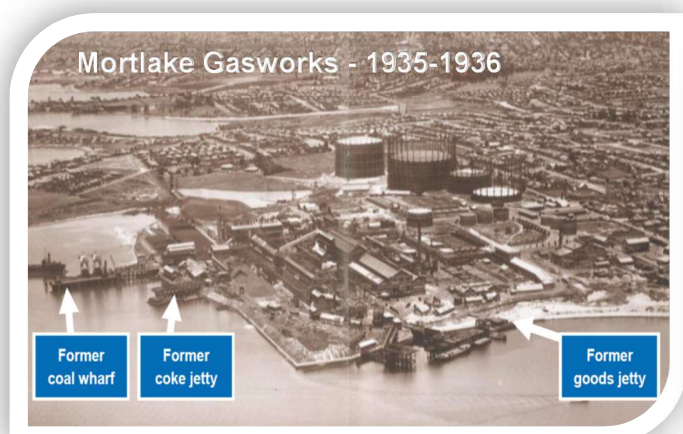
Project Background

Kendall Bay is located on the southern side of the Parramatta River approximately 10 km west of the Sydney Central Business District. Historically the bay was utilised for the loading and unloading of coal and other materials for the adjacent Mortlake Gasworks, which was established by AGL in 1886 and eventually ceased production in the 1980s.

The process of gas production resulted in the gradual accumulation of contaminants in the soils on the gasworks site and in the adjoining bay sediments. Following the decommissioning of the gasworks, the land adjacent to Kendall Bay to the west was remediated and has now been re-developed, forming part of the Breakfast Point residential area.

The only infrastructure from the old gasworks that remains along the Kendall Bay foreshore are portions of wharf timber piles associated with the former coal loading wharf, which extend below the river bed. Since the closure of the gasworks, other uses of Kendall Bay have predominantly been for passive water-based recreational activities.

In 2004, the bed of the Parramatta River and Kendall Bay within 200 metres of the shoreline bordering the former Mortlake Gasworks was declared a 'Remediation Site' by the NSW Environment Protection Authority (EPA) after investigations carried out by AGL established that areas of sediments within the bay had been contaminated by gasworks activities.



Agreement was reached with EPA regarding further investigation of the area to determine the nature and extent of the contamination, undertaking of a risk assessment, defining remediation areas and development of a Remediation Action Plan (RAP).

Jemena's Voluntary Management Proposal (VMP) for the remediation phase of the Project was accepted by the EPA in 2017. The RAP was completed in June 2018 and identified two remediation areas within Kendall Bay- Southern Remediation Area and the Northern Remediation Area (refer Figure 1).

Although the EPA-declared 'Remediation Site' is more extensive, substantial investigation and assessment work has enabled Jemena to refine the Remediation Areas. These were determined to be important to remediate due to the levels of gasworks-related contamination that pose a potential risk to human and ecological health.

The RAP establishes the remediation criteria, describes the management of the proposed methodology and works, and forms the basis for the environmental assessment undertaken in this EIS.

The EIS

The Kendall Bay Sediment Remediation Project (the Project) has been declared a State Significant Development (SSD), so before permission is given to undertake remediation works, Jemena is required by Part 4 of the *Environmental Planning and Assessment Act 1979* to prepare and submit an EIS assessing the impacts of the Project.

Aims of the EIS

- To enable the SSD application to be assessed under Part 4 of the EP&A Act
- To provide information on the Project, including the need for the Project and alternatives considered
- To assess the potential key environmental and social impacts, as identified in the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project
- To set out Jemena's commitments to minimising and managing potential environmental and social impacts
- To establish a robust level of environmental management through the development of the mitigation and management measures proposed; and
- To enable the refinement of a preferred remediation methodology through a review of available and feasible options and suitable access / processing sites.

Objectives of the Remediation Project

The Project will meet Jemena's obligations under the VMP and the key remediation objectives set out in the RAP which are to:

- ensure long-term protection of the health of users of the Kendall Bay foreshore and recreational users of the waterway from potential impacts from gasworks-related contamination. This includes the southern beach and adjacent mangrove area where gasworks contaminated sediments are currently exposed at low tides,
- improve the health of the Kendall Bay marine ecosystem in areas where it is adversely affected by acutely toxic gasworks contaminated sediments;
- improve the amenity of readily accessible areas of Kendall Bay;
- ensure that a durable remediation outcome is achieved that satisfies the requirements of the VMP; and
- provide a remediation solution that is technically sound, environmentally justifiable and meets EPA requirements and community expectations.



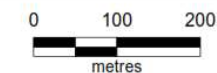


- Legend:**
- Staging Site (140 Tennyson Road, Mortlake)
 - Declared
 - Northern Remediation
 - NA1
 - NA2
 - NA3
 - SA1
 - SA2
 - SA3
 - SA4
 - SA5
 - Sea Wall
 - Water Based**
 - 10 Metres from Sea Wall
 - 20 Metres from Sea Wall

Note: Declared and remediation area approximate only



Scale at A4 1:8,000



Coor. Sys. GDA 1994 MGA Zone 56

Kendall Bay Sediment Remediation Project,
Sydney, New South Wales

PROJECT AREA

Figure 1



What Areas Are Being Remediated?

The Southern Remediation Area (see Figure 2) is located at the southern (beach) end of Kendall Bay directly to the east of the Breakfast Point residential development and comprises:

- sediments in the south-western corner of the bay (SA1)
- the south-western foreshore (SA2)
- the mangroves and stormwater delta (SA3); and
- the beach (SA4 and SA5).

The Northern Remediation Area (see Figure 3) is located on the eastern foreshore of Kendall Bay, where the former coal wharf was located, and comprises:

- the eastern foreshore (NA1); and
- sediments located in deeper water to the east of the foreshore (NA2 and NA3).

Remediation in NA1 and SA2 will be adjacent to the seawall on the western side of Kendall Bay.

The Project Area also includes the Jemena owned Staging Site located at 140 Tennyson Road, Mortlake and the adjoining wharf area leased by Jemena from Roads and Maritime Services.

The Project will be managed from the Staging Site, which will be used as a central point where equipment will be deployed and contaminated sediment will be received and transferred to trucks for offsite treatment and disposal.

Access to the Northern and Southern Remediation Areas from the Staging Site will be by a water based corridor (refer to Figure 1).

With the exception of the seawall on the western side of Kendall Bay, the Remediation Areas are entirely within Kendall Bay itself.



Detail of Proposed Remediation Works

The Project is divided into 3 phases:

1. **Site Establishment** – setting up the Staging Site, bringing in all the necessary equipment and materials for the remediation works and the establishment of all the required environmental controls.
2. **Remediation Works** – will involve several remedial technologies, each chosen based on the level of contamination and the remediation criteria required to be met, as well as specific site constraints.

The areas to be remediated (refer to Figures 2 and 3) and the technologies proposed are detailed below:

Areas SA1 + NA2 + NA3: remediation will use a technology called in-situ stabilisation (ISS) which involves stabilisation of sediments through mixing cement and other additives into seabed sediments. The ISS treatment will provide containment of impacted sediment and reduce the ongoing source of contamination to Kendall Bay. At SA1 (and potentially NA2+NA3 depending on field trials) steel sheet piles will also be installed to form a continuous wall around the perimeter of the site to control turbidity plumes in the water. Depending on the depth to stable clay seabed sediments, a raft slab over a supporting grid of ISS columns embedded into the seabed may be installed to cap the contaminated sediment below. Alternatively mass soil mixing will be undertaken to create a single monolith (and no supporting columns) extending to the clay seabed sediments to achieve the same purpose. The approach will be confirmed following field trials. Once the raft / monolith is in place, the top will be excavated to a depth of 0.5 m to adjust the height and to remove the upper profile of stabilised material. Additional capping material (e.g. geotextile layer, rock and sand) will be placed on top to reform the seabed surface and provide clean upper profile. Where sheet piling has been used, following completion of works, the sheet piles will be driven into the underlying clays or cut so the top of the sheet piles are at the level of low tide.

Area SA2 + NA1: remediation will be undertaken by excavating and removing stained surface sediments and rubbish to a depth of 0.3 m. The existing seawall will be cleaned to remove surface staining. Removal of one mature mangrove plant only at the south-western end of the beach and some small offshoots, will be necessary to achieve the remediation criteria for these areas. A geotextile fabric and capping material (cobble sized rock and sand / mud) will then be placed on top of the excavated areas to provide clean upper profile.

Area SA3: remediation will be undertaken by excavating and removing surficial coke, coal and rubbish material (by hand operated equipment in sensitive mangrove areas) to a depth of 0.2 m. Clean sand will be placed on top to provide clean upper profile.

New spur wall structures will also be constructed to train stormwater flows and retain sand in the mangrove area.

Area SA4: remediation will be undertaken by excavating and removing stained surface sediments and rubbish to a depth of 0.2 m using small earthmoving equipment. Clean sand will be placed on top of the excavated areas to provide a clean beach area. An approximately 30 metre long seaward extension of the existing sandstone wall as part of a beach nourishment program will assist in retaining placed sand.

Area SA5: remediation will be undertaken by excavating and removing coke, coal and debris on the surface and to a depth of 0.3 m. Clean sand will then be placed on top to provide a clean offshore wading area. An erosion control system will be installed where the existing stormwater pipe discharges onto the beach, to help prevent sand from washing away due to erosion.

All excavated material removed from the remediation areas will be transported by barge in sealed bins to the Staging Site, for transfer onto trucks from where it will be transported offsite for further processing at an EPA licensed facility. The disposal of all contaminated waste will be at an EPA licenced waste treatment and landfill facility.

3. **Post Remediation Validation, Decommissioning and Site Management** – will involve assessment and validation of the completed work to ensure it meets RAP objectives, disassembling and removal of Project infrastructure, cleaning of the Staging Site and implementation of the post-remediation Site Management Plan.

When is this happening? How long will it take?

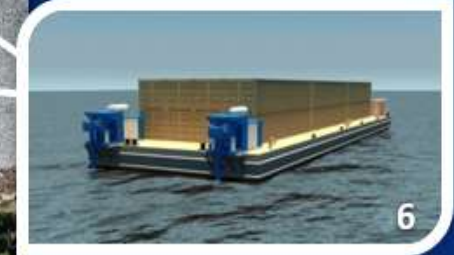
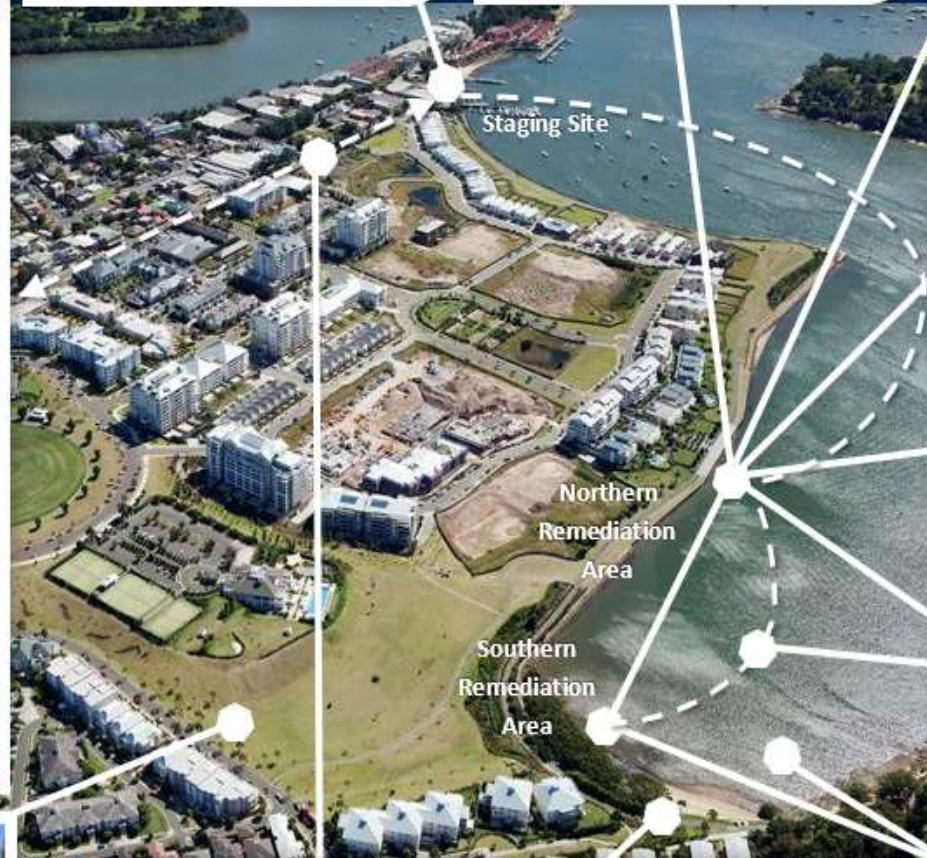
Jemena anticipate the Project will be completed within a 16 - 28 month timeframe from the commencement of the site establishment phase to the decommissioning and rehabilitation phase. The start date of the Project is planned for the second quarter of 2019, on the assumption that approval for the RAP, remediation trials and EIS is granted before then.

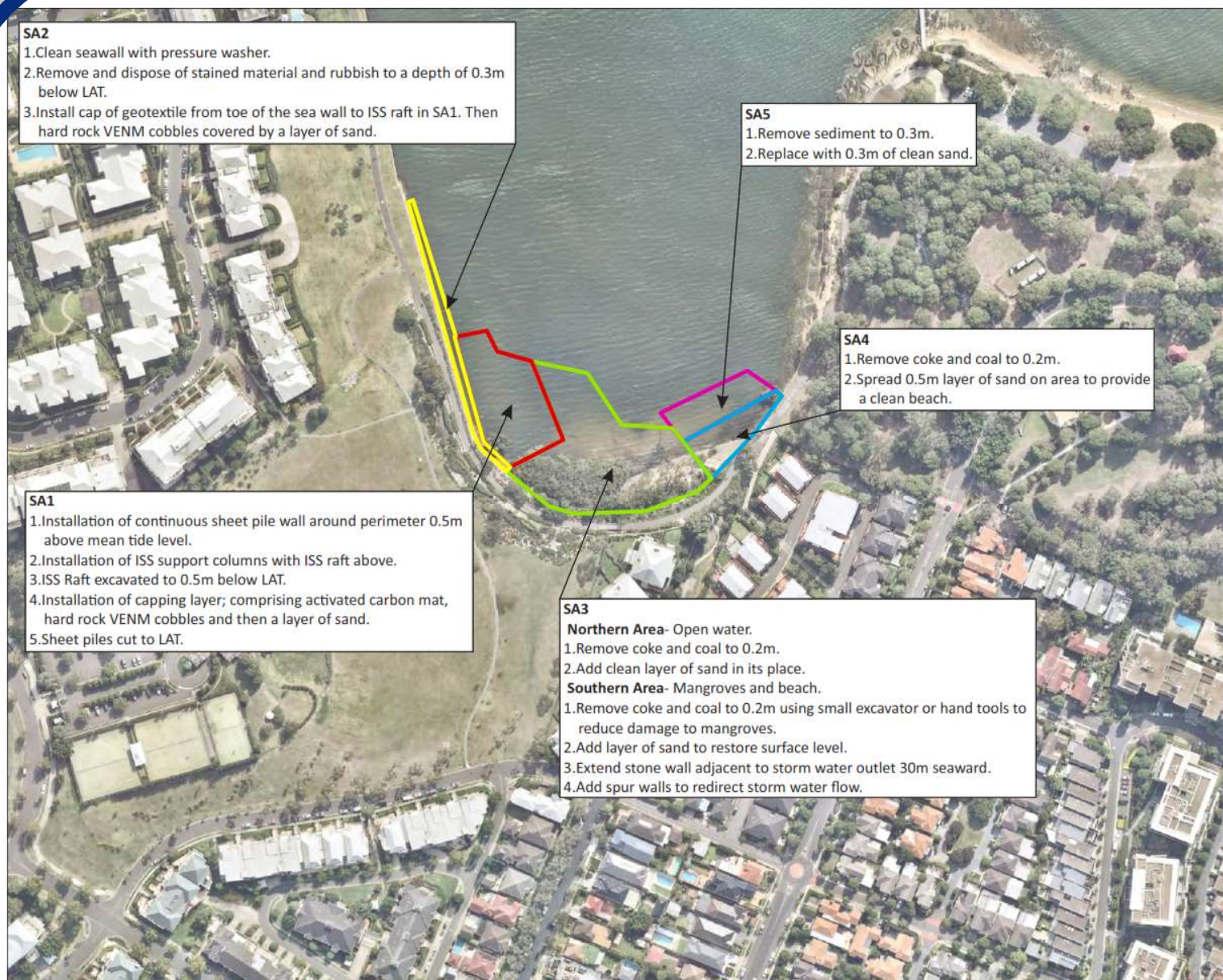
All remediation works will occur between 7am and 5pm Monday to Friday, and between 8am and 1pm on Saturdays.

No works are proposed for public holidays or Sundays

The Project Process involves:

1. **Staging Site establishment**, and mobilisation of equipment and materials to Staging Site
2. **Installation of environmental controls** (sheet piling, silt fences and other environmental protection and monitoring measures) within the Northern and Southern Remediation Areas
3. **In-Situ Solidification (ISS)** of contaminated sediment using barge mounted drill rig and concrete mixing within Remediation Areas SA1 and NA2+NA3
4. **Excavation** of top 0.5 m of ISS raft / monolith (SA1 and NA2+NA3) and removal of cement and contaminated sediment
5. **Further excavation** and removal of contaminated sediment from remaining Remediation Areas
6. **Transport of contaminated sediment by barge** in sealed bins to the Staging Site
7. **Backfill** with clean imported material
8. **Extension of seawall**, storm water diversion devices, removal of coal and rubbish, and placement of clean imported sand in the Southern Remediation Area
9. **Transport of contaminated sediment** in trucks by road to approved offsite treatment site for treatment and then to an approved offsite landfill facility
10. **Site demobilisation** and return of Kendall Bay with improved amenity for the local community.





Legend:

- SA1-Southern Area 1
- SA2-Southern Area 2
- SA3-Southern Area 3
- SA4-Southern Area 4
- SA5-Southern Area 5

Note:
LAT = Lowest astronomical tide.
ISS = In situ stabilization.
VENM = Virgin excavated natural material.



Job No: 54864

Client: Jemena Limited

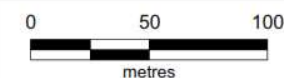
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Date: 30-Aug-2018

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Kendall Bay Sediment Remediation Project,
Sydney, New South Wales

**SOUTHERN REMEDIATION AREA WORKS
SUMMARY**

FIGURE 2



Legend:

Remediation Area

- NA1-Northern Area 1
- NA2-Northern Area 2
- NA3-Northern Area 3
- Remediation Boundary

Note:

LAT = Lowest astronomical tide.

ISS = In situ stabilization.

VENM = Virgin excavated natural material.



Job No: 54864

Client: Jemena Limited

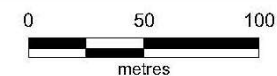
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**Kendall Bay Sediment Remediation Project,
Sydney, New South Wales**

**NORTHERN REMEDIATION AREA WORKS
SUMMARY**

Figure 3

The Planning Process

Following the declaration of the Project Area as SSD, the SEARs for the Project were issued in September 2014. The SEARs were revised with minor changes and reissued by the Department of Planning and Environment (DP&E) in March 2017. The EIS has been prepared to comply with these SEARs and the comments provided by other relevant government agencies and the City of Canada Bay. In addition to compliance with the SEARs, the EIS addresses matters required by environmental planning laws.

Given the long history of the Project, numerous specialist studies have been undertaken to understand and refine the various remediation methodologies and potential impacts. These studies have been drawn on in this EIS and where required, updated or undertaken again to reflect changes in the remediation approach and to address stakeholder concerns.



Stakeholder Consultation

Jemena has engaged in extensive consultation with the local community since 2012. This has included community meetings, information and feedback sessions, stakeholder briefings, community newsletters, a project website and a Community Liaison Group.

The focus of pre-remediation communications and consultation has been on providing updates to stakeholders as the remediation planning progresses, and seeking feedback on issues relating to the proposed remediation strategies.

The program of stakeholder engagement will be continued for the duration of the remediation works and, where applicable, in the period following completion of those works.



Kendall Bay Sediment Remediation Project Newsletter Issue 18, August 2016



This newsletter provides the latest updates on the Kendall Bay Sediment Remediation Project. All newsletters are available on the project website www.kendallbayremediation.com.au

Project Updates

Since the last newsletter in February this year, the Jemena team has been busy undertaking further scientific investigations and sampling in Kendall Bay.

This additional work was commissioned in response to an Environment Protection Authority (EPA) request to further assess the nature and extent of contamination in specific parts of Kendall Bay. The results were also required to inform a more refined remediation approach.

Since March 2015, additional sediment sampling has been undertaken in different locations across the Bay. Detailed analysis of contaminants in the sediments was also carried out, as was an assessment of the mangroves and benthic organisms (organisms that live in and on the sea/river bed) in comparable locations.

Results were recently discussed in a workshop with key government agencies, including the EPA, Department of Planning and Environment (DP&E), Roads and Maritime Services, Fisheries and Canada Bay Council. This was the latest in a series of ongoing discussions with the key agencies over the last 12 months.

Upcoming Dredging Trial

On 22nd September Jemena will be undertaking a dredging trial in the Bay at the location marked on the map. The aim of the trial is to collect bulk samples for sediment stabilisation trials and to allow odour and contaminant sampling.

Jemena has been advised by local residents that, during certain hot weather conditions, there are noticeable odours from the Bay in that area. The sampling will assist to determine the specific nature of contamination there and the preferred remediation method.

The Project Team will be available from 9:30am to 11:30pm on location for all who would like to come along, observe and ask questions.



email: kendallbay@jemena.com.au • phone: 1800 266 863 • web: www.kendallbayremediation.com.au

Jemena is committed to ongoing consultation with the community.

Potential Impacts of the Project

Community consultation conducted since 2012 has consistently identified that the primary environmental concerns for the local community are air quality (odour), noise, marine ecology and mangroves, traffic, water quality and visual amenity.

The EIS assesses the environmental impact of the Project as required by the Act, including these concerns and addresses other issues such as cultural heritage, waste management, and hydrology. Some of the impacts of primary concern to the community and the main mitigation measures are described below.

Air Quality

The sediments present in Kendall Bay currently have a strong unpleasant tar and hydrocarbon odour at low tide. There is potential for a similar odour to be produced from a number of sources during the remediation works, including through excavation of material from the bay, evaporation from exposed excavated material, soiling of the work area and from handling and transportation of contaminated material to the Staging Site.

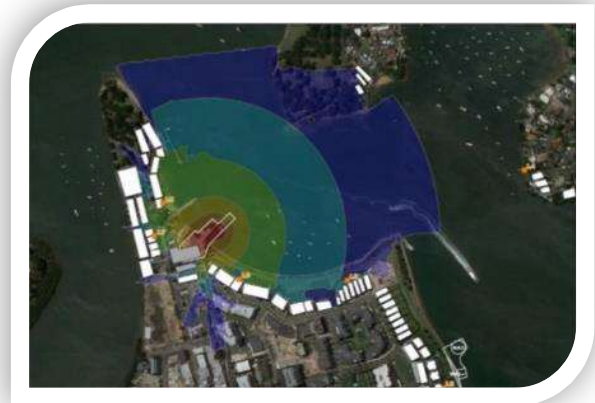
Odour modelling and modelling of evaporation of volatile chemicals, was undertaken based on conservative assumptions. Modelling shows that none of the chemicals relevant to the gasworks waste are predicted to be present in shoreline locations at concentrations that are above conservative ambient air quality guidelines (even under worst case dispersion conditions). The Project is therefore not expected to result in adverse health impacts for surrounding residents or any other receptors, including pedestrians along the promenade. It is possible that unpleasant odours will be noticeable at times but only for short periods.

Overall the remediation works will have beneficial impacts to the community by removing or containing the contaminated sediments which are the current source of the odour.

Key Commitments

Jemena will:

- Develop an Air Quality Management Plan
- Limit remediation activities to daylight hours
- Only excavate / expose the minimum area of sediment necessary at any one time
- Cover or seal each skip bin of excavated material immediately once filled
- Minimise the drop height of the excavator (i.e. limit the height from which material is dropped into the bin), and
- Continue ongoing community engagement including complaints management



Noise

Clearly audible levels of noise may be produced by remediation works but are expected to vary on a day-to-day basis and over the various phases of the Project. Primary noise sources include machinery and equipment (e.g. excavators, drill rigs), barges / small vessels and light and heavy vehicles used for transportation of equipment and materials to and from the Staging Site. Installation of sheet piling (proposed in certain areas of the remedial works to control turbidity plumes), may result in short duration noise and vibration impacts.

Noise modelling undertaken predicted potential Project noise levels at the closest or potentially most affected noise sensitive receptors were below, and comply with, the Project specific noise management levels in accordance with the NSW *Interim Construction Noise Guideline 2009*, with the exception of potential marginal exceedance during limited sheet pile installation works. Vibration impacts will be negligible, if any, for the majority of activities proposed and for most of the nearest sensitive receptors.

The character of noise from the Project works is likely to be similar to other construction activities associated with the substantial construction work which has occurred within the broader Project area over the years (e.g. Breakfast Point and Majors Bay).

Key Commitments

Jemena will:

- Develop a Noise Management Plan
- Strictly adhere to standard construction hours and enforce respite periods of necessary
- Erect temporary mobile screens where necessary
- Ensure management of construction vehicles
- Conduct noise and vibration monitoring where required
- Conduct ongoing community engagement including complaints management

Land Based Traffic

The Staging Site, at 140 Tennyson Rd Mortlake, will be the unloading / loading location for Project equipment and materials, and handling of excavated sediments prior to being transported to an approved facility for treatment and / or disposal. The Project is expected to generate an average of 5.26 heavy vehicle movements per day, however this will vary from day to day and over various stages of the Project. In addition to truck movements, there will be light vehicle movements (approximately 40 movements per day) associated with Project workers travelling to and from the Staging Site.

A detailed assessment of alternative routes and a traffic impact assessment concluded that heavy vehicle movements generated by the Project will be less than 1% of the total vehicle traffic within the local road network at present. Traffic congestion is not expected and no disruption to bus routes or pedestrians is likely.

The increase in traffic from the Project will be minor, short term and will cease at the completion of the Project.

Key Commitments

Jemena will:

- Develop a Traffic and Pedestrian Management Plan prior to commencement of Project
- Prepare a road dilapidation study prior to remediation works
- Ensure that no more than 15 public parking spaces are utilised for the Project
- Continue ongoing community engagement, including complaints management



Water Quality and Sediments

The activities associated with the proposed remediation works have the potential to cause the suspension of sediment within the water column during marine transport, in-situ stabilisation, excavation works, and the placement of backfill. A geotechnical model of sub-surface materials was developed and sediment sampling and analysis was undertaken to determine the potential impacts from remediation activities on water and sediment quality. It was determined that disturbance of the bed of Kendall Bay, disturbance of potential acid sulphate soils, release of unbound contaminants, and turbidity plumes may result during a range of Project activities.

Mitigation measures have been developed to address these potential impacts. In particular, use of sheet piling, primary and secondary silt curtains and bunds will minimise the risk of turbidity and mobilised contaminants moving outside the Remediation Areas. The potential water quality and sediment impacts within the Remediation Areas will be short-term and the Project will ultimately result in a significant improvement in sediment quality through the removal or containment of contaminated material.

Key Commitments

Jemena will:

- Develop and implement a Remediation Works Environmental Management Plan which will include a Water and Sediment Management Plan
- Prepare an Acid Sulfate Soil Management Plan
- Undertake a Water Quality Monitoring Program
- Install semi-permanent (i.e. for the duration of the remediation project) silt curtain barriers, oil absorbent booms and spill response kits at relevant areas
- Complete sheet piling as quickly as practicable and consider scheduling final stages of sheet pile construction during periods of lower tidal range and currents
- Conduct regular inspections for leaks / spills at silt curtain shore connections and immediately complete any required repairs
- Delineate construction areas in accordance with NSW Roads and Maritime Services requirements
- Issue of a 'Notice to Mariners' in coordination with NSW Roads and Maritime Services to advise the boating community of the extent, nature and duration of construction activities
- Utilise sealed bins in barges and covered trucks to transport materials on and offsite
- Design the capping materials to satisfy performance criteria
- Develop and implement a post remediation Site Management Plan for any agreed post remediation monitoring



Visual Amenity

The Project will require the establishment of temporary equipment and infrastructure during the course of the remediation works which will cause a temporary loss of amenity and some disruption of views of the Parramatta River and Kendall Bay.

The physical presence of the Project is likely to impact on visual amenity from publicly accessible viewpoints, particularly along the promenade and from neighbouring residential properties, however, these impacts will be phased over time, temporary and restricted to the life of the remediation works.

Once remediation works are completed and the Project infrastructure has been demobilised, the result will be an overall positive impact for the visual amenity of Kendall Bay, particularly in the beach and mangrove area of the southern area of the bay.

Key Commitment

Jemena will:

- Ensure good housekeeping at all sites and that areas are screened, where practical, to reduce any potential visual impacts.



Marine Ecology and Mangroves

The original proposed remediation approach raised stakeholder concerns in relation to the impacts of the remedial works on marine ecology. In particular, local community members were concerned about the potential for removal of all or most of the mangroves located at the southern end of Kendall Bay.

Subsequent to community consultation, the remedial approach was revised, resulting in a significant reduction in the impact of the works on the mangroves in the bay. It is now anticipated that only one mature mangrove and some small offshoots will have to be removed as a result of the work in Southern Remediation Area.

Assessment and investigations undertaken for the EIS indicate that impacts to threatened species are not expected as there are no critical marine habitats in the Project Area and no threatened marine species known to utilise the marine resources in Kendall Bay.

Impacts to the local marine environment from the removal of rubbish and contaminated material from the beach and mangroves area, cleaning of the seawall and disturbance of the seabed from implementation of the ISS methodology are expected to be minor and temporary. Removal, stabilisation and capping of contaminated sediments and reinstatement of the seafloor, seawall and beach with clean fill will positively impact the quality of the marine environment and amenity of this area of Kendall Bay.

Key Commitment

- Implement management measures relating to water quality to manage potential impacts to marine species.



Next steps

Submission of the EIS

Jemena is seeking approval from the Minister for Planning (or delegate) to obtain development consent for the remediation works proposed by the Kendall Bay Sediment Remediation Action Plan developed for the Project.

The next steps in the process are:

- **Exhibition of the Environmental Impact Statement** for a minimum of 30 days and an invitation to the community and stakeholders to make submissions.
- **Consideration of submissions.** Submissions received by the Secretary of the Department of Planning and Environment will be provided to Jemena and any relevant public authorities. Jemena may then be required to prepare and submit a submissions report, which contains responses to issues raised in the submission, and / or further design development and subsequent environmental impacts.
- **Determination of the Development Application.** The Secretary of the Department of Planning and Environment will provide an Environmental Assessment Report on the Development Application to the Minister for Planning (or delegate) who will then make a decision on the Project and, if approved, can set Conditions of Approval.

Stakeholder Engagement during the EIS Public Exhibition Period

Jemena will continue to engage with the local community during the public exhibition period for the EIS. A community information session will be conducted at the Project office (140 Tennyson Road, Mortlake) during this period and Jemena Project team members will be available to respond to any queries raised.

Following the community information session, the Project website will be updated to ensure members of the community and stakeholders not able to be present at the session have access to the latest information available.

www.jemena.com.au/about/projects/remediation-project/kendall-bay

The Project newsletter, and advertising in print and electronic media will also provide information about the EIS process, key aspects of the EIS public exhibition period and opportunities.

Conclusion

The assessment of the potential impacts of the Kendall Bay Sediment Remediation Project undertaken in the EIS indicates that there will be some temporary impacts experienced during the Project. However the EIS also demonstrates how these impacts will be mitigated by the Project-specific management measures which will be put in place to avoid, reduce or remedy the impacts identified.

The Project will provide an overall environmental and social benefit by improving the health of the marine ecosystem of Kendall Bay in areas where it is adversely affected by acutely toxic gasworks contaminated sediments and improve the amenity of readily accessible areas of Kendall Bay for the local community.



1. INTRODUCTION

1.1 OVERVIEW

Jemena Limited (Jemena) is seeking development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Kendall Bay Sediment Remediation Project (the Project). The Project involves remediation of gasworks-related contaminated sediments from two areas of Kendall Bay, located on the southern side of the Parramatta River adjacent to Breakfast Point.

This Environmental Impact Statement (EIS) has been prepared in accordance with the provisions of the EP&A Act and requirements for preparation of an EIS under Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* for a State Significant Development (SSD) application. It addresses the Secretary of the NSW Department of Planning and Environment Environmental Assessment Requirements No. SSD 6701 (the SEARs) dated 2 December 2014, which were re-issued on 7 March 2017.

In addition to addressing the SEARs, this EIS provides an assessment of potential environmental impacts of the remediation works and proposes management and mitigation measures to mitigate these potential impacts and ensure that they are managed in accordance with statutory requirements, regulations, community expectations and best industry practice.

1.2 ABOUT THE PROPONENT

Jemena is an Australian infrastructure company that builds, owns and operates a diverse portfolio of major electricity, gas and water assets across eastern and northern Australia. Jemena was formed following the acquisition of assets and businesses from Alinta Ltd, including the gas distribution business formerly owned by The Australian Gas light Company (AGL).

In NSW, Jemena owns and manages gas transmission and distribution pipelines. These gas pipelines enable the transfer of natural gas directly to over one million NSW households and businesses.

Details of the Proponent are outlined below:

Proponent	Jemena Limited
Primary Contact	Phil Hutson
Address	Level 14, 99 Walker Street, North Sydney NSW 2060
Phone	1800 571 972
Email	kendallbay@jemena.com.au

1.3 PROJECT BACKGROUND

Kendall Bay is located approximately 10 km west of the Sydney Central Business District (CBD) on the southern side of the Parramatta River (refer Figure 3-1). Historically the bay was utilised for the loading and unloading of coal and other materials for the adjacent Mortlake Gasworks, which were established by AGL in 1886 and eventually ceased production in the 1980s. The process of gas production resulted in the accumulation of contaminants in soils on the gasworks site and in the adjoining bay sediments. Following the decommissioning of the gasworks, the land adjacent to Kendall Bay to the west was remediated and has now been re-developed, forming part of the Breakfast Point residential area.

In 2004, the bed of the Parramatta River and Kendall Bay within 200 metres of the shoreline bordering the former Mortlake Gasworks was declared a 'Remediation Site' by the NSW Environment Protection Authority (EPA) after investigations carried out by AGL established that areas of sediments within the bay had been contaminated by gasworks activities. Agreement was reached with EPA regarding further investigation of the area to determine the nature and extent of the contamination, undertaking of a risk assessment and development of a Remediation Action Plan (RAP).

Jemena inherited AGL's obligations and responsibility for Kendall Bay contamination, following corporate transactions in 2006 and 2007. After further investigations and risk assessments, Jemena proposed a Voluntary Management Proposal (VMP) to govern its remediation activities. This VMP was accepted by the EPA in August 2017.

The RAP, completed in June 2018, identified two remediation areas - Southern Remediation Area and the Northern Remediation Area (refer Figure 1-1). A RAP addendum was also prepared in June 2018 to provide an independent assessment by a certified practitioner of the adequacy of the RAP, make some minor amendments to the RAP and address further stakeholder feedback.

The remediation Project was declared a SSD and SEARs issued for the preparation an EIS to support a SSD Application for the Project.

A detailed history of activities and environmental investigations in the Project Area is outlined in Chapter 2 Justification and Alternatives. A regulatory history of the Project is discussed in Chapter 5 Statutory Framework.

1.3.1 PROJECT AREAS

For the purposes of the SSD Application, the Project Area encompasses the Southern and Northern Remediation Areas within Kendall Bay, buffer zones associated with the Remediation Areas, a portion of the western seawall on Kendall Bay, a land-based Staging Site at Mortlake (including buildings and wharf area). The Project will also use a water-based corridor extending between Kendall Bay and the Staging Site (refer Chapter 3 Project Location and Context for further detail of the Project Area).

The Southern Remediation Area is located at the southern (beach) end of Kendall Bay and comprises five areas referred to as SA1 to SA5:

- sediments in the south-western corner of the bay (SA1).
- the south-western foreshore (SA2)
- the mangroves and stormwater delta (SA3); and
- the beach (SA4 - onshore and SA5 - nearshore seabed).

The Northern Remediation Area comprises three areas referred to as NA1 to NA3:

- the foreshore (NA1); and
- sediments located in deeper water to the east of the foreshore (NA2 and NA3).

The Staging Site will be established at 140 Tennyson Rd Mortlake at a property owned by Jemena.

The Project Area is shown in Figure 1-1 and further detail is provided in Chapter 3 Project Area Location and Context.

1.4 OBJECTIVES OF THE PROJECT

The overall objectives of the Project are to:

- provide significant environmental benefit by alleviating the potential long-term exposure risks to users of the nearshore environment caused from elevated levels of contaminants within the defined Remediation Areas
- promote ecological diversity and alleviate adverse ecological impacts; and
- meet Jemena's obligations for the management / remediation of sediments within Kendall Bay, as outlined in the VMP agreed with the EPA.

Remediation of the Southern and Northern Remediation Areas will realise a significant community benefit by targeting impacted sediment associated with odour and improving the visual and physical amenity of the southern beachline area of Kendall Bay.

1.5 OVERVIEW OF PROPOSED WORKS

The proposed remediation works will generally follow the key stages set out below:

- **Preparatory works and site establishment:** this will involve works associated with setting up the Remediation Areas and Staging Site, preliminary works waste and environmental controls and site security.
- **Remediation works:** remediation works in the Remediation Areas will include installation of silt curtains and sheet pile walls (where appropriate) to manage risks of contaminated sediment mobility, immobilising contaminated sediment utilising the in-situ solidification methodology, partial removal (excavation) of cement stabilised sediment and other surficial contaminated materials, placement of a capping layer to facilitate establishment of viable benthic communities and beach stabilisation works. One mature mangrove is also expected to be removed from the western end of the beach to allow remediation to be undertaken.
- **Transport of sediments:** excavated material removed from the Remediation Areas will be transported by barge in sealed bins to the Staging Site for transfer onto trucks and transport offsite to an EPA licenced facility.
- **Disposal of immobilised sediments and other materials:** in-situ cement stabilised materials will be tested off-site before being sent to an EPA licenced landfill facility. Untreated material will be sent off-site in sealed skips to an EPA-licenced facility for treatment if required before transfer to an EPA-licenced landfill for disposal.
- **Demobilising:** at the completion of the remediation works, all project related infrastructure will be disassembled and transported offsite.

Following completion of the remediation works, a validation and audit process will be undertaken to ensure that the remediation works have satisfied the objectives of the RAP.

Remediation Project activities are described in detail in Chapter 4 Description of Project Activities. Post-remediation activities are described in detail in Chapter 18 Environmental Management Framework and Key Commitments.

**Legend:**

Staging Site (140 Tennyson Road, Mortlake)

Declared Area

Northern Remediation Area

NA1

NA2

NA3

SA1

SA2

SA3

SA4

SA5

Sea Wall

Water Based Corridor

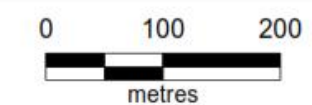
10 Metres from Sea Wall

20 Metres from Sea Wall

Note: Declared and remediation area approximate only



Scale at A4 1:8,000



Coor. Sys. GDA 1994 MGA Zone 56

**Kendall Bay Sediment Remediation Project,
Sydney, New South Wales**

PROJECT AREA

Figure 1-1: Project area

1.6 OVERVIEW OF PLANNING AND APPROVALS REQUIREMENTS

The relevant Commonwealth, State and local legislative planning and approvals framework in relation to the Project is discussed in detail in Chapter 5 Statutory Framework. The Project activities which are the subject of the SSD Application, are described in detail in Chapter 4 Description of Project Activities.

The approval process will start with the submission of the EIS to the Department of Planning and Environment (DP&E). Following this review, the EIS will be placed on public exhibition to allow the public, government bodies and other stakeholders to review.

1.6.1 PREPARATION OF THE EIS

This EIS has been prepared by Jemena and JBS&G Pty Ltd (JBS&G) to address the SEARs as issued in March 2017 and achieve the aims set out in Section 1.7 below.

A number of specialist studies and assessments for aspects of the Project were previously prepared for Jemena by Environmental Resources Management Australia Pty Ltd (ERM) for a superseded proposal for the remediation Project during 2012-2015. These reports have been reviewed by JBS&G and Jemena in the context of the current Project description and remediation methodology. Where relevant, content of the reports has been updated or amended for inclusion in the EIS, with acknowledgment in the relevant chapter of the EIS and appropriate attribution to ERM.

Preparation of this EIS has also drawn on information, descriptions and discussion contained in the Kendall Bay Remediation Project - Remediation Action Plan (RAP) (S&W, 2018a). The RAP is appended to this EIS at Appendix 2. The RAP addendum prepared in June 2018 to provide an independent assessment of the RAP by a certified practitioner is also provided in Appendix 2.

1.7 AIM AND STRUCTURE OF THE EIS

This EIS supports an application for SSD approval from the Minister for Planning under Part 4 of the EP&A Act. It has been prepared in accordance with the EP&A Act and the SEARs.

1.7.1 EIS AIMS

The aims of this EIS are to

- enable the SSD application to be assessed under Part 4 of the EP&A Act
- provide information on the Project, including the need for the Project and alternatives considered
- assess the potential key environmental and social impacts, as identified in the SEARs issued for the Project
- set out Jemena's commitments in terms of minimising and managing potential environmental and social impacts
- establish a robust level of environmental management through the development of the mitigation and management measures proposed; and
- enable the refinement of a preferred remediation methodology through a review of available and feasible options and suitable access / processing sites.

1.7.2 STRUCTURE OF THE EIS

This EIS has been prepared to ensure that the Project is described adequately, the potential environmental impacts are assessed and proposed mitigation measures are identified. To present this information, the EIS consists of two volumes:

- the main environmental assessment is contained in Volume 1 as outlined in Table 1-1; and
- the supporting technical assessments and other documentation are contained in the Appendices in Volume 2, as outlined in Table 1-2.

Table 1-1: Structure of the environmental assessment (Volume 1)

Chapter Number	Chapter Title	Chapter Summary
1	Introduction	Provides an overview of the Project, the Proponent and structure of the EIS.
2	Project Justification and Alternatives	Provides a review of the remediation options assessed and a justification for the Project having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.
3	Site Location and Context	Provides information on the Project location and the broader land use in order to establish the geographical context of the Project.
4	Description of Project Activities	Presents a description of the proposed remediation approach and key Project activities, drawing on the remediation methodology presented in the RAP.
5	Statutory Framework	Details the regulatory history of the Project and the relevant Commonwealth, State and local legislative framework in relation to the Project.
6	Stakeholder Engagement	Summarises the consultation activities undertaken with key external stakeholders (including government agencies, local industry and the local community).
7	Project Environmental Risks	Describes the approach and outcome of the environmental risk assessment undertaken for the Project.
8	Air Quality and Odour	Discusses the potential air quality impacts of the Project, including odour, on receptors in the surrounding area and describes measures that will be used to mitigate those impacts.
9	Noise and Vibration	Discusses potential noise and vibration impacts generated during the Project and describes measures that will be used to mitigate those impacts.
10	Hydrology	Discusses the potential impacts of the Project on the existing Kendall Bay and Fairmile Cove hydrological processes and outlines mitigation measures to manage these impacts.
11	Water Quality and Sediments	Discusses potential impacts of the Project on water quality and sediments and outlines measures that will be

Chapter Number	Chapter Title	Chapter Summary
		used to mitigate those impacts, including the proposed monitoring program.
12	Biodiversity	Discusses potential impacts of the Project on critical habitats, threatened species and ecological communities, summarises the findings of the Ecological Risk Assessment undertaken for the Project and mitigation measures including management of mangroves and re-establishment of benthic flora and fauna.
13	Cultural Heritage	Describes the Aboriginal and non-Aboriginal cultural heritage within the broader Project Area and provides an assessment of the potential impact of the Project on cultural heritage and the measures that will be used to mitigate those impacts.
14	Human Health	Discusses potential impacts of the Project on human health, summarises the findings of the Human Health Risk Assessment undertaken for the Project and provides justification in terms of existing risks to human health, and management of human health impacts during and post following the remediation phase.
15	Landscape and Visual	Describes existing landscape and visual amenity of the Project Area, and provides an assessment of potential impact of the proposed remediation works on these existing values from the perspective of members of the community in the Project Area.
16	Traffic and Transport	Discusses potential impacts of the Project on the local road network and marine vessel movements during the life of the Project, and outlines mitigation measures that will be used to manage those impacts.
17	Waste Management	Provides an overview of anticipated waste streams to be generated during the Project including classification, treatment, handling and disposal of waste materials.
18	Environmental Management Framework	Provides a summary of Project-specific Environmental Management Plans and a consolidated summary of key commitments in the EIS and proposed environmental management and monitoring measures.
19	References	Lists references referred to or relied on in the EIS.

Table 1-2: Supporting documentation and technical reports (Volume 2)

Appendix	Report	Reference
1	Secretary's Environmental Assessment Requirements 2 March 2017	-
2	Remediation Action Plan and RAP Addendum	Synnot and Wilkinson (2018a) Swane & Associates (2018)
3	Human Health Risk Assessment	EnRisks (2018)
4	Ecological Risk Assessment	Synnot and Wilkinson (2018c)
5	Stakeholder Management Plan	Jemena (2018)
6	Air Quality Impact Assessment	Todoroski (2018)
7	Noise Impact Assessment	Resonate Acoustics (2017)
8	Hydrological Assessment	Royal Haskoning DHV (2018a)
9	Soil and Water Assessment	Royal Haskoning DHV (2018b)
10	Biodiversity data	Appendix 13
11	Marine Benthic Infauna Assemblages Study	Synnot and Wilkinson (2018b)
12	Statement of Heritage Impact	SOHI (2018)
13	Landscape and Visual Impact Assessment	LVIA (2018)
14	Traffic Impact Assessment	GTA Consultants (2018)
15	Navigation Study	Royal Haskoning DHV (2018c)
16	Quantity Surveyors Report	CARAS (2018)
17	Emergency Management Plan	Jemena (2018)

1.7.3 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

This EIS has been prepared in accordance with the SEARs issued in March 2017 for the Project, which are summarised in Table 1-3 and provided at Appendix 1. Chapter references identifying where the SEARs are addressed within the EIS are also provided in Table 1-3.

Table 1-3: Summary of SEARs March 2017

Issue	Description	Addressed in the EIS
General Requirements	The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the <i>Environmental Planning and Assessment Regulation 2000</i> .	Whole Document (see Table 1-4 below)
	In addition, the EIS must include: - a detailed description of the development, including: - need for the proposed development; and - justification for the proposed development, including alternatives considered.	Chapters 2, 3 and 4
	Remedial Action Plan, which includes:	Appendix 2

Issue	Description	Addressed in the EIS
	– characterisation of the nature and extent of contaminated material – details of the proposed remediation process, including the process to treat the contaminated material – details of the proposed remediation management measures including justification of the remediation criteria and proposed disposal of treated sediments and waste, and management of wastewater – a site validation plan; and – details of compliance with the <i>Contaminated Land Management Act 1997</i>.	
	• final landform following remediation and suitability of fill material.	Chapter 11 and Appendix 2
	• final revegetation plan and process for ongoing management following remediation works.	Chapter 12
	• consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments.	Chapter 5
	• risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment.	Chapter 7
	• detailed assessment of the key issues specified below, and any other significant issues identified in the risk assessment, which includes: – a description of the existing environment, <u>using sufficient baseline data</u> – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and / or contingency plans to manage any significant risks to the environment.	Chapters 8 to Chapter 17
	• consolidated summary of all the proposed environment management and monitoring measures, highlighting commitments included in the EIS.	Chapter 18
	• The EIS must also be accompanied by a report from a qualified quantity surveyor providing: – a detailed calculation of the capital investment of the proposal (as defined in Clause 3 of the <i>Environmental Planning and Assessment Regulation 2000</i>), including details of all assumptions and components from which the CIV calculation is derived – a close estimate of the jobs that will be created by the development; and	Appendix 16

Issue	Description	Addressed in the EIS
	– certification that the information provided is accurate at the date of preparation.	
The EIS must address the following specific matters:		
Air Quality and Odour	Air quality and odour including: • an assessment of odour from the excavation, dredging, transport, treatment and storage of contaminated sediments • an air quality impact assessment of each stage of the remediation works and treatment facility including details of the emission control measures at the treatment facility, odour / dust suppressants and stockpile management • details of the proposed odour and air emission controls for each stage of the remediation process, including the proposed treatment site at 140 Tennyson Road; and • details of an air quality monitoring program including the identification of air quality criteria.	Chapter 8 and Appendix 6
Human Health and Ecological Risk Assessment	Human Health and Ecological Risk Assessment including: • an assessment of the potential health implications of the development (including from the extraction of sediments, treatment and disposal of treated material), during and following remediation, including details of exposure scenarios and demonstration that the development will not have unacceptable acute or chronic health effects on humans or ecological resources.	Chapter 14 and Appendix 3 (Health) and Chapter 12 and Appendix 4
Traffic	Traffic including: • details of the land-based and water-based traffic that would be generated by the Project • transport routes • traffic management procedures for the Staging Site and parking requirements, including a construction traffic management plan and measures to manage and repair any damage to the local road network; and • navigation and safety impacts on other water based traffic and ferry commuter services from any piping or barging of contaminated material, including details of any proposed measures to manage navigational conflicts.	Chapter 16 and Appendix 14
Water Quality and Sediments	Water quality and sediments including: • erosion and sediment controls during excavation, dredging, transport and treatment of sediments, stockpiling and backfilling of the Bay.	Chapters 10 and 11 and Appendices 8 and 9
	• details of a water quality monitoring program for Kendall Bay, with a focus on turbidity and key contaminants • management of stormwater and treated wastewater discharges from the treatment facility • management of wastewater generated during dewatering of extracted sediments.	Chapter 11 and Appendices 8 and 9

Issue	Description	Addressed in the EIS
	- impacts on surface water and groundwater, including potential impacts on bed and bank stability of Kendall Bay and the Parramatta River; and - assessment and management procedures for acid sulphate soils.	Chapters 10 and 11 and Appendices 8 and 9 Chapter 11 and Appendix 9
Waste Management	Waste management-including: details of the classification, treatment, handling and disposal of all waste materials, including wastewater generated by the development.	Chapter 17 and 11
Noise and Vibration	Noise and vibration including: an assessment of construction and operational noise from excavation, dredging, traffic and operation of the treatment facility.	Chapter 9 and Appendix 7
Biodiversity	Biodiversity including: - an assessment of any impacts on critical habitats, threatened species, populations, or ecological communities and their habitats. - measures to minimise harm to mangrove habitat and details of proposed biodiversity offsets for impacts on aquatic habitat. - details of backfill material that supports the re-establishment of aquatic flora and fauna.	Chapter 12 and Appendices 4 and 10
Hazards	Hazards including: - a Preliminary Hazard Analysis (PHA) of the treatment facility including a detailed assessment of the potential off-site risks; and - an Emergency Management Plan detailing the measures to be put in place to minimise risks and respond to incidents and emergencies.	PHA not required (no treatment facility set up proposed) Appendix 17
Visual	Visual including: an assessment of the visual impact of all aspects of the development, particularly on any adjoining landowners and significant vantage points in the public domain.	Chapter 15 and Appendix 13
Heritage	Heritage including: an assessment of non-Aboriginal and Aboriginal heritage impacts.	Chapter 13 and Appendix 12
Cumulative Impacts	Cumulative impacts particularly in relation to: air, noise and traffic associated with nearby industrial and commercial operations.	Chapters 8-17
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the <i>Environmental Planning and Assessment Regulation 2000</i> . These documents should be included as part of the EIS rather than in separate documents.	Whole Document
Consultation	During the preparation of the EIS, must consult with the relevant local, State or Commonwealth Government	Chapter 6 and Appendix 5

Issue	Description	Addressed in the EIS
	authorities, service providers, community groups and affected landowners. In particular you must consult with: • Environmental Protection Authority • City of Canada Bay Council • NSW Health • SafeWork NSW • Department of Primary Industries (DPI) including DPI Water and DPI Fishing • NSW Roads and Maritime Services • Office of Environment and Heritage • Transport for NSW (Sydney Ferries); and • Local community and other stakeholders. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 1 (of the SEARs) contains a list of some of the guidelines, policies and plans that may be relevant to the environmental assessment of this development.	Whole Document Chapter 19

Table 1-4: EIS requirements under Schedule 2 Part 3 of EP&A Regulations

Regulation	Description	Addressed in the EIS
6 a	Name, address and professional qualifications of the person by whom the statement is prepared	Chapter 1
6 b	Name and address of the responsible person	Chapter 1
6 c	Address of the land in respect of which the development application is to be made	Chapter 3
6 d	Description of the development, activity or infrastructure to which the statement relates	Chapter 4
6 e	An assessment by the person by whom the statement is prepared of the environmental impact of the development, activity or infrastructure to which the statement relates	Chapters 8 to 17
6 f	Declaration by the person by whom the statement is prepared to the effect that: (i) the statement has been prepared in accordance with this Schedule, and (ii) the statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates, and	EIS Declaration

Regulation	Description	Addressed in the EIS
	(iii) that the information contained in the statement is neither false nor misleading.	
7 (1) a	Summary of the environmental impact statement	Non-Technical Summary
7 (1) b	Statement of the objectives of the development, activity or infrastructure	Chapter 1 and Chapter 4
7 (1) c	Analysis of any feasible alternatives	Chapter 2
7 (1) d	Analysis of the development, activity or infrastructure including:	
	i) full description	Chapter 4
	ii) general description of the environment likely to be affected	Chapter 3
	iii) likely impact on the environment	Chapters 8 to 17
	iv) full description of the measures proposed to mitigate	Chapters 8 to 17
	v) list of any approvals that must be obtained under any other Act or law	Chapter 5
7 (1) e	A compilation (in a single section of the EIS of the measures referred to in item (d) (iv)	Chapter 18
7 (1) f	Reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.	Chapter 2

2. PROJECT JUSTIFICATION AND ALTERNATIVES

This chapter provides a comprehensive review of the remediation methods assessed and a justification for the Project having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.

2.1 HISTORY OF ENVIRONMENTAL INVESTIGATIONS

The contamination status of sediments within Kendall Bay have been the subject of considerable environmental investigation since 1989, including human health and ecological risk assessments. In general, the findings of the investigations and studies and the nature of contaminants found within the sediments are consistent with the historical use of the former AGL Mortlake Gasworks site. A brief overview of these investigations including a description of the findings is provided in Table 2-1.

2.1.1 CONTAMINANTS OF POTENTIAL CONCERN

The sediments in Kendall Bay are contaminated with wastes from gasworks operations, primarily from coal gasification (and related processes) which occurred at the Mortlake Gasworks between 1886 and 1971, as well as metals and other pollutants common to other areas of the Parramatta River (S&W 2018a). Based on the investigations of marine sediments within the bay, Contaminants of Potential Concern (COPCs) primarily include heavy oils and tarry residues, which have resulted in areas of sediments having levels of PAHs and total recoverable hydrocarbons (TRH) levels significantly in excess of sediment quality guidelines.

The sediments in the main impacted areas of Kendall Bay are generally characterised as being black and oily and have a strong tar, hydrocarbon or naphthalene odour, typical of gasworks contamination. This contaminated sediment is present to a maximum depth of more than 4 metres in the area to the north-west of the bay, where coal and coke wharves were located, and to a maximum depth of almost 8 metres in parts of the southern end of the bay, where a former stream had cut into the sandstone bedrock (S&W 2018a).

Table 2-1: Historical environmental investigations

Investigation	Description and key findings
Environmental Remediation Feasibility Study, AGL Mortlake (Dames and Moore 1989)	The investigation involved the collection of samples from 12 sub-tidal locations within Kendall Bay adjacent to the former gasworks site. The investigation concluded that the upper 0.1 to 0.5 metre layer of sediment along the foreshore was contaminated with oil, grease and trace metals in higher concentrations than those found in other locations within Sydney Harbour. Visual observations suggested that coal tar was the primary component of the oil and grease.
EIS for the AGL Mortlake Rehabilitation Project (Dames and Moore 1996)	The investigation assessed aquatic ecology and sediment quality and found that sediments adjacent to the gasworks site (particularly around the former wharf sites in Kendall Bay and the Parramatta River) were contaminated by heavy oils. The presence of these heavy oils contributed to elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in the nearshore sediments.
AGL Mortlake Facility Sediment Investigations, Section 77 Notice, CLM Act (Dames and Moore, 1999)	Samples of surface sediments were collected for investigation of bio-availability and bio-accumulation of contaminants of concern in fish. The study found low toxicity and low potential availability of trace

Investigation	Description and key findings
	metals bound in sulphides. PAHs were identified in whole fish specimens but not in filleted portions, indicating preferential accumulation of PAHs in the liver and organs of fish.
Sediment Quality at Mortlake, Parramatta River (URS 2002)	The results of the investigation concluded that concentrations of PAHs within the sediments exceeded the adopted health screening level criteria, however the concentrations identified were considered unlikely to impose an unacceptable risk to human health.
Environmental Risk Assessments for Sediments Adjacent to the Former Mortlake Site (URS 2006)	The investigation concluded that concentrations of PAHs in the intertidal zone were generally low, while the shallow sub-tidal sediments demonstrated high concentration of PAHs, which decrease with distance from the shore.
Human Health Risk Assessment of Estuarine Sediments Adjacent to the former Mortlake Site (URS 2007a)	The investigation concluded that accessible areas along the shoreline of Kendall Bay demonstrated potential for elevated exposure to PAHs by adults and older children, during regular wading activities. This investigation resulted in the delineation of 2 remediation areas (then known as Areas A and B), in the locations which largely correspond to the current Southern and Northern Remediation Areas (refer Chapter 5 Statutory Framework).
Updated Human Health and Ecological Risk Assessment (HHERA) (SKM 2014a)	This further investigation, which was conducted as part of the preparation of the draft 2014 RAP, confirms that accessible areas along the shoreline of Kendall Bay demonstrated potential for elevated exposures to PAHs by adults and older children, during regular wading activities.
Remedial Action Plan (SKM 2014b)	The 2014 RAP gave an overview of the environmental investigations carried out within Kendall Bay to 2014 and outlined a remediation approach, including sediment excavation methods, capping and backfilling. Note: following extensive review from a remediation contractor, the remediation method proposed in this version of the RAP was deemed to be not feasible.
Sediment Investigation (Stage 1) 2015 (Referenced in Synnot and Wilkinson 2016a)	Investigation of the nature and extent of contamination within the mangroves, beach and stormwater delta sediments at the southern end of Kendall Bay.
Sediment Investigation (Stage 2) 2015 (Referenced in Synnot and Wilkinson 2016a)	Investigation of the environmental condition of surface sediments in parts of Kendall Bay where previous investigations had identified areas of concern, and suitable background areas, to obtain data for revision of the Human Health Risk Assessment, preparation of an Ecological Risk Assessment and development of scientifically justifiable remediation criteria and strategies.
Sediment Investigation (Stage 3) 2016 (Referenced in Synnot and Wilkinson 2016a)	Investigation of the sub-surface sediments of parts of Kendall Bay to fill data gaps and to define area, depth and volume of gasworks-contaminated sediments.
Sediment Investigation (Stage 4) 2016 (Referenced in Synnot and Wilkinson 2016a)	Excavation trial of some of the most contaminated sediments to: • obtain bulk samples for testing of sediment properties and for use in trials of various methods of in situ solidification of contaminated sediments • to obtain samples for leachate testing of stabilised materials; and • to quantify the nature and extent of odour issues that were likely to be produced during remediation works.

Investigation	Description and key findings
Human Health Risk Assessment (HHRA) – Sediments, Kendall Bay, New South Wales (EnRisks 2018)	Confirms that human health risks are driven by potential direct contact and / or ingestion of gasworks-impacted sediments from some areas within Kendall Bay. Calculate site-specific human health remediation criteria for use in the 2018 Remediation Action Plan (Synnot and Wilkinson 2018a)
Kendall Bay Remediation Project – Ecological Risk Assessment Report March 2018 (Synnot and Wilkinson 2018c)	Assesses the risk to aquatic organisms in Kendall Bay and the adjacent Parramatta River and develop site-specific remediation criteria for the gasworks contaminated sediments for input to the RAP.
Kendall Bay Remediation Project Remediation Action Plan (Synnot and Wilkinson 2018a)	Draws on data and assessment from all technical reports completed for the Project to 2018, summarises the nature and extent of site contamination, and evaluates and recommends options for remediation.
Kendall Bay Sediment Remediation Project 2018 Marine Benthic Infauna Assemblages (Synnot and Wilkinson 2018b)	Expanded marine benthic infauna sampling to include nearby embayments to better understand levels of background toxicity existing in areas outside the proposed remediation areas in Kendall Bay and in nearby embayments in the Parramatta River.

2.1.2 MOST RECENT ENVIRONMENTAL INVESTIGATIONS

The Kendall Bay Sediment Remediation Project RAP (S&W 2018a) summarises the nature and extent of site contamination and details additional work which has been undertaken to provide evidence of the presence and nature of toxicity in sediments inside Kendall Bay and in reference bays upstream and downstream in the Parramatta River. The RAP evaluates and recommends options for remediation including specifying the particular areas of the bay in which remediation is to occur based on the updated assessments of human and ecological risks of gasworks-related contamination.

The 2018 RAP is supported by an updated Human Health Risk Assessment (HHRA) (EnRisks, 2018) which was undertaken to review existing data in regard to human health risks posed by PAH contamination in Kendall Bay sediments. The HHRA develops site-specific risk-based sediment criteria for PAHs to be applied to the remediation methodology at identified remediation sites. Additional bioaccessibility testing for human health risk assessment was also undertaken to meet new EPA requirements.

An updated Ecological Risk Assessment (ERA) (S&W 2018c) was also prepared to

- obtain the additional data requested by EPA on sediment chronic toxicity, plus associated chemistry and ecology data
- distinguish gasworks contamination in Kendall Bay, and its effects, from background chemical contamination known to be present throughout the Parramatta River; and
- provide reliable data to be used to derive remediation criteria, define remediation areas and specify the nature and extent of remediation recommended for each area.

The RAP is attached at Appendix 2, the HHRA is attached at Appendix 3 and the ERA is attached at Appendix 4. The RAP Addendum is attached in Appendix 2. The RAP Addendum provides an independent assessment of the RAP by a certified practitioner.

2.2 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

2.2.1 RISKS TO HUMAN HEALTH

As noted in Table 2-1 above, there have been multiple assessments over the last decade of the human health risks associated with contaminated sediments in Kendall Bay. These include:

- *Human Health Risk Assessment of Estuarine Sediments Adjacent to the Former AGL Mortlake Site*. (URS 2007a)
- *Updated Human Health and Ecological Risk Assessment, Kendall Bay Remediation Project, Sydney*. (SKM, 2014a); and
- *Human Health Risk Assessment – Sediments, Kendall Bay, New South Wales* (EnRisks, 2018).

In summary, the potential human health risks from gasworks contaminants have been found to be predominately through three main pathways:

- direct contact with contaminated sediments
- direct ingestion of sediments; and
- vapour exposure.

To address potential contact and / or ingestion risks, the Project will ensure that discoloured or odorous surface sediments are not present where people may come into direct contact with them, or near the seabed surface where normal disturbance during wading may allow people to come into contact with contaminated sediments (S&W 2018a).

Relevantly, odour modelling and modelling of volatile chemicals for the Project has indicated that during excavation of sediments, none of the chemicals attributed to gasworks wastes are predicted to be present (even under worst-case dispersion conditions) at concentrations that are above conservative ambient air guidelines (S&W 2018a). A limited trial referred to as the bulk sediment excavation trial, carried out in September 2016, supported the findings of the modelling of odours and the volatilisation of chemicals.

Air quality and odour is discussed in further detail in Chapter 8 Air Quality and Odour.

2.2.2 ECOLOGICAL RISKS

The Project remediation activities address gasworks-related contamination issues which should improve the environmental quality and / or reduce the current ecological risks arising from gasworks contaminated sediments in Kendall Bay (see also Section 2.5 below).

The ERA (S&W 2018c) utilised data from sediment contamination studies, water quality monitoring, biological tissue monitoring, marine benthic community studies, and bioavailability and ecotoxicology studies conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Simpson and Spadaro 2015; Simpson et al. 2016), to assess the risks to organisms exposed or potentially exposed to the gasworks contaminated sediments of Kendall Bay.

In summary, the studies and reports indicate that there is currently both an acute and chronic ecotoxicity risk to marine biota living within areas of Kendall Bay sediments. However, some of this risk (majority of chronic risk) is driven by the high level of background metal concentrations existing more broadly within the river bed of the Parramatta River (not specifically gasworks related).

A detailed assessment of the current ecological risks in the form of chemical bioavailability and ecotoxicity of sediments associated with gasworks contaminants in Kendall Bay was conducted by CSIRO and Simpson et al. (2016). These reports are appended to the RAP (Appendix 2). Marine ecology is discussed in further detail in Chapter 12 Biodiversity.

2.3 VOLUNTARY REMEDIATION AGREEMENT AND ENVIRONMENTAL RESPONSIBILITY

Jemena is committed to meeting its obligation under the Voluntary Management Proposal (VMP) (refer Chapter 5 Statutory Framework) which it has entered into with the EPA. Under the VMP Jemena must undertake remediation works to address significant contamination which presents a risk to human health and the environment. Jemena is also committed to undertake the Project to meet the company's corporate, social and environmental responsibilities.

2.4 PROJECT JUSTIFICATION

In accordance with the SEARs and Regulation 7 of the *Environment Planning and Assessment Regulation 2000* (EP&A Reg), the Project requires justification having regard to 'biophysical, economic and social considerations' including the principles of ecologically development. These aspects are addressed in more detail below.

2.4.1 SOCIAL AND ECONOMIC CONSIDERATIONS

The Project will address gasworks-related contamination in Kendall Bay which presents potential human health and ecological risks. In this regard, the objective of the Project also accords with a core objective of *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55), which aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. SEPP 55 is discussed further in Chapter 5 Statutory Framework.

The Project should alleviate the current human health risks associated with the contaminated sediments which are a result of the former gasworks operations on adjacent land. From a social and environmental responsibility standpoint, as well as Jemena-corporate perspective, the company is committed to meeting its obligations under the VMP to address gasworks related contamination which present potential ecological and human health risks.

Remediation activities should also provide significant social benefits by restoring visual and public amenity and site aesthetics to the Project area (refer Chapter 3 Project Location and Context), particularly the beach and mangrove area.

Jemena does not own the bed of the bay (or have any rights to develop or otherwise use it), and as such will not receive any direct economic gain by proceeding with the Project.

2.4.2 BIOPHYSICAL CONSIDERATIONS

As outlined in Chapter 1 Introduction, two of the three key objectives of the Project are to

- provide significant environmental benefit by alleviating the potential long-term exposure risks to users of the near shore environment caused from elevated levels of contaminants within the defined remediation areas; and
- promote ecological diversity and alleviate adverse ecological impacts resulting from the contaminated sediments.

Through the proposed remediation of contaminated sediments, the ecological condition of Kendall Bay should improve and ecological risks to marine biota utilising the area should be reduced. This will be achieved through the adoption of the preferred remediation approach as described in Section 2.5. In brief, by stabilising and capping the contaminated soils in-situ, future interaction with and disturbance of these materials should be prevented.

2.4.3 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Clause 4 of Regulation 7 of the EP&A Reg sets out the four key principles of ESD, which can be used to guide the decision-making process:

- the precautionary principle
- inter-generational equity
- conservation of biodiversity and ecological integrity; and
- improved valuation, pricing, and incentive mechanisms.

An assessment of the Project against the above ESD principles is discussed in the sections below.

Precautionary Principle

The precautionary principle as defined in the EP&A Reg states:

"If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."

In accordance with the precautionary principle, the decision-making process should be guided by:

- wherever practicable: careful evaluation to avoid serious or irreversible damage to the environment; and
- an assessment of the risk-weighted consequences of the options considered.

As discussed above and addressed in the RAP, an assessment of alternative remediation methods was undertaken, along with an analysis of land and water based sites which would be required to access the remediation areas in Kendall Bay (refer Section 2.5). This evaluation was critical in the decision-making process to determine the preferred remediation method and develop the mitigation and management measures outlined in this EIS to avoid and / or minimise impacts to the environment and the surrounding community.

Inter-Generational Equity

Inter-generational equity as defined under the EP&A Reg states:

"The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations".

The health, diversity and productivity of Kendall Bay will be enhanced as a result of implementing the remediation strategy. Proceeding with the Project would address gasworks-related contamination which presents human health risks and enhance the marine area for future recreational users of Kendall Bay. The future health of the marine ecosystem in Kendall Bay should also be improved, promoting an increase in marine biodiversity.

Biodiversity and Ecological Integrity

The EP&A Reg states that:

"The conservation of biological diversity and ecological integrity should be a fundamental consideration."

The numerous studies undertaken across the Project area and in particular those undertaken in 2014 and 2016 to 2018, demonstrate that:

- there are no listed threatened species, endangered ecological communities, endangered populations and associated habitats within Kendall Bay and the Project area
- the embayments (in this portion of the harbour) support heterogenous infaunal communities despite the levels of sediment contamination observed; and
- overall diversity and abundance of marine species has been impacted by the toxicity of the sediments in Kendall Bay.

The proposed remediation has been designed to reduce the ecological risk presented by contaminated sediments and over time will allow an improvement in the abundance and diversity of marine species in Kendall Bay.

Improved Valuation, Pricing and Incentive Mechanisms

The environmental factors relevant to this Project that should be included in the valuation of assets and services include:

"Those who generate pollution and waste should bear the cost of containment, avoidance or abatement." and

"Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems."

Jemena has inherited AGL's obligation to undertake remediation in areas of Kendall Bay under the CLM Act and is committed and willing to pay the costs for this remediation in accordance with the VMP.

2.5 REFINED REMEDIATION AREAS

Remediation within Kendall Bay targets areas where contamination presents a potential human health risk or exceeds the CSIRO-derived ecological criteria in the upper sediment layer and where:

- the sediments were found to be acutely toxic; or
- the sediments were found to contain no benthic fauna; or
- oily gasworks contamination was present in surface sediments or within 5 mm of the surface.

Two Remediation Areas were defined on the basis of the above criteria – the Southern Remediation Area (SA1, SA2, SA3, SA4, SA5) and the Northern Remediation Area (NA1, NA2, NA3) (see Figure 3-2 Chapter 3 Project Location and Context).

Specific remediation objectives developed for each of these areas and the overall remediation Project are summarised in Chapter 4 Description of Project Activities and are provided in detail in the RAP (Appendix 2).

2.6 PROJECT ALTERNATIVES AND SEDIMENT TREATMENT OPTIONS

2.6.1 EVALUATION OF REMEDIATION TREATMENT OPTIONS

Multiple remediation options were assessed as part of the RAP development process and are detailed in Table 8.2 of the RAP (Appendix 2).

In evaluating the remediation options, guidance was provided by NSW EPA and USEPA guidelines and best practice. The USEPA has for many years evaluated methods for dealing with soils and sediments associated with gasworks, including excavation, treatment and landfilling of the wastes, onsite encapsulation and containment, in situ solidification and capping. Consideration of options also took account of the overall objectives of the Project (refer Chapter 1 Introduction).

In relation to remediation of contaminated materials, the NSW EPA's policies and the CLM Act require that:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed. This principle is of special relevance to the remediation of sediments, the disturbance of which:
 - has a high potential to mobilise contaminants into the water column; and
 - necessarily completely destroys any existing ecosystem located on or within the sediments.
- The preferred order of options for remediation and management of contaminated soil (in order from most preferable to least preferable), which also applies to sediment, is:
 1. Onsite treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level
 2. Offsite treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site
 3. Removal of contaminated soil to an approved disposal site or facility, followed where necessary by replacement with clean fill; and
 4. Consolidation and isolation of the soil onsite by containment within a properly designed barrier.

2.6.2 REMEDIATION TREATMENT OPTIONS

The range of Project alternatives assessed for all Remediation Areas included:

1. No action
2. Enhanced / monitored natural recovery
3. Removal of contaminated sediments (excavation / dredging)
4. Capping of contaminated sediments; and

5. In situ solidification.

In addition, the RAP included an assessment of the technical constraints, advantages and disadvantages of each remediation approach / methodology to determine its applicability and if it should be included in a more detailed assessment.

A summary of the remediation options for the Project is provided in Table 2-2 below. For full details of the six options considered please refer to Table 8-1 in Chapter 8 of the RAP (Appendix 2).

Table 2-2: Summary of remediation options assessed

Alternative Category	Description of Alternatives	Advantages	Disadvantages	Option Assessment	
Do nothing approach	Not undertaking the Project and leaving northern and southern remediation areas contaminated.	Cost effective, minimal cost. Relies on use of institutional controls, e.g. signage and educational measures, to reduce exposure to humans and limit human activity on and in contaminated areas.	Does not reduce contamination levels or concentrations. Signs installed to date have been destroyed and require replacement. Existing controls on fishing may not always be observed by all users.	No	Not undertaking remediation within the identified Remediation Areas would contravene VMP commitments made to EPA. Contaminated sediments would continue to present risks to human health and environment are unlikely to significantly decrease or be eliminated over time under this approach.
Monitored natural recovery (MNR)	Uses naturally occurring processes in sediment to reduce toxicity or bioavailability of contaminants	Low capital cost. Less impact on local community and environment – odour, noise, vehicle movements.	Natural recovery, whilst occurring in Kendall Bay, is not occurring in a reasonable timeframe over the entirety of the remediation areas. Long-term monitoring required to ensure processes are continuing and achieving remediation goals.	No	MNR is not and will not occur at a reasonable rate across the remediation areas.
Enhanced monitored natural recovery (EMNR)	EMNR applies material or amendment to enhance natural recovery processes.	Placement of a thin sand cap or equivalent can provide habitat for benthic community and remove acute risk to ecosystems. Non-invasive technique and does not disrupt or destroy biologically active zones. Low capital cost compared to more aggressive technologies. Less impact on local community in terms of odour, noise, truck movements - compared to more aggressive technologies. Thin cap with no impermeable layer is not subject to hydrostatic uplift.	Dissolution of contaminants from contamination at depth may occur into the pore space of clean cap. EMNR will not reduce source contamination in a reasonable timeframe. Retention of existing bathymetry will not be achievable without excavation/dredging prior to placement of thin cap. Long-term monitoring required to ensure processes are continuing and achieving remediation goals. Scouring of the thin cap may occur during storm events.	Feasible	Provisional technology for further consideration, noting: - There is potential for impacts from odour-generating works in Kendall Bay and impacts associated with the offsite treatment and transport of contaminated sediments. - Potential issues associated with stability and durability of capping.

Alternative Category	Description of Alternatives	Advantages	Disadvantages	Option Assessment	
Removal of contaminated sediments	Excavation	Removes contamination and associated risks. Minimises volume of contaminated water that must be treated before disposal to landfill. Minimise odour and vapours.	Requires construction of retaining walls – costly process. High energy consumption. Intrusive with large impact on local community. Sediment stability in excavation.	Feasible	Option is robust as it would remove majority of contamination, however is the most intrusive option, has the largest impact on the community (odour, truck movements) and potentially most expensive.
	Dredging	Efficient method of removing and transporting sediment. Minimises odours and vapours. Precise surgical removal of contaminated sediments achievable.	Excessive water treatment required. High energy consumption. Excessive quantities of contaminated sediments to landfill. Success highly dependent on achieving required depth of dredging.	Feasible	Option not retained for further assessment.
Capping of contaminated sediments	Placement of clean material over the contaminated sediments	Reduces exposure to contamination without need to remove contaminant mass. Reduces volume of sediment requiring excavation and treatment compared to other options. Eliminates requirement for treatment of contaminated water.	Retention of existing bathymetry not possible without excavation/dredging prior to the placement of the cap. Long term maintenance of cap may be required. Potential for significant offsite impacts associated with odour generation, offsite treatment and transport of contaminated sediments excavated / dredged prior to placement of cap. Success highly dependent on required depth of dredging.	Feasible	Potentially an option for further consideration, however option has potential offsite impacts associated with odour and impacts associated with the offsite treatment and transport of contaminated sediments. Assessment of this solution is highly dependent on required depth of dredging.
In situ solidification (ISS)	In-situ solidified columns and raft to form competent surface, install permeable cap and excavate (wet process) inshore areas	Allows for more efficient cap design, reduced settlement and improved seabed stability. Assist project meet landfill criteria. Reduces need for offsite treatment of materials. Reduces the volume of materials excavated and treatment.	Energy inefficient. Portion of contaminated sediment (and therefore some contaminant load) remains in the bay.	Favoured	Most favoured option. Has least impacts of odour generating works in Kendall Bay and least impacts associated with offsite treatment and transport of contaminated sediments. Most stable in situ treatment of contaminated sediments.

2.6.3 RATING OF PREFERRED REMEDIATION OPTIONS

The feasible remediation options were assessed and rated considering the objectives of remediation, which are to:

- reduce as far as practicable the generation of oily releases from the sediments and the generation of hydrocarbon sheens in the river water
- minimise the generation of odours that could impact the amenity of the nearby community
- ensure the remediation approach provides a robust and durable solution and there is a low risk of maintenance work being required
- negate the need for long-term management of sediments after the completion of the remediation work and adopt a commercially practicable defects liability period
- ensure the benefits of long-term mitigation exceed the short-term nuisance/amenity impacts of the remediation work
- comply with Ecologically Sustainable Development (ESD) principles
- minimise waste generation and the unnecessary use of resources
- minimise the time taken to complete the remediation works and thereby reduce impact to the amenity of the nearby community; and
- reinstate the seabed in remediated areas to the existing bathymetry.

2.6.4 SUMMARY OF PREFERRED REMEDIATION OPTIONS

To meet the remediation objectives of the Project (see Section 2.6.1) and based on a detailed assessment, the preferred sediment remediation options proposed for the site are:

In-situ treatment

In areas where contaminated sediment requires remediation to protect human or ecological health (SA1, NA2+NA3), in situ solidification (ISS) will be undertaken. Solidified columns are to be formed down to a competent surface, and a raft of stabilised material created across the area. In areas where depth to a competent surface is less than approximately 3m, a stabilising monolith is proposed (NA2+NA3). The top 0.5 metres of the solidified raft / monolith will then be excavated and a permeable cap installed over the area excavated in the top of the raft.

Sheet piling is proposed at SA1, and may also be used at NA2+NA3 depending on the outcomes of remediation field trials. In SA1 sheet piling will be particularly useful for controlling turbidity plumes in shallow water where silt curtains may be less effective. Following remediation works the sheet pile will be cut at an elevation of 0.00 LAT, remaining below the sediment to hydraulically confine the untreated sediment under the stabilised raft.

In situ solidification of contaminated sediments involves a process where stabilising chemicals are mixed with the sediments where they occur. The most common stabilising chemical is cement. Other chemicals are also commonly used as additives to cement, including fly ash, slag, bentonite and flowing agents. The function of in situ solidification is to create stabilised sediment which both retains the contamination and provides a significant increase in strength that renders the contamination immobilised for long-term retention where it occurs, and provides a robust remediation solution (S&W 2018a).

The ISS method is commonly applied in areas where physical disturbance is required to be minimised (e.g. shallow bays and estuaries) and can be used to stabilise a variety of organic contaminants such as PAHs derived from gasworks plants. In situ solidification / stabilisation has been used extensively in

the USA since the 1980s for control of Polychlorinated biphenyls, PAHs, metals, Trichlorethylene, Volatile Organic Compounds and other contaminants in soils and sediments, and more recently in Asia.

The principal advantage and benefit of utilising the ISS method in Kendall Bay is the significant reduction in key Project impacts such as noise and particularly odour when compared to more conventional sediment dredging-related remediation options. This is primarily due to the majority of works being conducted underwater. Odour modelling conducted for the Project design demonstrated that contaminated sediments that are disturbed when remaining under water produce significantly less odour than when above the water surface.

The process of in situ solidification is discussed further in Chapter 4 Description of Project Activities and in the RAP (Appendix 2).

Removal / Capping

Where intertidal areas near the seawall require remediation to protect human or ecological health (SA2, NA1), it is proposed to carefully remove stained rock / rubble and associated contaminated sediment and replace that material with clean sandstone to restore site aesthetics, and interstitial sand to support a benthic community.

Remediation (removal and sand replacement)

In the area where sediments pose an unacceptable risk to human health to users of the beach and mangroves (SA3), coke and coal material will be carefully removed from amongst the mangroves and replaced with clean imported sand as required. Where restoration of visual and public amenity and site aesthetics is required on the beach area (SA4, SA5) coke and coal material will be removed from the sand surface and replaced with clean imported sand as required on beach and nearshore area. The work will be completed using appropriately sized machinery or by hand as required to prevent disturbance to the mangroves and the existing seawall.

The detailed remediation objectives for each part of the Remediation Area are summarised in Table 2-3 and presented in more detail in Chapter 4 Project Description and the RAP (Appendix 2).

Table 2-3: Southern and Northern Remediation Areas – remediation objectives and strategy

Remediation area	Treatment approach	Objective	Strategy
Southern Area Remediation Objectives and Strategy			
SA1	In-situ treatment	Remediate to the extent practicable, surface sediments that pose an unacceptable risk to human health and pose an acute risk to the marine ecosystem and in which no viable marine community has been identified.	Installation of sheet piles 0.5 m above mean tide level. Sheet piles will be cut to LAT on completion of works. Solidify sediments into columns to support a cemented raft over the top. Excavation of sediments on top of raft to 0.5m below LAT, classification of those sediments for offsite disposal / treatment. Installation of a capping layer following excavation. Establish a clean surficial capping layer of material on the seabed.
SA2	Capping	Remove contaminated sediments that present a human health risk and / or an acute ecological risk, remediate	Remove stained rock / rubble and sediments to a depth of 0.3m below LAT between the seawall and to a nominal distance of 5m seaward or to

Remediation area	Treatment approach	Objective	Strategy
		stained surfaces and sediments giving rise to emission of odours when exposed at low tides and rubbish in accessible areas of the mangroves and along the foreshore, adjacent to the seawall.	the surveyed LAT contour in the northern most part of the area and between the seawall and the edge of SA1 on the southern section of the area.
SA3	Manual remediation	Manage sediments that pose an unacceptable risk to human health, to users of the beach and to mangrove areas. Install control measures to manage stormwater discharge to remediated areas of Kendall Bay.	Remove any coke and coal from the intertidal sand surface to a nominal depth of 0.2m. Replace the removed material with a layer of clean, imported sand to restore the existing surface (to be VENM compatible). Construction of spur wall to train stormwater flows.
SA4	Manual remediation	Restore the amenity of the beach.	Remove any coke and coal from the intertidal sand surface to a nominal depth of 0.2m. Screened sand, if any, can be returned to the beach. Add a further 0.5m of clean, imported sand over the area (to be VENM compatible). Extension of seawall 30 m seaward to assist in retaining placed sand.
SA5	Manual remediation	To provide a clean, firm underfoot offshore wading areas, accessible from the beach.	Shallow excavation of the existing seabed to 0.2m followed by placement of 0.3m layer of clean sand. Installation of energy dissipation structure where stormwater pipe discharges onto the beach, to help retain sand.
Northern Area Remediation Objectives and Strategy			
NA1	Capping	Protect human health by preventing people using the area from being exposed to contaminated sediments.	Remove stained rock / rubble and any contaminated sediment to 0.3m below LAT from the designated area adjacent to the vertical seawall and replace with clean sandstone and sand to restore site aesthetics.
NA2 and NA3	In-situ treatment	Remediate to the extent practicable the surface sediments that pose an unacceptable risk to human health and pose an acute risk to the marine ecosystem	Solidify sediments followed by excavating to 0.5 m depth below LAT and installation of a capping layer. Establish a clean surficial capping layer of material on the seabed.

2.6.5 OPTIONS FOR ACCESS TO KENDALL BAY

In order to undertake the Project, a suitable location is required to facilitate access to Kendall Bay ('Staging Site'). Both land-based and water-based options were assessed and are outlined in Table 2-4.

Table 2-4: Analysis of access options

Access option	Discussion	Preferred option
Breakfast Point Development	An existing cleared area, which forms part of the Breakfast Point Community Land, is located immediately west of Kendall Bay. Whilst use of this site would have minimal impact on vegetation, it forms part of the Community Lands of the Breakfast Point Community Title and consent would be required to utilise the land for this purpose. Jemena approached the Owners Corporation and Developer in June 2011, however the Owners Corporation indicated it would prefer Jemena identify an alternative site.	No
Cabarita Park	The original remediation approach proposed use of the adjacent Cabarita Park as a staging area to accommodate a temporary works compound and allow access to Kendall Bay for remediation works and transport of treated sediment waste for off-site disposal. A planning proposal to temporarily reclassify (under the <i>Local Government Act 1993</i>) a portion of Cabarita Park from 'community land' to 'operational land' for the purpose of a staging site was not supported by the Canada Bay Council and consequently an alternative staging site location was identified.	No
140 Tennyson Road, Mortlake	In March 2014, Jemena successfully acquired the proposed Staging Site at 140 Tennyson Road, Mortlake. The Staging Site is a former marina operated by River Quays Pty Ltd and provides direct barge access to the Parramatta River and the Kendall Bay remediation site. The Staging Site is also easily accessible by road allowing heavy vehicles to readily access the site to remove any treated sediment and supply Project-related materials and equipment.	Yes
Other water based options	Between 2009 and 2012, a search of waterfront properties along the Parramatta River / Sydney Harbour was conducted by APP (on behalf of Jemena) to identify a suitable site. The search covered the Parramatta River and Sydney Harbour, but focused on locations to the west of the Harbour Bridge, in waters within a 10 km radius of Kendall Bay. From this search, 22 sites were identified, however only one site was considered available and suitable. This site was Wharf 6 located at White Bay, however the option was discarded due to: • being too close to residential areas • would require rezoning; and • is not in close proximity to Kendall Bay (over 10 km by water).	No

3. PROJECT LOCATION AND CONTEXT

3.1 OBJECTIVES AND SCOPE

This chapter provides information on the Project location and the broader land use in order to provide a geographical context to the Project.

3.2 LOCATION

The Project Area is located within Kendall Bay on the Parramatta River, approximately 10 km west of the Sydney CBD, both within and in waters adjacent to the City of Canada Bay Local Government Area (refer Figure 3-1).

Kendall Bay is a small northward opening bay on the southern side of the Parramatta River at Mortlake and comprises:

- a small beach at the head of the bay (south) and a small beach on the north-west side
- a stand of mangroves around the southern edge
- a sandstone seawall along the southern and western edges
- large stormwater drains that drain the extensive surrounding residential catchment
- Cabarita Park located on the eastern side; and
- a ferry terminal at the north-east point (Cabarita) which services Rivercat and Harbourcat services.

The Project Area encompasses:

- the delineated Southern and Northern Remediation Areas (previously known as Areas A and B respectively), located in Kendall Bay directly to the east of the Breakfast Point residential development and to the north of the suburb of Cabarita (refer Figure 3-2).
- five metre buffer zones associated with the Northern and Southern Remediation Areas, and a 10 – 15 m buffer zone from the outer limit of the Remediation Areas required for silt curtains
- a portion of the seawall on the western margin of Kendall Bay
- the land-based Staging Site at 140 Tennyson Road, Mortlake, located on the southern shoreline of Fairmile Cove on the Parramatta River and situated approximately 1.4 km north-west of the Remediation Areas in Kendall Bay. This comprises a property owned by Jemena and a wharf area leased by Jemena from RMS.

The Project will also require use of a water-based corridor extending between Kendall Bay and the Staging Site located within the Project Area as shown in Figure 3-3.

3.3 SITE HISTORY

Historically, industrial development around Kendall Bay was concentrated on the western side of the bay and was mostly associated with the former Mortlake Gasworks facility. In 1883, AGL purchased the land at Mortlake (to the immediate west of Kendall Bay) for the development of a coal gasification facility.

The production of gas commenced in 1886, with the site eventually becoming the largest coal gasification facility in the southern hemisphere (Dames & Moore 1996). Various factors contributed to AGL phasing out coal gasification by 1971, including decline in the availability of labour during World War II, an increase in the availability of petroleum as feedstock for the production gas, and the development of natural gas as a viable alternative. From 1971 to the mid-1980s, the Mortlake facility produced gas from naphtha¹. Production then ceased but the site was retained for various network operational purposes including as a hub for odourising and distributing natural gas from Central Australia until the use of the facility for operational purposes ceased in 1990.

Throughout the operation of the former Mortlake Gasworks, coal was off-loaded on wharves located on the southern foreshore of the Parramatta River and within Kendall Bay (Plate 3-1 and Plate 3-2). These were used for loading and unloading coal, coke, by-products and other materials. In addition, an oil / tar pipeline wharf and coal loading wharf were in operation on the foreshore; these have since been demolished. Dredging of sediments was used to maintain access to the wharves during operation of the gasworks. A number of the smaller wharves and a coal loading wharf that were in operation on the foreshore were demolished in the 1950s. The larger coal wharf to the south of the coke jetty remained as the main loading facility until after the gasworks closed.

The layout of Mortlake Gasworks was subject to various changes over its operation, with significant land reclamation occurring along its northern, eastern and south-eastern shorelines until the mid-1940s. Of relevance to Kendall Bay was the presence of a large water supply dam, waste storage areas and retention ponds on reclaimed land to the west of the south-western foreshore of Kendall Bay.



Plate 3-1: 1935-1936 Aerial photo of the Mortlake Gasworks (Source: AGL, 1986)

¹ A flammable oil containing various hydrocarbons, obtained by the dry distillation of organic substances such as coal, shale, or petroleum.



Plate 3-2: 1972 aerial photo of Mortlake Gasworks and Kendall Bay (Source: S&W, 2017)

The land on the former gas works has since been redeveloped for residential and open space land use. The only infrastructure from the old gasworks that remains along the Kendall Bay foreshore are portions of wharf timber piles associated with the former coal loading wharf, that extend below the river bed. Since the closure of the gasworks, the uses of Kendall Bay have predominantly been for passive water-based recreational activities.

The Cabarita Park area on the eastern shoreline of Kendall Bay was reserved as a recreation area in 1856 and has been continuously used as a public reserve since the mid to late 19th century.

The Staging Site, which comprises a property owned by Jemena, and a wharf area leased from RMS is currently vacant. Before being acquired by Jemena, this site was an operational marina operated by River Quays Pty Ltd.



Plate 3-3: 2018 aerial photo of Breakfast Point development (Source: Cbus Property, 2018)

3.4 EXISTING ENVIRONMENT

3.4.1 KENDALL BAY

The Parramatta River is a tidal, estuarine tributary of Sydney Harbour. Kendall Bay forms a shallow north-facing embayment on the southern side of the Parramatta River between Breakfast Point to the west and the north-western tip of Cabarita Point to the east. The Northern Remediation Area is located within the central western portion of Kendall Bay, while the Southern Remediation Area is located within the southern portion of Kendall Bay.

The eastern shoreline of Kendall Bay comprises a dissected and gently sloped bedrock platform, stretching from the Cabarita Ferry Wharf and beyond, back towards the head of the bay. Sand occurs between the rock outcrops within the platform, the accumulation becoming deeper and more prominent with distance into the bay. A well-developed beach is located at the southern end, separating the rocky eastern shore from a stand of mangroves at the head of the bay.

The mangroves extend from the beach and low-level sandstone block wall around the head of the bay, terminating at the base of a sloped sandstone revetment which lines the south-west corner of the bay within the Southern Remediation Area. The sloped revetment merges with a vertical seawall which continues along the western shore to the Northern Remediation Area, characterised by basalt rip-rap and rubble at the base of the seawall. The seawall reverts to a more substantial sloped sandstone boulder revetment further to the north, eventually joining with a vertical block seawall at Breakfast Point.

There are seven stormwater outlets along the Kendall Bay shoreline. These range in size from approximately 300 mm to 1650 mm in diameter, with both the smallest and the largest discharging from behind the mangroves at the head of the bay. The large diameter pipeline drains a catchment of approximately 75 hectares, and has been known to cause scouring and erosion along the drainage channel between the outfall and the shoreline during major storm events.

Within Kendall Bay, the bathymetric levels are typically less than -2m Chart Datum² (CD) with the exception of a -5m CD channel extending from the site of the former coal loading wharf on the western foreshore. The southern part of the bay is less than -2 metres CD deep, as is a narrow fringe along the seawall north of the former coal wharf. The deepened approach across Kendall Bay to the former coal wharf is artificial and was originally dredged to provide unimpeded access to the main channel of the Parramatta River.

Water levels in the Parramatta River adjacent to the former gasworks site fluctuate primarily in response to astronomical tides. Storm surge, local wind and wave set up, and fresh water flooding may also slightly increase the water level.

Pedestrian and cyclist access consists of an existing shared pathway located around the perimeter of the Breakfast Point area, which extends from Cabarita Park to Fairmile Cove. An existing public boat ramp is also located to the immediate east of Kendall Bay, adjoining Cabarita Park.

There are no services available within Kendall Bay.

3.4.2 STAGING SITE AND FAIRMILE COVE

Like Kendall Bay, Fairmile Cove is a shallow north-facing embayment on the southern foreshore of the Parramatta River. The bay is formed by Mortlake Point on the western foreshore and Breakfast Point on the eastern foreshore. Fairmile Cove is also bound by sections of sloping concrete and a facing of mortared sandstone blocks with rock toe protection, similar in construction to the older seawall structure found around the head of Kendall Bay, that restrict water access. The shoreline of Fairmile Cove is landscaped with native plantings on the northern side of the paved foreshore walk with open grassed areas on the southern side forming part of the Breakfast Point estate.

The wreck of the 'Lady Edeline' is partially submerged just off the shoreline approximately 50 metres south-east of the Staging Site and 10 metres north-east of the shoreline. Within Fairmile Cove the bathymetric levels are typically less than -2 metres CD close to shore and grade away from the shore towards the main channel to around -10 – 20 metres CD.

The topography of the Staging Site at 140 Tennyson Road is relatively flat, with a slight fall towards the water's edge. There is a fall from the street level (Tennyson Road) into the site, of approximately 1 m. With the exception of a number of small trees located towards the northern section of the site, the Staging Site is largely devoid of vegetation adjoining the shoreline. The Staging Site consists of an existing industrial building, a hardstand area located within the forecourt of the building, extending via a series of gangways to a piled concrete wharf area.

Existing facilities at the Staging Site include two large warehouses (previously used for ship repair), a foreshore hardstand area, a concrete piled wharf structure, a number of mooring piles and several gangways providing access to floating pontoons. The Staging Site has existing water, electricity, telecommunications and natural gas facilities available. The site has direct vehicle access to Tennyson Road and benefits from existing transport infrastructure, for both land based (trucks and other vehicles) and marine (vessels, barges, etc) based movements.

A drain protruding through the seawall at the eastern boundary of the Staging Site is part of the public drainage network and receives stormwater runoff from inlet pits along Tennyson Road. In addition, several minor stormwater pipes protrude through the seawall structure located at the eastern side of the site which are understood to drain rainwater collected from the roof of the warehouse building. Five

² Chart Datum (CD) is approximately the level of Lowest Astronomical Tide (LAT) and is approximately 0.9 metre below Australian Height Datum (AHD).

surface inlet pits exist over the hardstand area which are likely to have been part of a first flush drainage system (draining to a central sump) for the former marina.



Plate 3-4: Kendall Bay and Fairmile Cove. (Source: Cbus Property, 2018)

3.4.3 CURRENT LAND USE AND PLANNING CONTROLS

The current land uses surrounding Kendall Bay and the Staging Site are described in Table 3-1. below. Land use and planning controls are shown in Figure 3-3 to Figure 3-6 below and discussed in detail in Chapter 5 Statutory Framework.

Planning control maps include the Canada Bay Local Environment Plan surrounding land use (2013), Sydney Regional Environment Plan (2005) (Sydney Harbour Catchment) (Harbour REP) Zoning Map 3; Harbour REP Wetlands Protection Map 3; Harbour REP Strategic Foreshores AGL Site – Mortlake.

Table 3-1: Surrounding land uses

Location	Land use	Typical Views within Area
Kendall Bay		
North	The Parramatta River is located to the north of Kendall Bay. A mixture of powered private and commercial vessels uses the waterway and the waters of Kendall Bay, along with unpowered craft such as canoes, kayaks, rowing boats and small yachts. Passenger ferries also operate along the river between the Sydney CBD and Parramatta. The Cabarita Ferry Wharf is located east of the bay at Cabarita Point. A public boat ramp is located west of the ferry wharf on the north-eastern shoreline of the bay at Cabarita Park.	
East	Cabarita Park is located on the eastern shoreline of Kendall Bay, whose foreshore largely consists of rock outcrops and smaller pockets of mangroves. The Waterfront Park on the western side of Cabarita Park is a sloping open space area leading down to the Kendall Bay foreshore. It incorporates the foreshore walk, which runs from the Cabarita Ferry Wharf, following the foreshore of Kendall Bay along the northern side of the Breakfast Point development to the Staging Site. The foreshore walk is a shared pathway utilised by local residents for walking, jogging or cycling. Limited access to the mangrove and beach area is available to the public.	
South	The southern shoreline area consists of a small intertidal beach with mangroves and is less modified in comparison to the western shoreline. The beach and mangroves are overlooked by the Breakfast Point Country Club and medium density housing which forms part of the Breakfast Point development. The Breakfast Point development consists of residential dwellings which are predominately attached medium density dwellings and residential apartment buildings. The shared foreshore walk provides access to the beach and mangroves. Limited access to the mangrove and beach area is available to the public.	

Location	Land use	Typical Views within Area
West	The western shoreline of Kendall Bay is a constructed shoreline and seawall overlooked by the Breakfast Point residential development. The shared foreshore walkway continues along the top of the seawall and former gasworks wharf location around Breakfast Point to the Staging Site at Fairmile Cove.	
Staging Site		
North	The Staging Site is adjoined by the Parramatta River to the north and north-east. Moorings are located to the north and east of the site, within Fairmile Cove. The Mortlake Ferry (or Putney Punt) is a local car ferry which crosses the Parramatta River from Mortlake to Putney and is located approximately 100 metres north-west of the Staging Site. A slipway utilised for the maintenance of NSW Roads and Maritime Services (RMS) owned ferries is located immediately to the south of the ferry approach ramp. Putney Point is located on the northern shoreline of the Parramatta River approximately 400 metres north of the Staging Site. The area beyond Putney Point to the north and Tennyson Point to the north-east is consists primarily of residential housing.	

Location	Land use	Typical Views within Area
East	The northern extent of the Breakfast Point estate and open space area is located east of the Staging Site, with most of the eastern frontage of the estate adjoining Fairmile Cove.	
South	Immediately south of the Staging Site are light industrial and warehousing premises, which are largely located in the area bounded by Palace Lane, Tennyson Road, Hilly Street and Whittaker Street. The local area beyond this predominantly consists of residential dwellings, restaurants and cafes.	

Location	Land use	Typical Views within Area
West	The land to the immediate west of the Staging Site consists of light industrial and warehouse uses, with medium density dwellings dominating the streetscape of Hilly Street.	

Note: The Staging Site has separate development consent for the 'erection of a residential flat building', which was approved by the Land and Environment Court in 2004.

3.4.4 PROJECT AREA OWNERSHIP

Ownership details for the Project Area are provided in Table 3-2:

Table 3-2: Ownership details Project Area

Project Area	Ownership
Remediation Areas and buffer zones within Kendall Bay	NSW Roads and Maritime Services (RMS) is the authority responsible for administering all land below mean high water mark in Sydney Harbour. This includes the Remediation Areas and buffer zones within the Bay. This land is comprised in Lot 1 DP 945166 (the location of the former coal loading wharf), and a portion of CT Vol 5018-1 (a generic title covering Sydney Harbour and Botany Bay). Note: RMS is also responsible for the water-based corridor between the Staging Site and Kendall Bay, which will be used for the Project.
Sea wall on western side of Kendall Bay	The sea wall is on two separate lots associated with the Community Lands of the Breakfast Point Community Title: • Lot 1 DP 270347 • Lot 55 DP 270347
Staging Site at 140 Tennyson Road	This is a former operational marina that has been acquired by Jemena for the purpose of the Project. The Jemena-owned portion of the Staging Site comprises the following lots: • Lot 1 DP 589304 • Lot 1 DP 656212 • Lot 1 DP 735869 • Lot 1 DP 256227 • Lot 1 DP 740402 The Staging Site also includes a wharf structure located within Lot 1 DP 854000 that Jemena has leased from RMS, which will also be used for the Project.

Lands which are not part of the Project Area, but adjacent to Kendall Bay, are:

- Cabarita Park – most of Cabarita Park on the eastern shoreline of Kendall Bay is owned by the City of Canada Bay Council (Lot 1 DP 126394), along with a narrow strip on the eastern side owned by the Crown.
- The southern and western foreshore areas adjacent to Kendall Bay comprise the following lots: Lots 1 and 55 DP 270314 (owned by Breakfast Point Community Title), Lot 1 DP 270214 (community title of an adjacent residential development), and Lot 501 DP 1052824 (owned by the Council). It is noted that the foreshore walking trail alignment falls within Lot 501 DP 1052824.

3.4.5 SOCIAL INFRASTRUCTURE

Table 3-3 provides a brief overview of existing social infrastructure assets in the vicinity of the Project Area and immediate surrounds in order to understand potential receptors that may be impacted. Figure 3-7 shows the location of social infrastructure assets.

Table 3-3: Social infrastructure assets in the Project Area

Social infrastructure	Description
Public transport	Public transport services in the Project Area include bus services, passenger ferry services and car ferry services. Closest bus routes to the Project Area run along Cabarita Road to the Cabarita Ferry Wharf, and Tennyson Road to the Mortlake Ferry Wharf. Parramatta River ferry service between Parramatta and Circular Quay operates from Cabarita Ferry Wharf located in Cabarita Park (north east of the Southern Remediation Area). The Mortlake Ferry local car ferry service operates between Hilly Street in Mortlake (north of the Staging Site) to Pellisier Road in Putney. Further detail on public transport and traffic in the Project Area is provided in Chapter 16 Traffic and Transport.
Sport and recreation	Parramatta River and Kendall Bay – used for a range of leisure boating activities, with major mooring sites at Fairmile Cove (near the Staging Site), Morrisons Bay, Glades Bay, and the d’Albora Marinas at Cabarita Point Cabarita Park – provides a range of passive recreation facilities, including a foreshore walk, picnic tables, children’s play area, BBQ’s, amenities, rotunda, and shelters. Cabarita swimming centre is also located on the eastern side of the park and includes a 50 metre outdoor heated pool Waterfront Park - is a sloping area of passive open space leading down to the Kendall Bay foreshore and contains the foreshore walk, which runs from the Cabarita Ferry Wharf past both Remediation Areas and around Breakfast Point to the Staging Site. The foreshore walk is a popular recreation asset for residents for walking, jogging or cycling Breakfast Point Country Club – includes a two-storey sports, recreation and function centre overlooking Kendall Bay.
Schools and childcare	There are a number of schools and childcare assets in the immediate and wider catchments, which are either in proximity to the Staging Site, or along proposed transport routes (refer to Figure 3-7).

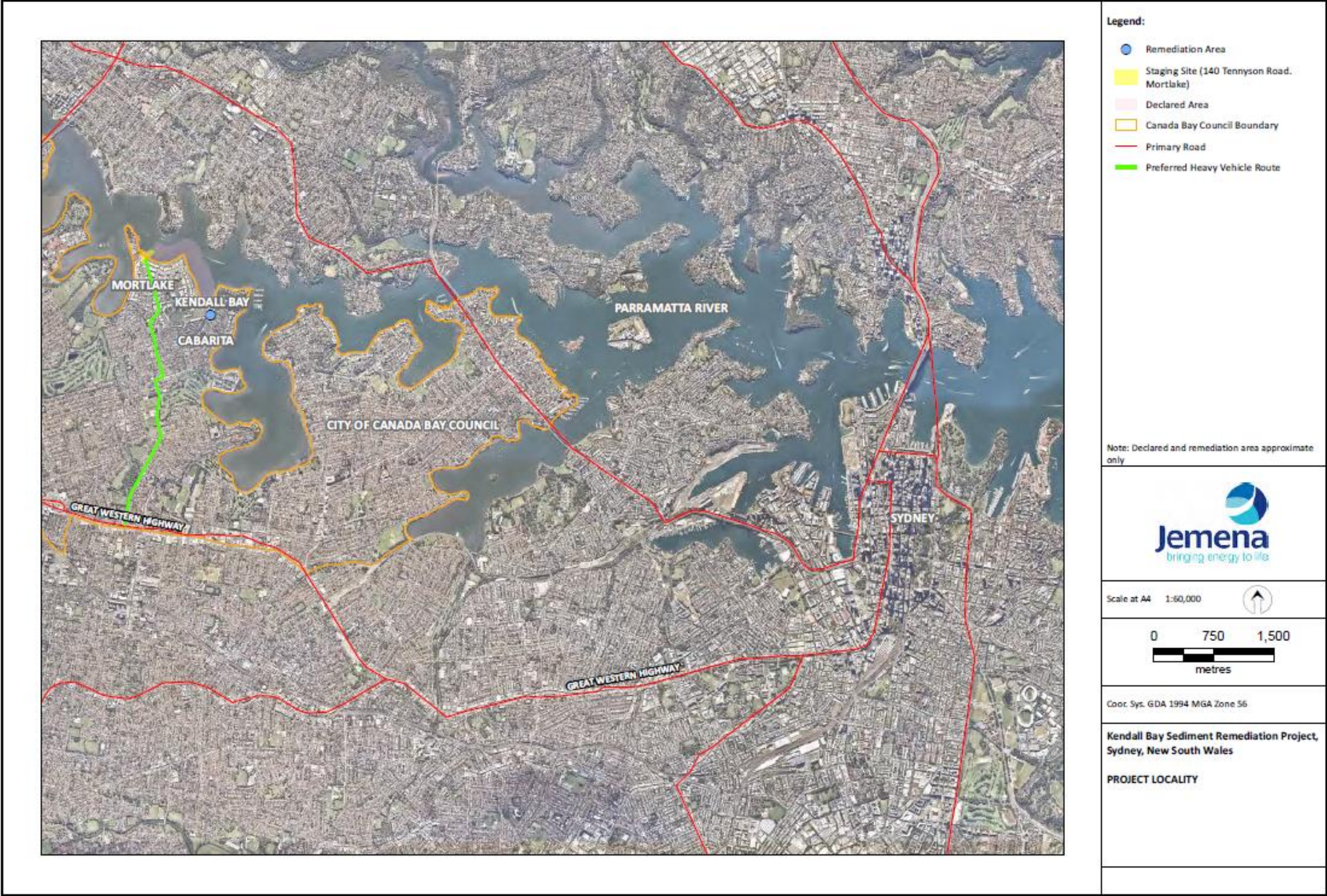


Figure 3-1: Project locality

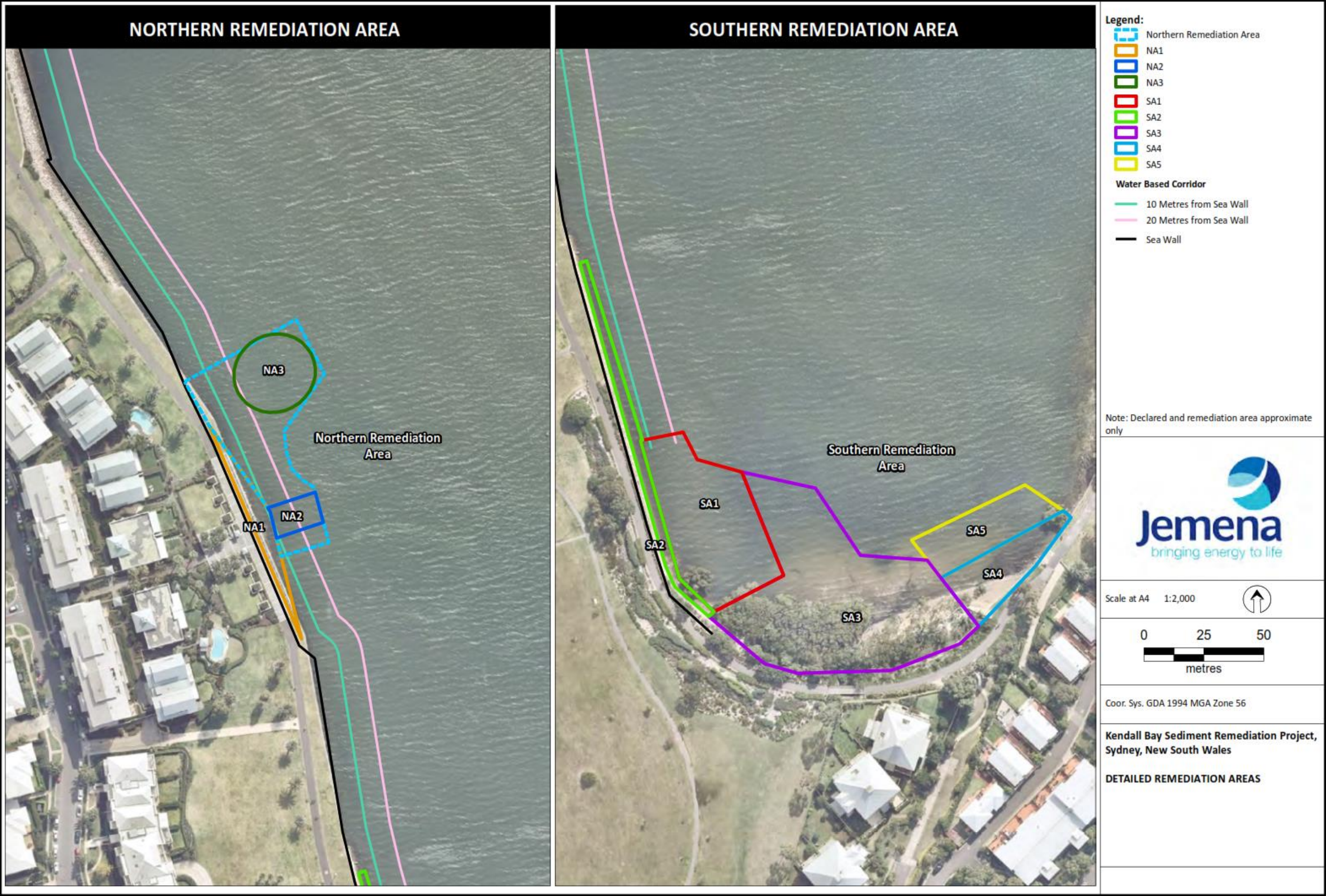


Figure 3-2: Detailed Remediation Areas

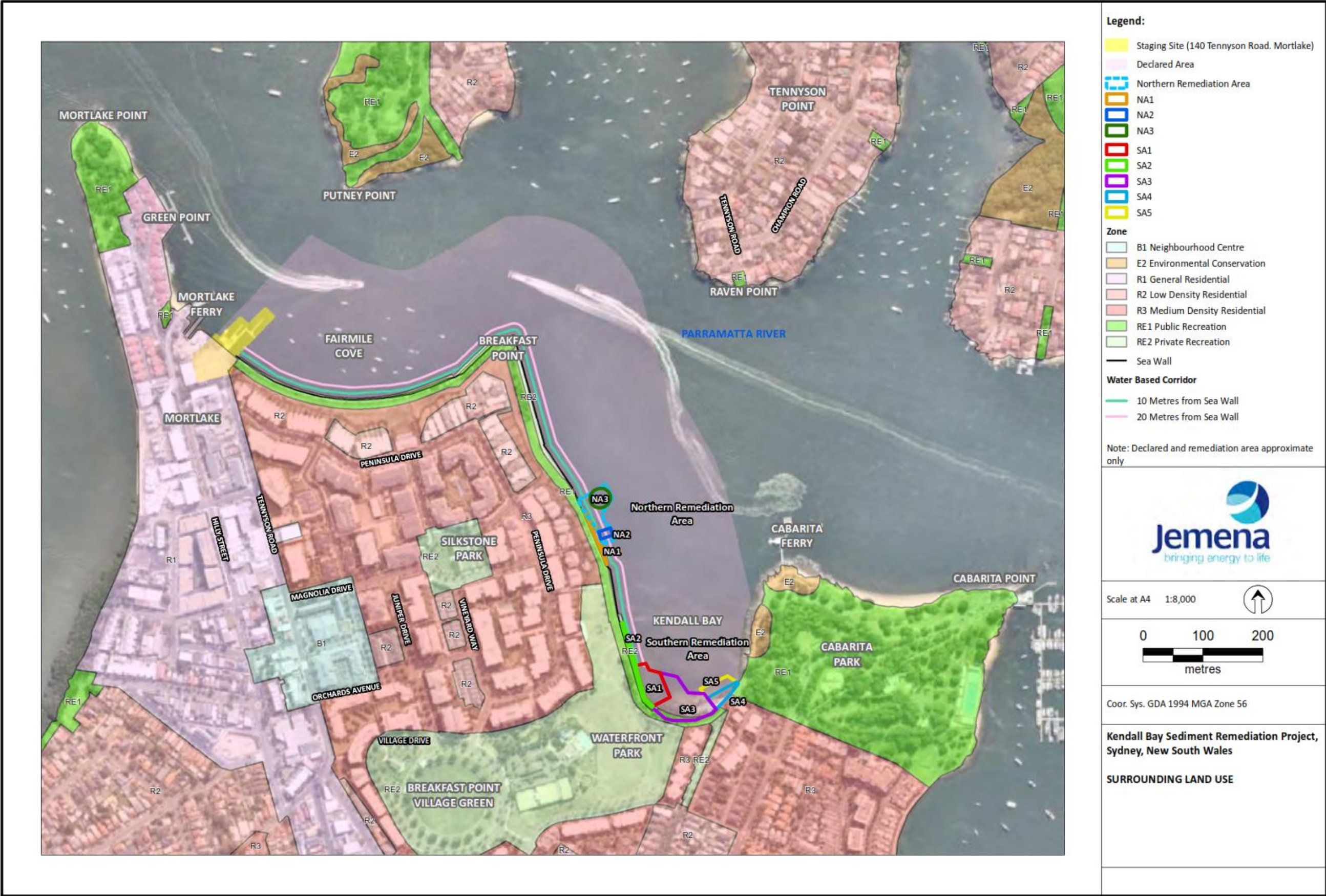


Figure 3-3: Remediation Areas and surrounding land use zoning (Canada Bay Local Environment Plan 2013)

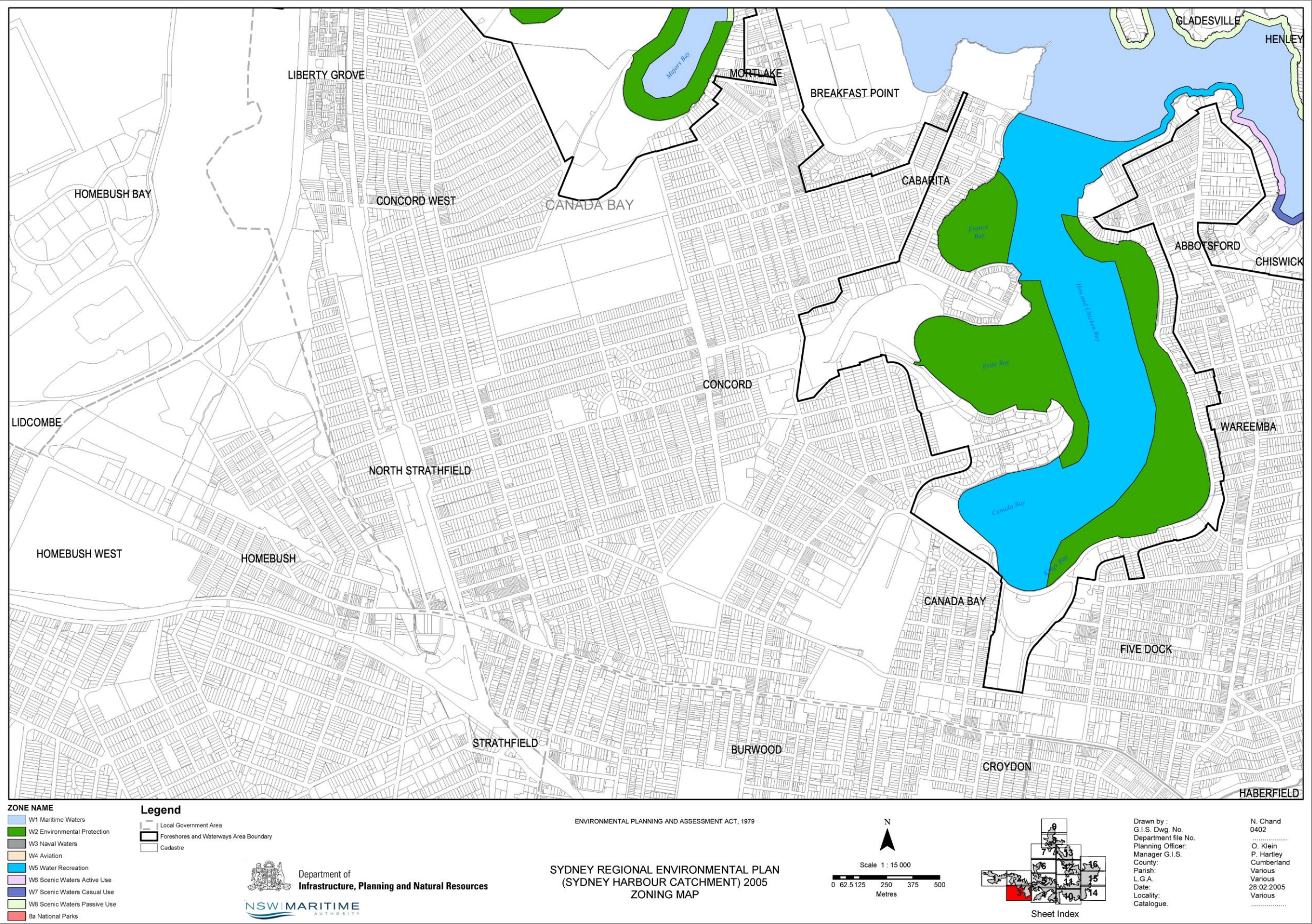


Figure 3-4: Sydney Regional Environment Plan - Zoning Map 3. (Source: NSW Department of Planning and Environment)

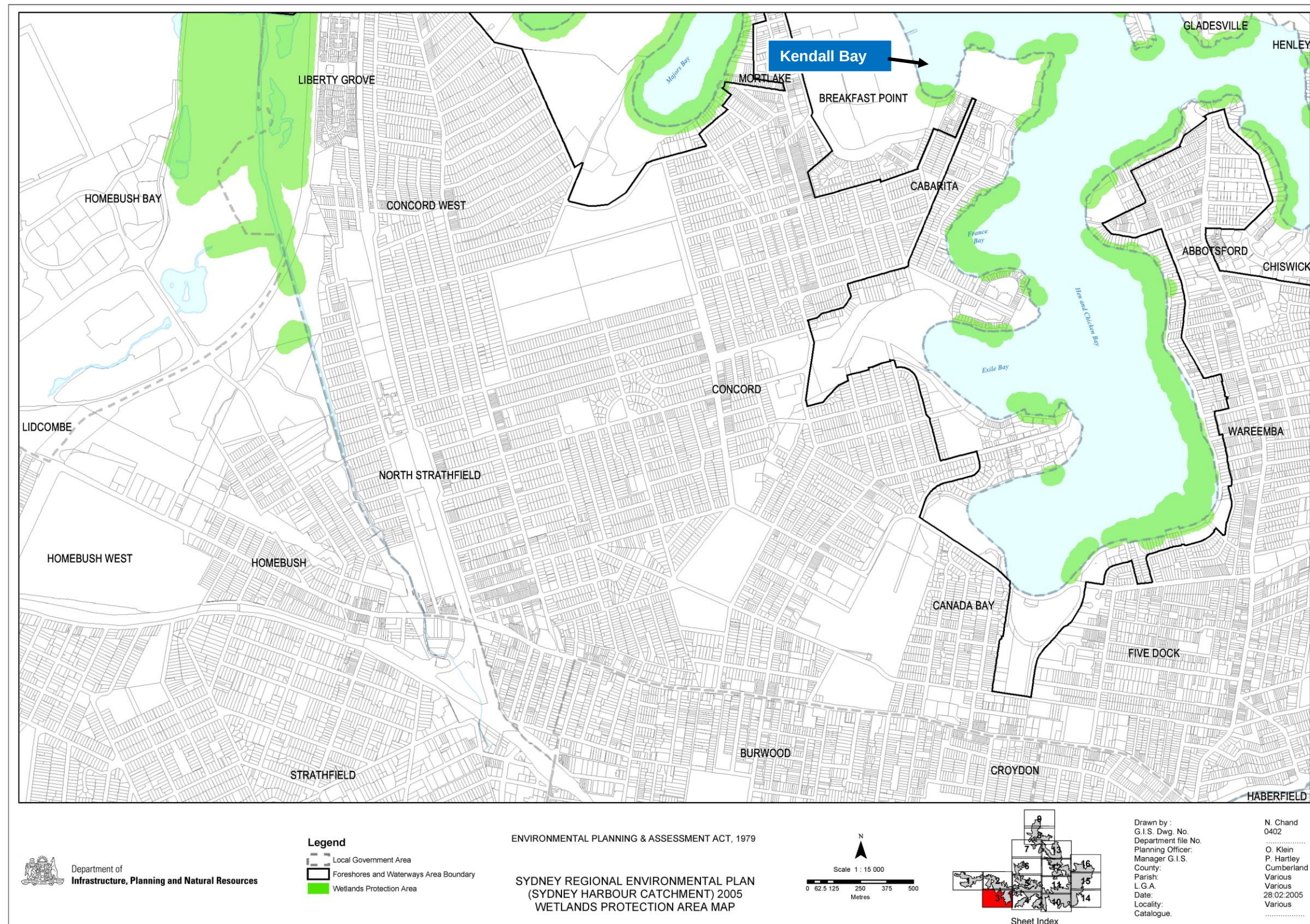


Figure 3-5: Sydney Regional Environment Plan – Wetlands Protection Area Map 3. (Source: NSW Department of Planning and Environment)

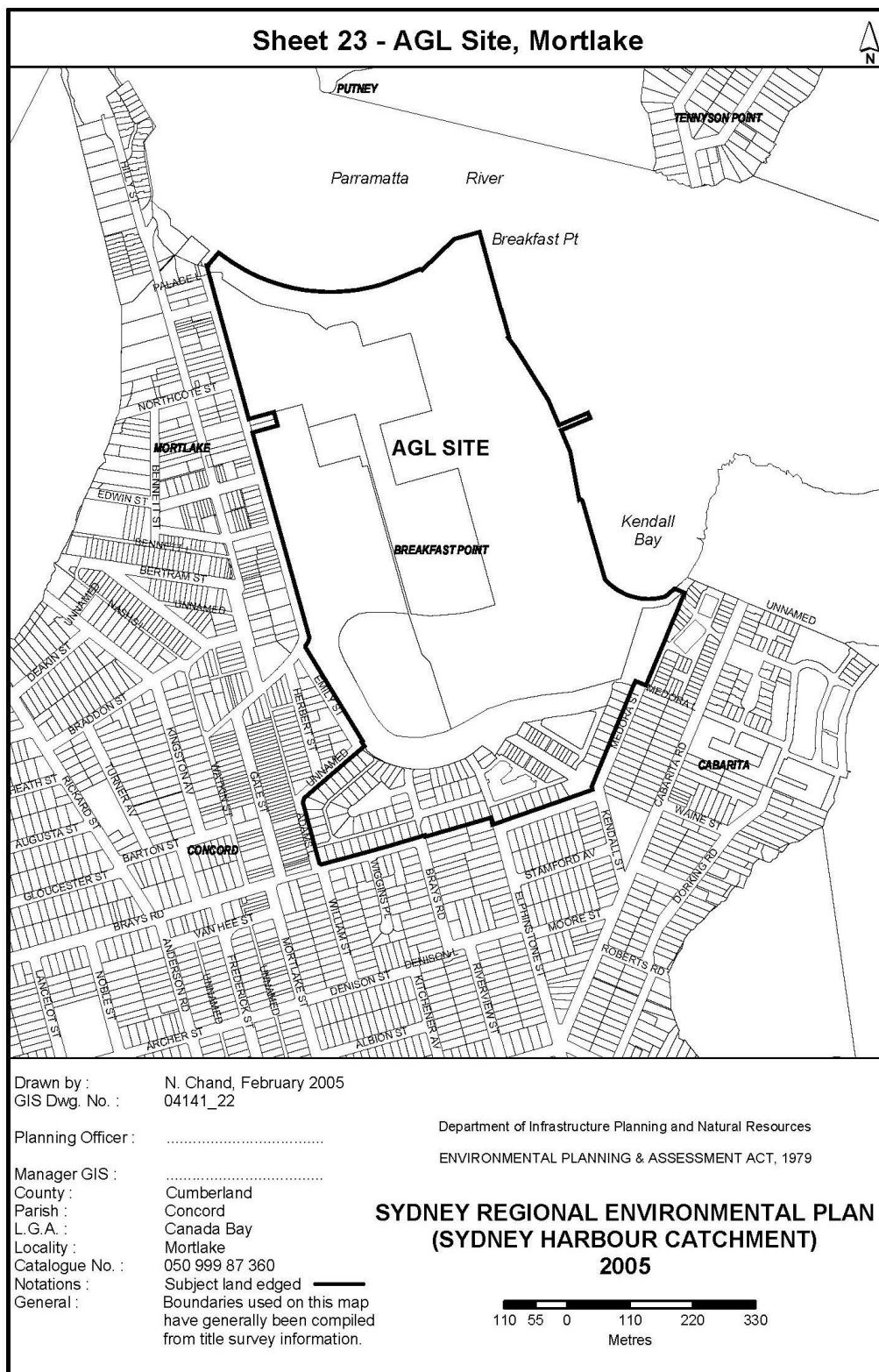


Figure 3-6: Figure 3 6: Sydney Regional Environment Plan – Strategic Foreshores AGL Site - Mortlake. (Source: NSW Department of Planning and Environment)

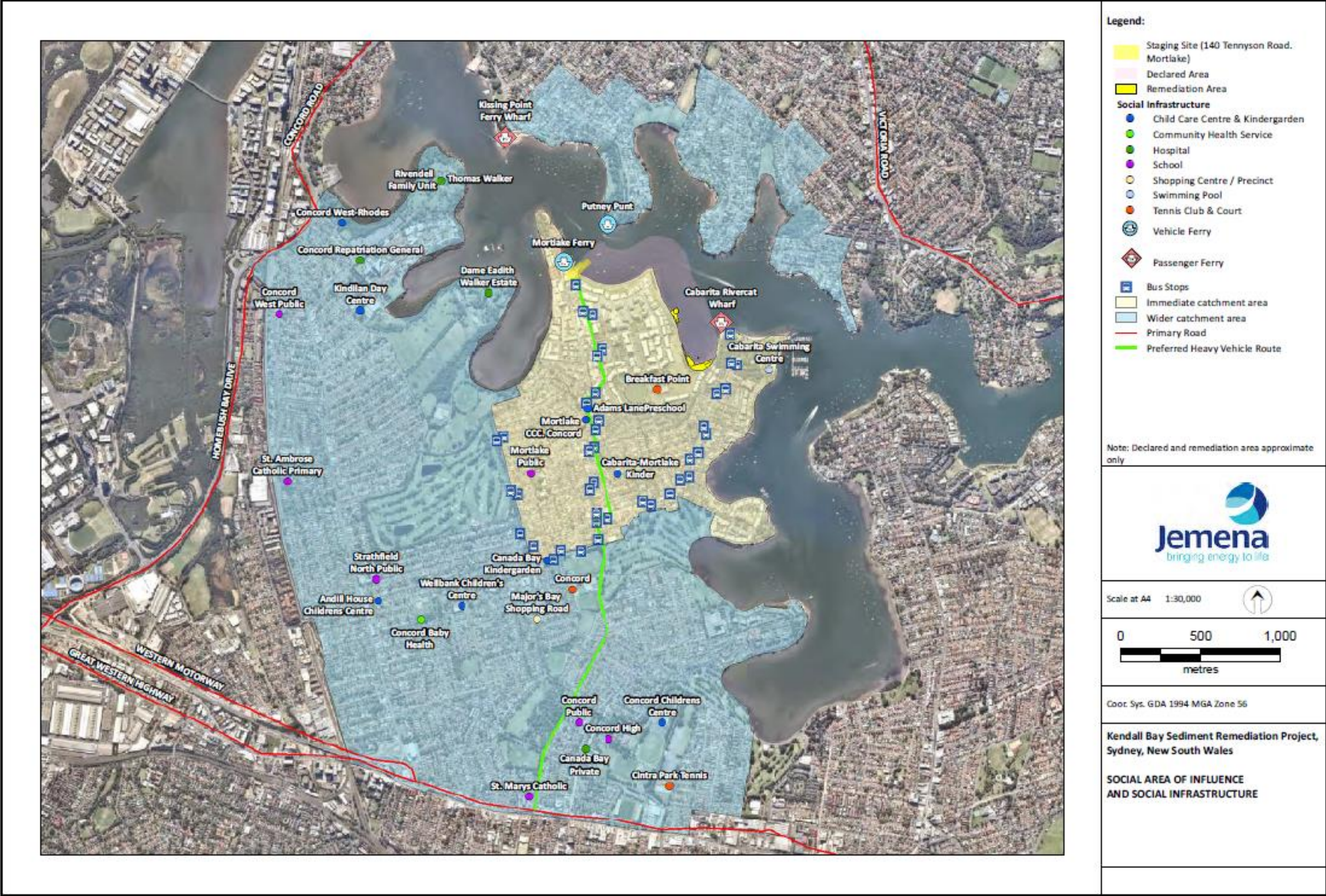


Figure 3-7: Location of social infrastructure relative to the Project Area

4. DESCRIPTION OF PROJECT ACTIVITIES

This chapter presents a description of the proposed remediation approach and key project activities, and draws on the remediation methodology presented in the Remediation Action Plan (Appendix 2).

4.1 OBJECTIVES AND SCOPE

The overall objectives of the Project are set out in Chapter 1 Introduction. Further, and in keeping with these overall objectives, the goals of the remediation works are set out in the RAP as follows:

- ensure long-term protection from potential impacts from gasworks-related contamination on the health of users of the foreshore of Kendall Bay (including the southern beach and adjacent mangrove area where gasworks-contaminated sediments are currently exposed at low tides)
- improve the health of the marine ecosystem of Kendall Bay in areas where it is adversely affected by acutely toxic gasworks contaminated sediments
- improve the amenity of readily accessible areas of Kendall Bay
- ensure that a durable remediation outcome is achieved that satisfies the requirements of the VMP; and
- provide a remediation solution that is technically sound, environmentally justifiable and meets EPA requirements and community expectations.

This chapter describes the proposed remediation approach for each Remediation Area, and discusses each stage of the Project from site establishment, through to decommissioning and rehabilitation.

This chapter addresses the following SEARs:

SEARs Requirement – Project Description

Include a detailed description of the development, which may be defined as –

“Remediation of the contaminated sediments within two areas of Kendall Bay (the Southern and Northern areas, formerly called Areas A and B), including:

- *immobilisation of contaminated sediments;*
- *excavation of contaminated sediments and materials along the shoreline;*
- *transportation of sediments and other contaminated materials to a land-based ‘Staging Site’ at 140 Tennyson Road, Mortlake via barge;*
- *treatment of the sediments at a licenced waste facility; and*
- *capping of excavated areas and reinstatement with clean soil.”*

4.1.1 SPECIFIC REMEDIATION PROJECT OBJECTIVES

Specific objectives developed for each of the Remediation Areas and for management of remediation works are summarised below and discussed in Chapter 2 Project Justification and Alternatives. Further detail is provided in the RAP (refer to Appendix 2):

Southern Remediation Area (SA1, SA2, SA3, SA4, SA5)

Remediation works in the Southern Remediation Area will be undertaken to:

- remediate to the extent practicable gasworks-contaminated sediments that pose an acute toxicity risk to the marine ecosystem
- remediate gasworks-contaminated sediments that pose an unacceptable risk to the health of users of the mangrove area, and areas of sediment that pose an unacceptable risk to human health when accessible at low tides
- remediate stained surfaces, gasworks-contaminated sediments giving rise to emission of odours when exposed at low tides, and rubbish in accessible areas of the mangroves, on the southern beach and in the foreshore, adjacent to the seawall; and
- install a physical barrier to control the discharge of stormwater from the large outfall at the southern end of the bay to ensure stormwater discharge into Kendall Bay does not impact the remediated parts of the Southern and Northern Remediation Areas.

Northern Remediation Area (NA1, NA2, NA3)

Remediation works in the Northern Remediation Area will be undertaken to:

- remediate to the extent practicable gasworks-contaminated sediments that pose an acute toxicity risk to the marine ecosystem; and
- remediate stained surfaces, gasworks-contaminated sediments giving rise to odour emissions when exposed at low tides, and rubbish in accessible areas of the foreshore adjacent to the seawall.

Management of Remediation Works

Management of the remediation works will be undertaken in accordance with the requirements of the RAP by:

- having a Jemena Project Manager who has extensive experience in complex remediation works
- engaging a remediation contractor that has extensive experience in in-situ solidification of sediments in waterways within urban environments
- engaging a validation consultant who have extensive experience in complex remediation works
- continuing to implement the community consultation plan prior to, during and after completion of the remediation works
- implementing a Remediation Works Environmental Management Plan (RWEMP) for the remediation works to ensure the protection of the environment and human health of users of Kendall Bay and the adjacent residential community, and workers undertaking the remediation works; and
- validating achievement of the goals of the remediation measures in the Southern and Northern Remediation Areas.

Post-Remediation Works

After the remediation works have been completed, post-remediation studies may be required to:

- verify the durability of the remediation measures through periodic monitoring, to assess any need for rehabilitation of remediation measures, or further monitoring or management measures
- continue engagement with and reporting to the community and regulatory authorities during the remediation program, and throughout the implementation of any post-remediation verification and management (if required); and

- implement a post remediation Site Management Plan (SMP) to ensure the ongoing integrity of the remediation measures once the works have been completed. The requirements of the SMP are yet to be confirmed and will be determined in consultation with the EPA, RMS and the site auditor.

4.2 REMEDIATION PROJECT LOCATIONS

4.2.1 REMEDIATION AREAS

The Project will involve the remediation of polycyclic aromatic hydrocarbon (PAH) and total recoverable hydrocarbon (TRH) impacted sediment from the 'Northern Remediation Area' and 'Southern Remediation Area' within Kendall Bay and related activities. In this document, these areas are collectively described as Remediation Areas.

The two Remediation Areas have been delineated based on the results of extensive environmental investigations (refer Chapter 2 Project Justification and Alternatives) and liaison with the EPA and other government stakeholders (refer Figure 3-2 Chapter 3 Project Location and Context).

The Southern Remediation Area is located at the southern (beach) end of Kendall Bay directly to the east of the Breakfast Point residential development and comprises sediments in the south-western corner of the bay (SA1), the south-western foreshore (SA2), the mangroves and stormwater delta (SA3) and the beach (SA4 and SA5). The Southern Remediation Area occupies an approximate area of 8,453 m² (with an additional 458 m² associated with a 5 metre buffer zone to the north and east).

The Northern Remediation Area is located on the eastern foreshore of Kendall Bay, where the former coal wharf was located and comprises sites NA1 (on the eastern foreshore) and NA2+NA3 (sediments located in deeper water to the east of the foreshore). The Northern Remediation Area occupies an area in Kendall Bay of approximately 3,215 m² (with an additional 1,388 m² associated with a 5 metre buffer zone to the north, east and south).

An additional area extending approximately 10 - 15 metres from the outer limit of the Remediation Areas (other than the landward side) is required for associated silt curtains. As noted above, buffer zones associated with the Remediation Areas extend 5 metres beyond the defined Remediation Area boundaries.

4.2.2 STAGING SITE

The land-based Staging Site for the Project is located at 140 Tennyson Road, Mortlake. The site has been purchased by Jemena to be used exclusively for the Project, for the sole purpose of facilitating operations associated with the Project and so that impact on the local community from remediation activities may be minimised. Jemena has also leased the wharf area of this location from RMS. The Staging Site benefits from direct access to both the Parramatta River and Tennyson Road, with existing wharf facilities and a large industrial building.

The Staging Site will be used as a base for contractors to store equipment and house crib huts, as well as to facilitate disposal of excavated sediments from the Remediation Areas.

4.2.3 WATER-BASED CORRIDOR

The Project also requires the use of a water-based corridor (refer Figure 3-3 Chapter 3 Project Location and Context) extending from Kendall Bay to the Staging Site, which will be used periodically to transport excavated and stabilised sediments to the Staging Site via a barge. The water-based corridor would also facilitate the movement of floating plant between the Staging Site and Kendall Bay to service the Project.

The water-based corridor between the Staging Site and the Remediation Areas within Kendall Bay is administered by RMS and comprises:

- an area approximately 10 - 20 metres seaward of the seawall alignment between the Staging Site and Northern Remediation Area
- a Project navigation route between the Staging Site and the Northern and Southern Remediation Areas; and
- the balance of the area declared by the EPA in Remediation Order Number 23022 (Declaration Number 21055, Area 3335) made on 22 June 2007.

4.3 DETAILED SCOPE OF THE PROJECT

The Project involves numerous remedial technologies, each chosen based on the level of contamination, as well as specific site constraints such as bathymetry and the presence of established vegetation (mangroves). A detailed remedial options evaluation was completed as part of the RAP.

Three distinct stages with respect to the completion of the Project remediation works can be identified as follows:

- Preparatory works and site establishment (RAP Chapter 9).
- Remediation (RAP Chapters 7 to 10).
- Post remediation validation, decommissioning and site management (RAP Chapter 14 and 15).

4.3.1 PREPARATORY WORKS AND SITE ESTABLISHMENT

Prior to establishing on site, the following preparatory works are to be completed by the appointed remediation contractor:

- completion of pre-remediation baseline monitoring
- obtaining relevant approvals and licences to facilitate the works
- completion of a seawall dilapidation survey of the seawall to the west of Kendall Bay and of the seawall and other assets at the Staging Site before commencement of the works. A comparative survey will be completed upon completion of the Project, and will include surrounding buildings, including those which may be impacted by the works, existing services, facilities and utilities
- completion of laboratory and fields trials to verify the applicability of the preferred remediation options and confirm the detailed technical specifications, following input from the appointed site auditor (Note: the field trials are the subject of a separate development application made to RMS in 2017); and
- preparation of a Remediation Works Plan (RWP) and associated management plans (refer Section 4.5).

On completion of the above, the appointed remediation contractor will move to establish the works area in Kendall Bay and the Staging Site to allow remediation works to commence. The Staging Site is the only land-based operational area for the Project, and will be used for loading and unloading of general goods and materials required for the Remediation Works, and as the receiving area for excavated sediment. A Staging Site Layout Plan is shown in Figure 4-1.

The establishment of the Staging Site is proposed to involve the following:

- removal of any redundant wharf facilities and pylons (if required)
- installation of additional operational facilities as needed including site offices, lunch, change and ablution facilities
- upgrading existing site infrastructure to be designed and engineer-approved to ensure compliance with high wind loadings
- installation of material lay-down areas and a material delineation / segregation system
- installation of site security fence (if required) and signage (safety, directional etc.), including lockable site notice boards
- review and upgrade of the existing site fire management system (if required)
- installation of spill kits, emergency showers, eye wash stations and decontamination units
- installation of fencing, gates, padlocks, hoardings, physical barriers and other protective devices to define and control work areas as required (see Plate 4-1) and
- installation of a vehicle / truck wash facility.



Plate 4-1: Indicative temporary screening / security fencing (Source: Aussie Erosion, 2017)

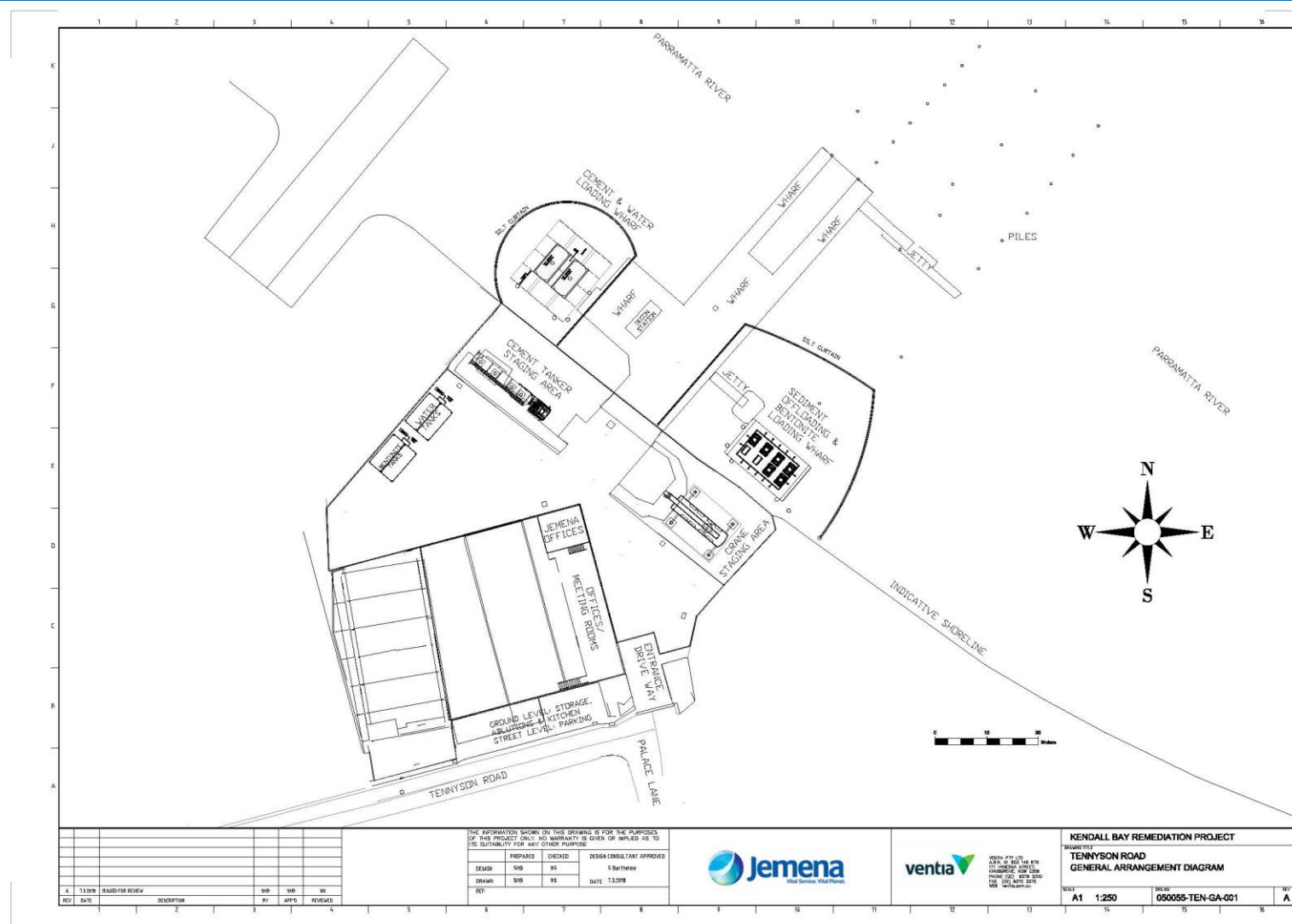


Figure 4-1: Staging Site layout plan

Both Remediation Areas will be accessed from the water and not from the surrounding land which is privately owned, or public land. Large remediation equipment will be mobilised to the Remediation Areas from White Bay, Rozelle Bay or a similar facility, while smaller remediation equipment, backfill and consumables will be mobilised from the Staging Site. Plate 4-2 shows access to the Paramatta River from the Staging Site.



Plate 4-2: Marine access from the Staging Site (Source: Jemena)

Marine-based remediation works will not commence until silt curtains (sheet piles in SA1) and an oil boom, providing three layers of protection, have been established within the area of works. The three layers of protection include:

1. A primary silt curtain control installed at the active excavation and piling work area to mitigate the lateral spread of contamination and turbidity from the immediate Remediation Area. Sheet piles are planned to be installed for SA1 as the primary control.
2. A secondary silt curtain control installed at the boundary of the marine work areas to further prevent migration of turbid water and contamination; and
3. An outer oil boom to prevent against wave propagation from passing vessels such as the Rivercat.

An example of sedimentation barriers is provided in Plate 4-3.



Plate 4-3: Indicative sedimentation barrier (Source: Jemena)

4.3.2 REMEDIATION METHODS

The following sections provide additional details with respect to the proposed remediation methods for each of the eight areas. This is based on information provided by Jemena to the Site Auditor. The remediation methods are summarised in Table 4-1 below and shown in Figure 4-3 and Figure 4-4.

Prior to the commencement of the Project, a field scale ISS trial will be completed in Kendall Bay to further refine the proposed ISS remedial approach described in further detail below (this is subject to a separate development approval process, with RMS as the consent authority).

Further details with respect to the remediation objectives for each area are provided in Chapter 2 Project Justification and Alternatives and Chapters 8 and 9 of the RAP.

Remediation Area SA1

The approach adopted for immobilising contaminated sediment within Remediation Area SA1 (and NA2 + NA3) is ISS which involves stabilisation of sediments through the mixing of cement and other additives into the sediments.

A summary of ISS and the broader remediation process for SA1 is set out below. Additional information can be found in Section 9.5 of the RAP.

- Steel sheet piles will be installed to form a continuous wall around the perimeter of SA1. The sheet piles will nominally extend 0.5 m above mean tide level and following completion of works, will be driven into the underlying clays or cut so the top of the sheet piles are at LAT (refer Section 4.3.3 for a description of the sheet piling methodology).

- A supporting grid of ISS columns will be installed using barge-mounted equipment comprising a drilling rig positioned using GPS control, mixing plant and grout pump. The ISS columns will extend into the competent clay unit (Unit 2B¹) (refer to Plate 4-4). A raft will be installed above the support columns, incorporating the top of the columns and extending from the existing surface to 1.5 m below LAT.

Following completion of the work above, the top of the cement stabilised raft will be excavated to 0.5 m below LAT. The work will be completed using an amphibious excavator or barge-mounted equipment (refer to Plate 4-5).

- Excavated material will be placed into an adjacent hopper barge or a barge carrying smaller hoppers or skip bins for transfer overwater by barge to the Staging Site disposal off-site to landfill (refer to Plate 4-6).
- A cap will then be installed comprising an activated carbon mat at the base (approximately 0.009m thick), then 150 mm capping layer of hard rock virgin excavated natural material (VENM) cobbles followed by 150 mm layer of sand. Where possible, the sand from other Remediation Areas may be reused (given its appropriate classification), or alternatively imported clean sand (VENM) used. The finished level for the cap is proposed to be approximately 0.2 m below LAT.

Further discussion of the fate of excavated sediment is provided in Sections 4.3.6 and 4.3.7.

Remediation Area SA2

The approach to removal of stained surfaces and sediments within Remediation Area SA2 (and NA1) includes cleaning of the existing seawall and excavation of contaminated sediment from within the area. Extra care will be taken during excavation works within the immediate vicinity of the toe of the seawall. A summary of the proposed approach is set out below. Additional information can be found in Section 9.5 of the RAP.

- The existing seawall will be cleaned to remove surface staining using a high pressure cold water spray. Stained rock / rubble unable to be cleaned will be removed and replaced with clean sandstone to restore site aesthetics and to provide habitat for intertidal fauna.
- Surface stained materials and rubbish will be removed to a depth of 0.3 m below LAT between the seawall and 5 m seaward (or extending to SA1 in the Southern Remediation Area). Geotechnical considerations for the seawall stability may restrict removal of material 0.3 m below LAT in some areas (i.e. to preserve existing toe support along seawall structure). In addition, excavation directly adjacent to seawall may only extend to the level of the seawall toe apron slabs.
- A cap comprising geotextile will be installed from the toe of the seawall to the ISS raft in SA1, with placement of a layer of hard rock VENM cobbles to a target finish level marginally below the level of LAT, and placement of a layer of VENM comprising sand over the cobbles sufficient to fill all the voids in the cobbles. The long-term stability of the seawall will need to be considered. The remediation contractor will consult with an engineering specialist as part of the detailed design for the full scale works to assess any additional requirements (i.e. assess whether reinstatement of clean materials back to the existing surface level is required) to ensure the long-term stability of the seawall.
- Removal of the westernmost mature mangrove may be required in the southern area of Remediation Area SA2 along with some small mangroves shooting up around it.
- Excavated material will be transferred overwater by barge to the Staging Site.

¹ See Section 11.3.4 for description of Unit 2B and other sediments

Discussion of the fate of excavated sediment is provided further in Sections 4.3.6 and 4.3.7.

Remediation Area SA3

The approach to removal of surficial waste material and sediments within Remediation Area SA3 includes excavation of contaminated sediment, as well as removal by hand-operated equipment in sensitive mangrove areas. Excavation by hand-operated equipment will be completed to minimise damage to the existing mangrove environment (i.e. plants, roots etc).

In addition, stormwater controls will be constructed to ensure stormwater discharge to Kendall Bay does not impact the remediated and managed parts of the Southern and Northern Remediation Areas (shown in Figure 4-2). A summary of the proposed approach for SA3 is set out below. Additional information can be found in Section 9.5. of the RAP.

- For the northern area of SA3, surficial coke, coal and rubbish material will be removed / excavated where practicable over the nearshore sand shoal using small earthmoving equipment to a depth of 0.2 metres.
- For the southern area of SA3, the existing established mangroves, will be retained and coke and coal removed / excavated using a small excavator with rake bucket / hand tools / vacuum excavation to depth of 0.2 metres as required to minimise any damage to the mangroves.
- Excavated material will be transferred overwater by barge to the Staging Site.
- For all areas of SA3, a layer of clean sand (VENM) will be spread over the area to restore the existing level of sand surface
- ‘Spur wall’ structures will be constructed at several points through the mangrove area to train stormwater flows and limit easterly migration of the discharge channel. Refer to Figure 4-2.

Discussion of the fate of excavated sediment is provided further in Sections 4.3.7 and 4.3.8.

Remediation Area SA4

The approach to removal of surficial waste material and sediments within Remediation Area SA4 involves excavation of contaminated sediment. In addition, an approximately 30 metre long seaward extension of the existing sandstone wall will assist in retaining placed sand as part of a beach nourishment program and alleviate the impacts of east-flowing stormwater. In addition, a revetment blanket will be installed to reduce erosion associated with discharge from the 450 mm stormwater pipe located on the beach. A summary of the proposed approach is set out below. Additional information can be found in Section 9.5. in the RAP.

- The existing sandstone wall will be extended 30 metres seaward to compartmentalise the beach and subtidal area, as shown in Figure 4-2.
- A grout-filled revetment blanket (or similar) energy dissipater will be installed where the 450 mm stormwater pipe discharges onto the beach, to help prevent sand from washing away due to erosion. Refer to Figure 4-2
- Surficial coke, coal and rubbish material will be removed / excavated where practicable over the nearshore sand shoal using small earthmoving equipment to a depth of 0.2 metres. Sand may be returned to the current area or alternatively reused to form the SA1 and NA2+NA3 cap (subject to material meeting suitability criteria).
- Excavated material will be transferred overwater by barge to the Staging Site.

- A layer of clean sand (VENM) will be spread by hand, or hydraulically, over the area to provide a clean beach area, at the same slope and platform alignment as the existing beach to minimise readjustment by waves.

Discussion of the fate of excavated sediment is provided further in Sections 4.3.6 and 4.3.7.

Remediation Area SA5

The approach to removal of surficial waste material and sediments within Remediation Area SA5 involves excavation of contaminated sediment.. A summary of the proposed approach is set out below. Additional information can be found in Section 9.5 of the RAP.

- Surficial coke, coal and rubbish material will be removed / excavated where practicable over the nearshore sand shoal using small earthmoving equipment to a depth of 0.3 metres.
- Excavated material will be transferred overwater by barge to the Staging Site.
- A 0.3 metre layer of clean sand (VENM) will be spread over the area to provide a clean offshore wading area, at the same slope and planform alignment as the existing beach to minimise readjustment by waves. Sand placement will extend to bedrock outcrops on the eastern shoreline, to the sandstone wall extension to the west. Beneficial reuse of the excavated fine-grained material would be achieved by supplementing it with sand used for capping of other Remediation Areas.

Discussion of the fate of excavated sediment is provided further in Sections 4.3.6 and 4.3.7

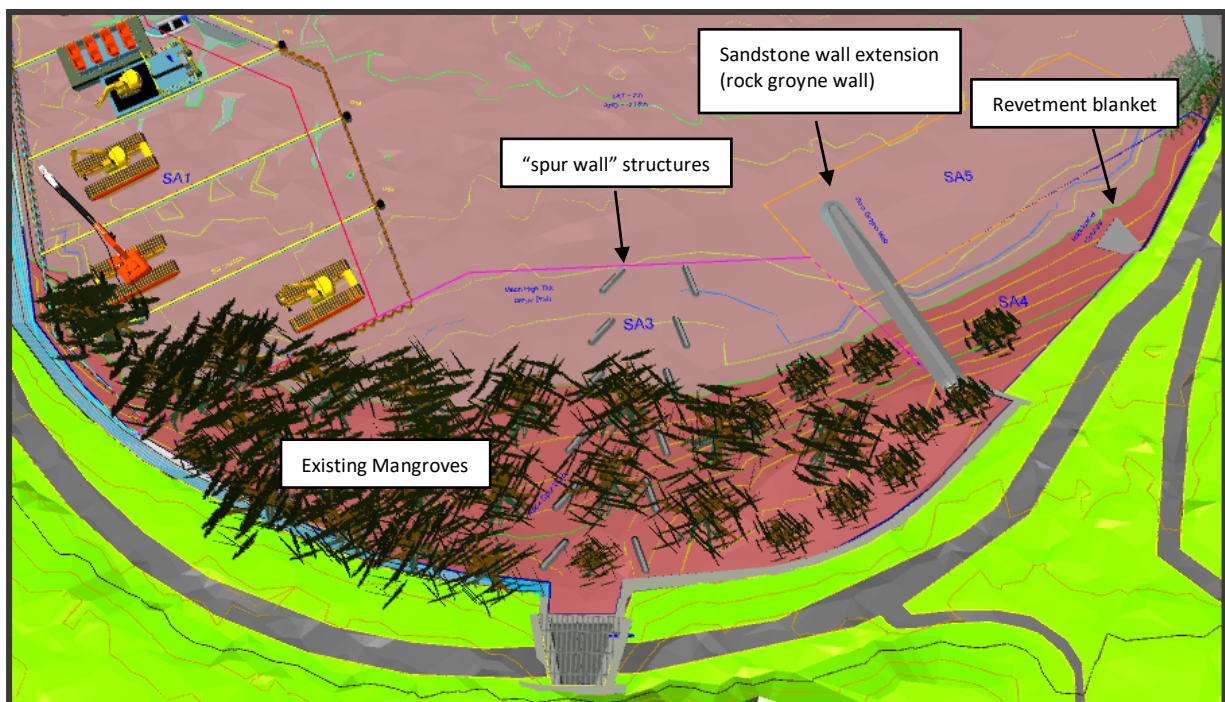


Figure 4-2: Proposed permanent stormwater control measures (Source: Ventia 3D Model 2018. Preliminary design)

Remediation Area NA1

The approach to removal of surficial waste material and sediments within Remediation Area NA1 is similar to that for SA2 and includes cleaning of the existing seawall and excavation of contaminated

sediment. A summary of the proposed approach is set out below. Additional information can be found in Section 9.5 in the RAP.

- The existing seawall will be cleaned to remove surface staining using a high pressure cold water spray.
- Stained rock / rubble and contaminated sediment will be removed to 0.3 m below LAT, whilst preserving existing toe support along seawall structure (see Remediation Area SA2 above for the geotechnical considerations with respect to the seawall stability).
- A geotextile mat will be put in place from the toe of the seawall to NA2/3 ISS structure, with a layer of hard rock VENM cobbles (sandstone), nominally 50 mm diameter and a layer of sand over the cobbles sufficient to fill voids in the cobbles.
- The target final level of the cap is marginally below the level of LAT and incorporates a 0.3 m thick cap. Engineering considerations will be as per SA2 (above) and may influence final level of cap.

Remediation Areas NA2 and NA3

The approach adopted for immobilising contaminated sediment within Remediation Areas NA2 and NA3 is the similar to that described for Remediation Area SA1, however an ISS monolith is proposed (i.e. no supporting columns are expected to be required). A summary of the proposed approach is set out below. Additional information can be found in Section 9.5 in the RAP.

- The need for sheet piles at NA2+NA3 will be assessed following the field trial.
- ISS will be undertaken to create a monolith within NA2+NA3 extending down to the competent Unit 2B. The approach for NA2+NA3 is based on the understanding that the competent unit is at a depth of 3 m or less below the sediment surface in NA2 and NA3. The results of a geotechnical assessment will confirm if a monolith is proposed for the entire area or whether an ISS raft with supporting columns will be applied in limited areas where the depth to the competent unit is >3 m (refer Remediation Area SA1); and
- A cap will then be installed comprising an activated carbon mat at the base (approximately 0.009m thick), then 150 mm capping layer of hard rock VENM cobbles followed by 150 mm layer of sand. The finished level for the cap is proposed to be approximately 0.2 m below LAT.

4.3.3 SHEET PILING METHODOLOGY

Sheet piling is proposed at SA1, and depending on the outcomes of the remediation trials, NA2+NA3 may also use sheet piling. In SA1 sheet piling will be particularly useful for controlling turbidity plumes in shallow water where silt curtains may be less effective. The sheet pile will be cut at an elevation of 0.00 LAT, remaining below the sediment to hydraulically confine the untreated sediment under the cement stabilised raft. It is anticipated that the installation works would be approximately 5.5 weeks in duration.

The proposed methodology for the installation of the piles is summarised as follows:

- removal of obstructions prior to sheet pile and mooring pile installation using a barge mounted excavator with grab attachment (or similar)
- the sheet piles will be sized between tkZ18-700 and tkZ24-700 sheet piles (or similar) based on the position of the piles, their embedment depth into the stiff clay foundation material and the loading scenario for each section of the wall (or similar). The mooring piles will be nominally sized as 506 OD 16 Tubular Steel Piles (or similar)

- sheet piles and mooring piles will be vibrated into stiff clay. No pile driving or pre-drilling is anticipated. All lifting and piling works will be performed by an excavator working from the deck of a construction barge; and
- cleaning of extracted sheet piles will be performed onboard the construction barge while it is situated within the silt curtains.

The equipment to be used as part of the sheet pile installation process is expected to include a construction barge, 30t excavator, vibrating sheet pile hammer, hydraulic pile drive (excavator-mounted), Broco underwater cutting lance with cutting rods and oxygen cylinders, tugs and work boats.

Mooring piles will be extracted with the excavator and if necessary, the piles will be vibration extracted or, failing that, extraction will be assisted with water jetting. Following the completion of works sheet piles will be cut using a diver-operated underwater cutting system. All cutting operations will be supported from the barge. Sheet piles will be supported during cutting and lifted by the barge-mounted excavator.

4.3.4 USE OF VIRGIN EXCAVATED NATURAL MATERIALS (VENM)

Imported fill material will be required for the purposes of capping works, stormwater abatement structures or other rectification works. As part of remediation works a layer of clean, imported sand (VENM) compatible with the existing natural seabed material will be placed as required to restore the existing sand surface where material was been removed. VENM cobbles will also be utilised at a number of the sites.

The RAP specifies that imported fill must satisfy the following criteria:

- only Virgin Excavated Natural Materials (VENM) are to be imported to the Remediation Areas
- VENM must satisfy the criteria stated in NSW EPA (2014a) and NSW DEC (2006c) guidelines and be demonstrated to be:
 - natural material (such as clay, gravel, sand, soil or rock fines)
 - materials that has been excavated or quarried from areas that are not contaminated with manufactured chemicals or process residues, as a result of industrial, commercial, mining or agricultural activities; and
 - materials that do not contain any sulfidic ores or soils or any other waste.

Materials will not be imported until the Jemena Project Manager has provided written approval to the remediation contractor.

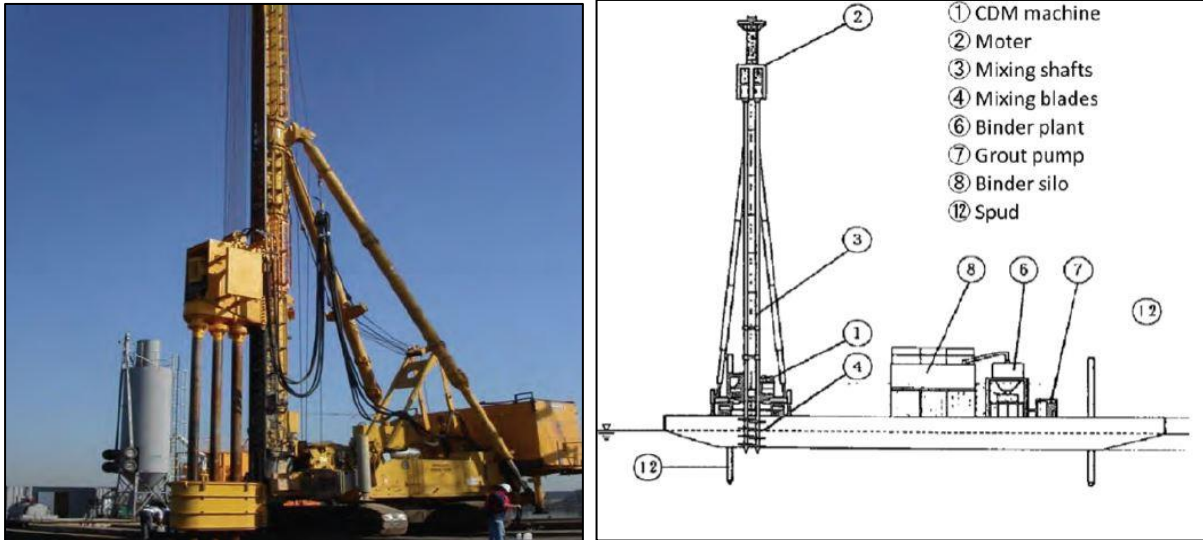


Plate 4-4: Indicative barge-mounted drilling rig for deep sediment mixed columns (Source: Taguchi, 2015)



Plate 4-5: Indicative amphibious excavator (Source: Ultratrex, 2017)



Plate 4-6: Example of small excavator tipping rock from floating barge. (Source: Jemena, 2017)



Plate 4-7: Example of barge mounted 30t excavator and sheet piles. (Source: EnviroMarine Services 2018)

Table 4-1: Summary table of remediation works for Remediation Areas

Remediation Area and Method	Sheet Piling	In situ stabilisation	Excavation of contaminated material	Cleaning of sea wall	Capping / Placement of sand / VENM material	Other works
SA1	Installation of sheet piles 0.5 m above mean tide level. Sheet piles will be cut to LAT on completion of works.	Installation of support columns and raft.	Top of cement stabilised raft excavated to 0.5 m below LAT.		Activated carbon mat, hard rock VENM cobbles and sand. Sand from other Remediation Areas may be reused (subject to appropriate classification).	
SA2			Surface stained materials and rubbish removed to a depth of 0.3 m below LAT between seawall and 5 m seaward.	Clean existing seawall to remove surface staining using a high pressure cold water spray.	Geotextile installed from toe of seawall to ISS raft in SA1. Placement of layer of hard rock VENM cobbles and sand.	Potential removal of westernmost mature mangrove and smaller plants.
SA3			Surficial coke, coal and rubbish material removed / excavated to depth of 0.2 m below LAT.		Layer of clean sand .	Construction of spur walls to train stormwater flows.
SA4			Surficial coke, coal and rubbish material removed / excavated to depth of 0.2 m below LAT.		Layer of clean sand .	Extension of seawall 30 m seaward to assist in retaining placed sand.
SA5			Surficial coke, coal and rubbish material removed / excavated to depth of 0.3 m below LAT.		Layer of clean sand .	Grout-filled revetment blanket (or similar) installed where stormwater pipe discharges onto the beach.

DESCRIPTION OF PROJECT ACTIVITIES — 4

Remediation Area and Method	Sheet Piling	In situ stabilisation	Excavation of contaminated material	Cleaning of sea wall	Capping / Placement of sand / VENM material	Other works
NA1			Stained rock / rubble and contaminated sediment removed to 0.3m below LAT.	Clean existing seawall to remove surface staining using a high pressure cold water spray.	Geotextile mat put in place from toe of the seawall to NA2+NA3 ISS structure. Placement of a layer of hard rock VENM cobbles and sand.	
NA2+NA3	Need for sheet piles at NA2+NA3 will be assessed following the field trial.	Monolith within NA2+NA3 extending down to competent Unit 2B.			Activated carbon mat at the base Placement of a layer of hard rock VENM cobbles and sand. Sand from other Remediation Areas may be reused (subject to appropriate classification).	

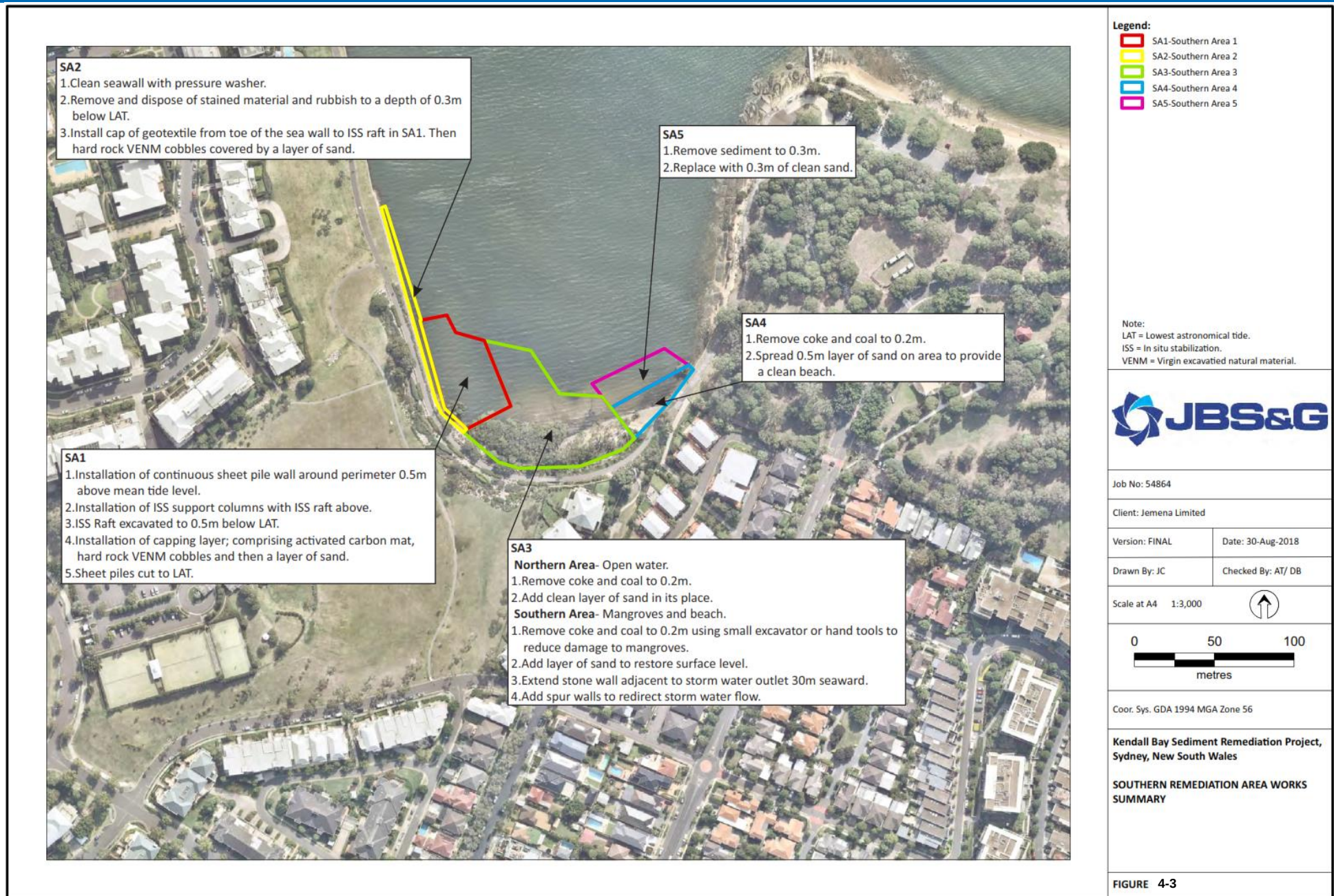




FIGURE 4-4

4.3.5 EXCAVATION

Completion of the remediation works will involve excavation to varying vertical and lateral extents across the Remediation Areas. Excavation will be undertaken with either a barge-mounted excavator or amphibious excavator, using mechanical dredging buckets (refer Plate 4-6). Excavation near the seawall and apron toe of the seawall will be conducted using appropriately sized excavators and buckets to ensure protection of the seawall.

Where excavation can be conducted on land (such as on the beach and in the intertidal zone during low tides), this will be completed using appropriately sized excavators, amphibious excavators and bobcats or similar equipment, and by hand where required (for example in mangrove areas of SA3). Where possible, GPS control will be used during excavation to ensure that excavation depths and lateral extents are achieved and over- excavation is minimised.

4.3.6 TRANSPORTATION AND HANDLING OF REMOVED SEDIMENTS

Excavated materials generated through remediation works will be transferred directly from the excavation into dedicated hoppers equipped with close-fitting covers or sealable containers for transfer by barge to the Staging Site. The excavated materials will be sorted into the following types:

1. top layer of ISS, already stabilised material from Remediation Areas SA1, NA2 and NA3
2. untreated material from the shoreline Remediation Areas SA2, SA3, SA4, SA5 and NA1
3. large rocks and rubble material
4. green waste; and
5. general rubbish removed from the foreshore and that is generated by contractors onsite.

Where barge-mounted hoppers are used, once loaded a close-fitting lid or cover will be drawn over the top to minimise odour emissions. Where sealed containers are used, these will be sealed prior to transport. The barge will then travel to the wharf at the Staging Site for unloading.

During the excavation of sediments, up to three barges are likely to be operating as transport vessels to ensure maximum production rates. The hoppers would be transferred from the barge to the wharf using mechanical lifting equipment and conveyed to a designated sediment and materials receiving area within the Staging Site.

It is anticipated that approximately 12,500 tonnes of clean materials (cement, additives, sand and rocks) will be imported and transferred via the Staging Site to the Remediation Areas using the barges. Table 4-2 sets out the indicative volumes and quantities of removed sediments within each of the Remediation Areas. These are indicative estimates only and may change following the remediation trial and as works progress.

Table 4-2: Indicative volumes requiring in-situ stabilisation, excavation and offsite disposal

Area	Surface area (m ²)	Extra over (+5m) surface area (m ²)	Average remediation depth (m)	Remediation volumes - columns (m ³)	Remediation volumes - raft slab (m ³)	Disposal volume (m ³)
SA1	2,218	458	1.75	1,176	4,856	2,851
SA2	1,221	-	0.3	-	-	367
SA3	3,269	-	0.2	-	-	-
SA4	809	-	0.2	-	-	-

Area	Surface area (m ²)	Extra over (+5m) surface area (m ²)	Average remediation depth (m)	Remediation volumes - columns (m ³)	Remediation volumes - raft slab (m ³)	Disposal volume (m ³)
SA5	936	-	0.2	-	-	-
NA1	421	-	0.3	-	-	127
NA2 / NA3	2,794	1,388	1.75	-	9,881	3,540
Total				1,176	14,737	6,885

4.3.7 PROCESSING OF EXCAVATED SEDIMENTS

The Staging Site will be designed to receive excavated materials in covered hoppers and / or sealed containers. The hoppers and / or sealed containers will be unloaded by a crane, or by dragging them on rails off the barge.

Once unloaded at the wharf, the hoppers or sealed containers will be moved to the designated sediment and materials receiving area. The sediment will remain in the sealed containers until it is transferred from the Staging Site to an EPA licenced facility for further treatment (if required) and disposal at a landfill. Oversized material, such as large rocks and other obstructions encountered in the Remediation Areas, would also be barged to the Staging Site for stockpiling, classification and disposal at an EPA-licenced waste facility. Such materials that are generated as a result of the remediation work will be classified in accordance with NSW EPA (2014a) *Waste Classification Guidelines. Part 1: Classifying Waste* (see Chapter 17 Waste Management)

All waste materials, whether stabilised or otherwise, must be dewatered sufficiently to meet spadability criteria prior to disposal. This will ensure that the materials are suitable for acceptance at the designated licenced waste facility, and will assist in eliminating spills during loading, haulage, unloading and general materials handling. All ISS excavated material from Remediation Areas SA1 and NA1 and NA2 will be transported to an EPA licenced solidification facility for confirmatory testing to ensure the material meets the requirements within the Site-Specific Immobilisation Approval, similar to the NSW EPA General IA 2005/14 (NSW EPA 2005), discussed further within Chapter 17 Waste Management.

Upon receipt of laboratory results confirming the stabilisation, ISS excavated materials will be sent to an EPA licenced waste disposal facility. Where laboratory results indicate additional stabilisation is required, the ISS excavated materials will be re-stabilised in conjunction with excavated material from the other Remediation Areas as outlined below.

If required, untreated material from Remediation Areas NA1, SA2, SA3, SA4 and SA5 will be sent offsite to an EPA licenced solidification facility for stabilisation, and from there to an EPA licenced waste disposal facility. The offsite treatment and landfilling will be carried out in accordance with the environmental protection licence of the respective facilities.

All trucks carrying sediment will be covered to prevent the generation of dust and mitigate the potential for spills to occur in transit.

4.3.8 WATER TREATMENT

Free waters pumped off the barges and potentially contaminated water from the Staging Site holding area will be stored within marked, untreated water holding tanks. These waters are expected to contain suspended and dissolved constituents.

Some minimal waste water will also be produced from the wheel wash and decontamination / wash down of equipment. This water will be stored in tanks at the Staging Site and a liquid waste contractor will be contracted to dispose of wastewater off-site. Stored wastewater would not leave the Staging Site until it has been assigned a liquid waste classification and an appropriately licenced waste facility has been identified to receive the wastewater.

The current plan is for collection and disposal of untreated waste water to a licenced offsite facility. Other options which may be considered for waste water disposal are listed below but are not currently planned for the project;

- 1) Treatment and discharge to Sydney Water sewer in accordance with a trade waste agreement;
- 2) Treatment and discharge to Parramatta River in accordance with an environment protection licence.

Offsite disposal will involve collection by a licenced liquid waste haulage contractor, and the nominated liquid waste facility will be lawfully authorised to accept, treat and dispose of the contaminated water.

4.3.9 DEMOBILISATION AND REHABILITATION

Following the completion of the Project, all Project-related plant will be disassembled and removed from the Staging Site including temporary buildings, structures, equipment, environmental protection provisions, traffic barriers and other utilities. The Staging Site will be cleaned to remove residual sediment, and any spillages or contamination that may have occurred during the works. If required, the Staging Site will be remediated to its pre-Project condition and where required, any vegetated areas will be restored. The existing industrial building will be restored to its condition at the start of the Project.

While not considered likely, should the seawall at the Staging Site be temporarily altered in any way during the Project, it will be returned to its original condition.

Rehabilitation of disturbed areas within Kendall Bay will be completed as part of the remediation program, and as such, no additional rehabilitation of the Remediation Areas or the broader Kendall Bay area is warranted.

4.4 PROJECT TIMEFRAME

Jemena anticipate the Project will be completed within a 16 - 28 month timeframe from the commencement of the site establishment phase, inclusive of a six month contingency period for the remediation works portion of the Project. A breakdown of key Project phases and their estimated duration is provided in Table 4-3.

Table 4-3: Project timeframe

Project phase	Expected duration	Expected duration with contingency	Estimated date*
Mobilisation and site establishment	2 months	4 months	Q2 2019 – Q3 2019
Remediation Works	12 months	18 months	Q3 2019 – Q3 2020
Demobilisation and Rehabilitation	2 months	4 months	Q3 2020 – Q4 2020

* Estimated start date is based on the assumption that SSD consent for the Project is granted in Q2 2019 after EIS and ISS trial outcomes are accepted by EPA

4.4.1 WORKFORCE

It is anticipated that the workforce will include a site manager and up to nine labourers / machine operators at any one time. Additional technical personnel including environmental consultants and engineers will undertake works at the Project Area as required.

4.4.2 HOURS OF OPERATION

It is anticipated that the remediation works will be undertaken during the following hours (or permitted pursuant to applicable approvals):

- Monday to Friday: 7:00 am to 5:00 pm
- Saturdays: 8:00 am to 1:00 pm
- Sundays and public holidays: not anticipated that work will be undertaken.

If required, maintenance work may be required outside the specified hours if it is not audible at the nearest affected receivers and it is permitted by the Authorities.

4.5 SITE MANAGEMENT, MONITORING AND VALIDATION

The Project will be completed under an overarching environmental management framework that will govern protection of the environment and human health during remediation works. The environmental management framework is comprised of the mitigation measures committed to in this EIS and the RAP, which will be implemented through Project-specific Environmental Management Plans developed to address potential environmental and human health risks during each stage of the Project.

Validation will be required in order to gather and report all information required by Chapter 14 of the RAP and to achieve a Final Site Audit Statement from the Site Auditor (which confirms completion of the remediation as meeting the objectives set out in the VMP). Successful completion of the remediation works will be demonstrated by the outcomes of monitoring under the Validation Sampling Analysis and Quality Plan (VSAQP). The VSAQP will be prepared by an independent and suitably qualified and experienced validation consultant and implemented with assistance from the remediation contractor following guidance provided in Chapter 14 of the RAP. Prior to its implementation, the VSAQP will be provided for endorsement by the Site Auditor.

A post remediation Site Management Plan (SMP) will be implemented to detail any ongoing monitoring and management of the Remediation Areas and surrounding parts of the bay to ensure that the objectives of the RAP have been maintained in the period after remediation is completed. The SMP is discussed in further detail in Chapter 18 Environmental Management Framework.

Chapter 18 Environmental Management Framework provides further detail on the plans listed below:

- Remediation Action Plan
- Remediation Works Plan
- Remediation Works Contingency Plan
- Remediation Works Environmental Management Plan
- Validation Sampling, Analysis and Quality Plan
- Work Health and Safety Plan

- Air Quality Management Plan
- Excavation Management Plan
- Acid Sulfate Soil Management Plan
- Backfilling Management Plan
- Navigation Management Plan
- Water and Sediment Management Plan, including water quality sampling requirements
- Traffic Management Plan
- Waste Management Plan
- Pollution Incident Response Management Plan; and
- Stakeholder Management Plan, including monthly reporting to the Department of Planning and Environment and the Environment Protection Authority.

5. STATUTORY FRAMEWORK

This chapter details the regulatory history of the Project and the relevant Commonwealth, State and local legislative framework in relation to the Project.

5.1 OBJECTIVES AND SCOPE

This chapter addresses the following SEARs:

SEARs Requirement – Statutory Framework

Include consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments.

5.2 PROJECT REGULATORY HISTORY

5.2.1 CONTAMINATED LAND REGULATION

In May 2004, the EPA (formerly the Department of Environment and Climate Change) declared the bed of the Parramatta River and Kendall Bay bordering the former Mortlake Gasworks and within 200 metres from the shoreline, to be a 'Remediation Site' under section 21 of the CLM Act. Sections 21 and 23 of the CLM Act were repealed in 2008 and under the transitional provisions in the CLM Act, a 'remediation site' is now taken to be 'significantly contaminated land'. Similarly, a 'remediation order' is taken to be a 'management order' for the purpose of the CLM Act.

As a result of investigations carried out by AGL (now known as Jemena), which established that areas of sediments within the Bay had been contaminated by operations at the gasworks, AGL entered into a VRP with the EPA in September 2005. This committed AGL to carry out further investigations and to:

- complete and deliver a management plan, including any necessary remediation strategy, to the EPA for approval; and
- implement the EPA approved management plan within a period to be agreed by the EPA.

A series of corporate transactions between 2006 and 2007 transferred ownership and responsibility for undertaking the VRP from AGL (through Alinta) to Jemena.

In 2007, following numerous environmental investigations and a detailed risk assessment involving the EPA, the NSW Department of Health and a number of technical experts, two remediation areas (then known as Areas A and B, and in locations largely corresponding to the current Southern and Northern Remediation Areas) were delineated within Kendall Bay.

In June 2007, the EPA issued a Remediation Order to the then Maritime Authority of NSW, now RMS, as owners of the seabed of Kendall Bay. The primary purpose of the order was to ensure that no-one disturbed the sediments of Kendall Bay without EPA approval (i.e. the remediation order was essentially a 'do not disturb' order). The responsibility of Jemena (then known as Alinta), as the project owner, was noted in the same order.

In November 2007, the EPA confirmed the Southern Remediation Area (formerly Area A) and Northern Remediation Area (formerly Area B) were the areas of sediments in Kendall Bay which required remediation. (see Figure 5-1: State Significant Development / EIS Process for the Project).

In late 2016, Jemena and the EPA discussed entering a new voluntary management proposal (VMP), for the remediation phase of the Project (noting the extensive further investigation and risk assessment work that had been carried out since the original VRP was entered into in 2005, and that a preferred remedial approach had now been identified). Jemena subsequently provided the EPA with a VMP, which was accepted by the EPA in August 2017. The objective of the VMP is stated to be to carry out remediation and other management activities to address significant contamination which presents a risk to human health and the environment. The VMP includes requirements for Jemena to:

- carry out a trial of the proposed in situ remediation method in Kendall Bay
- seek development consent for the Project
- carry out, complete and validate the remediation as set out in the RAP
- provide various reports and deliverables to the EPA, in accordance with specified timeframes.

With the approval of the 2017 VMP, steps are now being taken to have the 2005 VRP revoked.

5.2.2 ENVIRONMENTAL PLANNING REGULATION

The Project was initially declared a 'Major Project' under the former Part 3A of the EP&A Act in 2008. Director-General's Requirements were issued in August 2011 detailing requirements for the preparation of an Environmental Assessment to accompany a project application under Part 3A. Following repeal of Part 3A, the Project was then transitioned to State Significant Development (SSD) under what is now known as Division 4.7 of Part 4 of the EP&A Act.

An order to this effect was published in NSW Government Gazette Notice No. 44 on 12 April 2013.

Relevantly, the definition of the Project as SSD has an impact on the approvals that may be required under the various pieces of State legislation (i.e. some approvals that might otherwise be required for the Project are not required, and others are still required, but must be consistent with the SSD consent – see sections 4.41 and 4.42 EP&A Act).

With the 2014 incorporation of the Staging Site at Tennyson Road, Mortlake into the Project, a new SSD declaration was sought and issued, and subsequently published in the NSW Government Gazette No. 77 (19 September 2014). This declaration has the effect of ensuring the proposed sediment handling works and related activities at the Staging Site were integrated into the SSD.

Following the new SSD declaration, the Secretary's Environmental Assessment Requirements (SEARs) for the Project (refer to Chapter 1) were issued by the Department of Planning and Environment (DP&E) on 2 December 2014 (replacing the previous Director-General's requirements). The SEARs were revised and reissued on 7 March 2017, with only minor changes. This EIS has been prepared to address the SEARs.

5.3 COMMONWEALTH LEGISLATION

5.3.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the primary Commonwealth legislation regulating environmental matters. Under the EPBC Act, any action that is likely to have a significant impact on a 'matter of national environmental significance' (MNES) requires approval from the Commonwealth Minister for the Environment. MNES are defined in the EPBC Act and include:

- World Heritage properties;
- National Heritage places;
- Ramsar wetlands of international importance;
- Listed threatened species and communities;
- Listed migratory species;
- Commonwealth marine areas;
- Nuclear actions;
- Great Barrier Reef Marine Park; and
- A water resource (only in relation to coal seam gas and large coal mining developments).

It is the responsibility of the proponent of a proposed development to determine whether the proposal, or action, has the potential to significantly impact upon an MNES and therefore whether there is a need to refer it to the Commonwealth.

Implications for the Project

The Project is not located in a world heritage area, national heritage place, Ramsar wetland or Commonwealth marine environment. The Project is not a nuclear action, or coal seam gas or coal mining development.

Ecological investigations have identified that the Project will not impact on any listed threatened species and communities or listed migratory species. Given no impacts to MNES are anticipated from the remediation of Kendall Bay, the Project will not be referred under the EPBC Act to the Commonwealth Minister for the Environment.

Further information with respect to the biodiversity of Kendall Bay and potential impacts of the proposed remediation is presented in Chapter 12 of this EIS.

5.4 NSW LEGISLATION

5.4.1 CONTAMINATED LAND MANAGEMENT ACT 1997

The CLM Act is the primary NSW Act under which contaminated land is regulated and managed. The regulatory authority is the EPA. It is therefore the primary piece of legislation that applies to the Project.

The CLM Act provides a framework for establishing the process for the investigation and remediation, where significant contamination presents a risk to human and / or ecological health.

The Project Area is considered to be significantly contaminated land under s.11 of the CLM Act. It is the declaration of significant contamination that gives the EPA power to regulate contamination management at this site.

Under the CLM Act, four regulatory instruments currently apply to the sediments in Kendall Bay.

- 25 May 2004: The EPA issued a Declaration of Remediation Site, that applies to the sediments in Kendall Bay located in the seabed of Kendall Bay and the Parramatta River in an area that extends 200m from the shoreline of the former Mortlake Gasworks site into the bay and river. Stated in Section 5.2, a 'remediation site' is now taken to be 'significantly contaminated land' under the CLM Act.
- 20 September 2005: The EPA approved a VRP prepared by AGL in 2004. The 2005 VRA provided for additional investigations in Kendall Bay to inform the development of a Remediation Action Plan (RAP) and associated supporting documentation. Jemena are currently in discussions with the EPA to have the 2005 VRA revoked given the 2017 VMP (discussed below).
- 22 June 2007: The EPA issued a Remediation Order to the Maritime Authority of NSW (now Roads and Maritime Services NSW), as owners of the seabed of Kendall Bay. The primary purpose of the order was to ensure that no one disturbed the sediments of Kendall Bay without EPA approval.
- 7 August 2017: The EPA approved Jemena's VMP, which sets out a framework of objectives, milestones and deliverables for remediation to be carried out, completed and validated.

The EPA approved in November 2007 the two areas in Kendall Bay identified for remediation: Southern Remediation Area (referred to as Area A) and Northern Remediation Area (referred to as Area B).

The remediation works and related management activities proposed in the 2018 RAP will be regulated under the 2017 VMP.

5.4.2 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is a key piece of environment protection legislation administered by the NSW EPA, with a particular focus on noise, air, water and land pollution, and waste regulation.

In relation to the remediation works:

- Schedule 1 of the POEO Act sets out the types of activities that constitute a 'Scheduled Activity' and as such require licensing by the EPA under the POEO Act.
- Licences may also be issued for activities that are not listed in Schedule 1 of the POEO Act, but are likely to cause pollution of water. These activities are referred to as 'non-scheduled activities'.

Aspects of the Project set out in the RAP may require licensing under the POEO Act. These works include, but may not be limited, to the following:

- water based extractive activities to excavate contaminated sediment from the Project Area
- treatment of sediments to enable them to be disposed offsite and/or retained in situ
- treatment of excess waters to enable them to be discharged offsite; and
- application of chemicals for in situ stabilisation of sediments in the bed of the Bay.

Prior to the commencement of any works relating to the remediation, Jemena will determine if any of the activities to be undertaken require a licence and, if needed, will apply to the EPA for approval and be issued with an Environmental Protection Licence for those works. Relevant aspects of the works will be undertaken in accordance with licence conditions imposed.

5.4.3 PROTECTION OF THE ENVIRONMENT OPERATIONS (WASTE) REGULATIONS 2014

The *Protection of the Environment Operations (Waste) Regulations 2014* will apply to all material removed from the Project Area. These regulations require that:

- Waste is classified appropriately and in accordance with relevant guidelines (NSW EPA (2014a) *Waste Classification Guidelines: Part 1: Classifying Waste* (or as superseded)).
- Waste materials are transported from the site by an appropriately licensed transporter to a landfill facility licensed to accept the type of waste.
- Other materials are removed to facilities lawfully able to accept such materials; and
- Waste tracking records are kept for the remediation works, including copies of the waste transport and disposal certificates.

5.4.4 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

All development in NSW is assessed in accordance with the *Environmental Planning and Protection Act 1979* (EP&A Act). Part 4 of the Act provides for the control of development that requires development consent from a consent authority. Depending on the circumstances of a project, the consent authority may be the local council, the Minister for Planning, or a delegate such as the Secretary of the DP&E or Planning Assessment Commission.

State Significant Development (SSD)

As noted in Section 5.2.2 above, the Project is SSD. Part 4, Division 4.7 of the EP&A Act establishes an approval regime for developments declared to be SSD by either a State Environmental Planning Policy or Ministerial Order. In accordance with section 4.5(a) of the EP&A Act, the Minister for Planning is the consent authority for SSD.

Under section 4.12(8) of the EP&A Act, an environmental impact statement (EIS) is required to support a development application for SSD. Before preparing the EIS, the applicant requests SEARs from DP&E. The request for SEARs must be accompanied by supporting information which includes details of the location, nature and scale of the proposal, as well as a preliminary environmental assessment to identify key issues for further assessment in the EIS.

DP&E consults with relevant public authorities when preparing the SEARs, and then issues them to the proponent. In the case of the Project, the SEARs were issued to Jemena in 2017 (DPE 2017) (replacing earlier versions issued in 2011 and 2014).

The proponent must prepare an EIS in accordance with the SEARs, and the form and content requirements set out in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. The EIS is submitted to DP&E, which reviews the information provided to ensure that adequate detail is available for members of the community and other stakeholders to understand the proposal and its potential impacts.

Once DP&E is satisfied the EIS is adequate, it is placed on public exhibition for at least 30 days to allow public and agency submissions to be lodged, after which the proponent may be requested to respond to issues raised in the submissions.

The SSD / EIS process being undertaken for the Project is shown in Figure 5-1 below. The SEARs for the Project are detailed in each respective chapter.

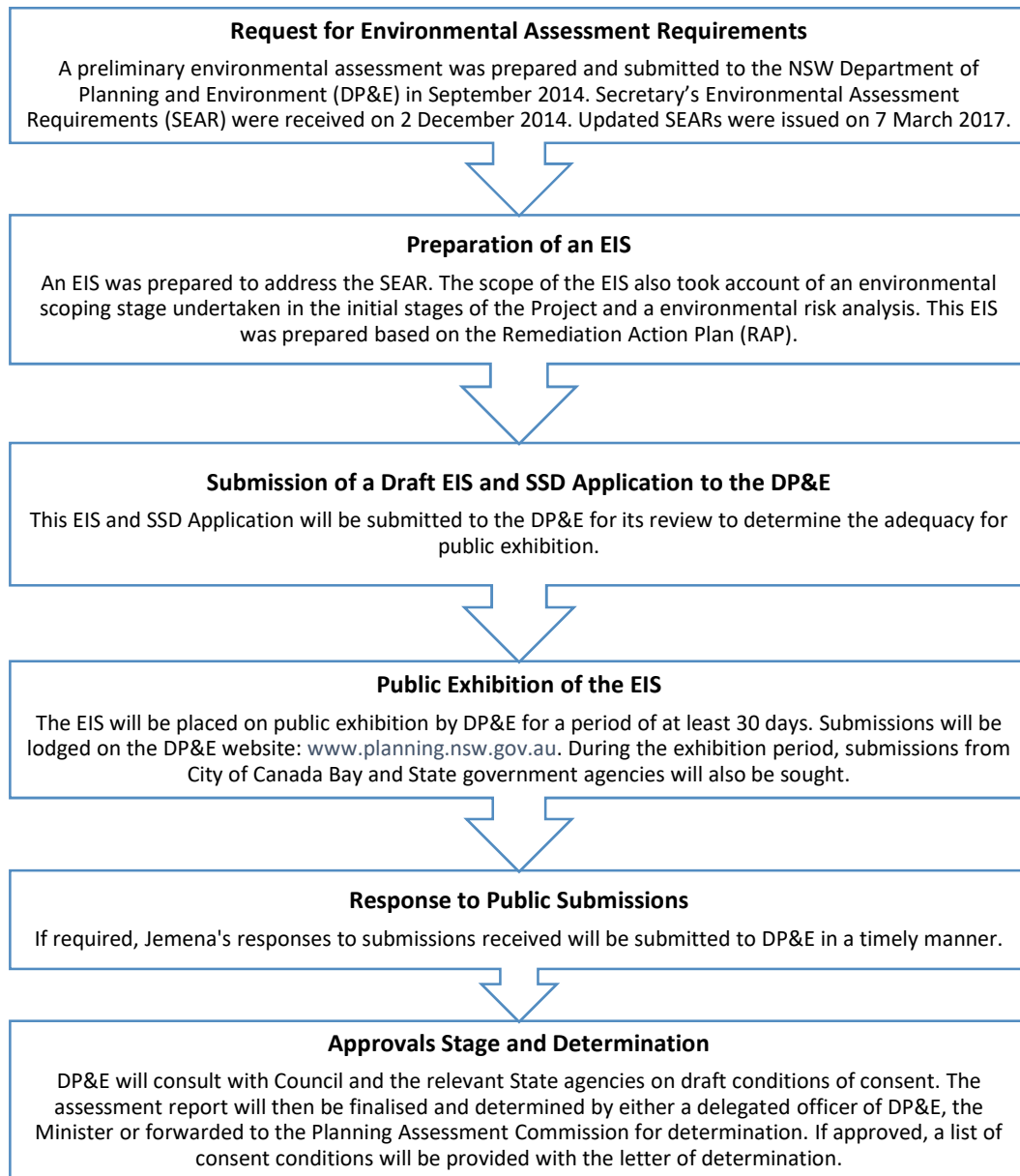


Figure 5-1: State Significant Development / EIS Process for the Project

5.4.5 ENVIRONMENTAL PLANNING AND ASSESSMENT REGULATION 2000

Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* sets out the requirements for the form and content of an environmental impact statement prepared under the EP&A Act. Jemena has ensured that this EIS has been prepared in compliance with the requirements of Schedule 2.

The requirements of clause 49 of the EP&A Regulation must also be satisfied with respect to land owner consent for the lodgement of the Project development application being obtained from:

- RMS (as owners of the Kendall Bay seabed areas and the Staging Site wharf area), and

- Breakfast Point Community Association (as owner of an area of seawall on the western side of Kendall Bay).

Note: A licence agreement with RMS will also be entered into by Jemena to occupy the Remediation Areas and surrounding buffer zone in Kendall Bay. A lease is already in place for the wharf area at the Staging Site.

5.4.6 APPLICABLE NSW APPROVALS AND PERMITTING – EFFECT OF SECTION 4.42 EP&A ACT

Under section 4.42 of the EP&A Act, certain authorisations (if applicable to the Project) cannot be refused if they are necessary for carrying out an approved SSD, and must be substantially consistent with the SSD consent. Table 5-1 sets out the implications for the Project of section 4.42.

Table 5-1: Approvals that must be applied consistently under section 4.42

Legislation	Description	Relevant Authorisations	Project Implications
<i>Fisheries Management Act 1994</i>	Provides for the conservation, development and sharing of fishery resources.	Aquaculture permit under section 144	N / A
<i>Mine Subsidence Compensation Act 1961</i>	Provides for compensation or repair services where improvements are damaged by mine subsidence resulting from the extraction of coal.	Approval for improvements within a mine subsidence district under section 15	N / A
<i>Petroleum (Onshore) Act 1991</i>	Provides for licencing of onshore exploration and production of petroleum.	A production lease under the Act	N / A
<i>Protection of the Environment Operations Act 1997</i>	Addresses waste disposal and pollution and provides the licencing framework for pollution generated by construction and operation of developments. Schedule 1 of the POEO Act provides a list of activities requiring an environmental protection licence under the Act.	An Environment Protection Licence under Chapter 3 (for purposes referred to in section 43). Potential scheduled activities include contaminated soil treatment, contaminated groundwater treatment, waste storage and transportation of trackable waste.	Aspects of remediation works potentially requiring licencing under the POEO Act include: • Treatment of sediments to enable them to be disposed offsite and / or retained in situ; and • Treatment of excess waters to enable discharge offsite. Prior to the commencement of any works, Jemena will determine if any of the activities to be undertaken require a licence and if needed, will apply to the NSW EPA for approval and be

Legislation	Description	Relevant Authorisations	Project Implications
			issued with and Environmental Protection Licence for those works.
<i>Roads Act 1993</i>	Provides the regulatory framework for undertaking activities on public roads.	A permit under section 138 for works or structures on public roads	No works are proposed to be undertaken on public roads.
<i>Pipelines Act 1967</i>	Provides regulatory and licencing framework for construction and operation of pipelines in NSW. Permit provisions are set out in Section 5.	A licence (to construct or operate) a pipeline under the Act	The Project will not include a pipeline as defined in the Act.

5.4.7 NON-APPLICABLE APPROVALS – EFFECT OF SECTION 4.41 EP&A ACT

Section 4.41 of the EP&A Act outlines approvals which are not required for an approved SSD. This includes authorisations relevant to the Project which may have otherwise needed to be obtained. These are shown in Table 5-2.

Table 5-2: Approvals that do not apply under section 89J

Legislation	Relevance to the Project
<i>Coastal Protection Act 1979</i> - concurrence required of the administering Minister under Part 3	N / A
<i>Fisheries Management Act 1994</i> - permits under section 201, 205, or 219.	Permits for dredging (section 201); potential harm to mangroves in a protected area (section 205); blocking of fish passage (section 219); and if the remediation works are likely to harm threatened species, population or ecological community, or damage habitat
<i>Heritage Act 1977</i> - approval under part 4 or excavation permit under section 139	N / A Cultural heritage assessment did not identify potential impacts to any State Heritage Register or interim heritage order listing.
<i>National Parks and Wildlife Act 1974</i> - an Aboriginal heritage impact permit under section 90	N / A Cultural heritage assessment did not identify any Aboriginal heritage items or places within the Project Area.
<i>Native Vegetation Act 2003</i> - authorisation to clear native vegetation or State protected land	N / A Native Vegetation Act does not cover mangroves, seagrasses or marine vegetation, which are covered by section 205 of the Fisheries Management Act.
<i>Rural Fires Act 1997</i> - bushfire safety authority	N / A
<i>Water Management Act 2000</i> – approvals under sections 89, 90 and 91	Covers controlled activity approvals (section 91) in, on or under waterfront land.

5.4.8 OTHER APPLICABLE APPROVAL REQUIREMENTS UNDER NSW LEGISLATION

Table 5-3: Other relevant NSW legislation

Legislation	Description	Implications for the Project
<i>Local Government Act 1993</i> Section 68	Provide the legal framework, responsibilities and powers for the system of local government for NSW and facilitate engagement with local communities.	Activities requiring approval are set out in s.68 and potentially include: approval for water supply, sewerage and stormwater drainage work; approval for management of waste; and approval for public roads.
<i>Biodiversity Conservation Act 2016</i>	Lists threatened species, populations and ecological communities under Schedules 1 and 2 which are priorities for conservation within NSW. Requires that significance assessments be completed for all endangered ecological communities, threatened populations and species listed under the BCA Act that would be directly or indirectly affected by the proposal.	Potential impacts on these environmental values are considered in the Biodiversity Chapter in accordance with the requirements of the BC Act and the EP&A Act. No listed threatened species or ecological communities have been observed in the Project Area during a series of studies (2009 to 2017). The assessment concludes that the Project would not have any adverse impacts on listed threatened species, communities or populations under the BC Act.
<i>Waste Avoidance and Resource Recovery Act 2001</i>	Establishes the waste hierarchy to ensure management options are considered for the effective management of resources against the following criteria: - avoidance of unnecessary resource consumption, - resource recovery (including reuse, reprocessing, recycling and energy recovery), and - disposal to assess how waste will be effectively disposed to minimise any adverse impacts on the environment	An assessment of the anticipated Project waste streams against the waste hierarchy criteria is provided in the Waste Management Chapter. Excavated material will be treated to a standard considered suitable for disposal to landfill in accordance with a site specific Immobilisation Approval (IA).
<i>Protection of the Environment Operations Act 1997</i>	EPA Site-specific immobilisation approval required for disposal of ISS treated excavated sediment.	Offsite disposal of some sediment treated by ISS is required for NA2+3 and SA1. The material will need to be treated to a standard considered suitable for disposal to landfill in accordance with an EPA site-specific immobilisation approval.

5.5 STATE ENVIRONMENTAL PLANNING INSTRUMENTS

A suite of environmental planning instruments have been made under the EP&A Act, setting out a more detailed layer of environmental planning regulation. Environmental planning instruments control, amongst other things, land use and development.

The key environmental planning instruments that are relevant to the Project are:

- State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP) (DP&E 2011)
- State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) (DPE 1998)
- Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (Harbour SREP) (DPE 2005a); and
- Canada Bay Local Environmental Plan (2013).

5.5.1 STATE ENVIRONMENTAL PLANNING POLICY (STATE AND REGIONAL DEVELOPMENT) 2011

Clauses 9 to 11 of the State and Regional Development SEPP apply to the Project, as SSD declared under section 4.36 of the EP&A Act. Relevantly, clause 11 provides that development control plans do not apply to SSD.

5.5.2 STATE ENVIRONMENTAL PLANNING POLICY NO. 55 – REMEDIATION OF LAND (SEPP 55)

SEPP 55 provides for a State-wide planning approach to the remediation of contaminated land and in particular aims to promote the remediation of contaminated land for the purpose of reducing risk of harm to human health or the environment by, amongst other things:

- specifying when development consent is required, and when it is not required, for a remediation work; and
- requiring that remediation work meet certain standards and notification requirements.

Implications for the Project

Under Clause 8(1) of SEPP 55, a person may carry out remediation work in accordance with SEPP 55 despite any provision to the contrary (subject to certain exemptions that do not apply to the Project).

SEPP 55 draws a distinction between category 1 remediation work, which requires development consent, and category 2 remediation work, which may proceed without development consent. Typically, significant remediation projects are category 1, and minor remediation works fall into category 2.

The Project is category 1 remediation work as defined by clause 9 of SEPP 55. In particular, the remediation work will be carried out in an area or zone which, under the provisions of the Harbour SREP (see Section 5.5.3 below) is classified as a 'wetland' (DP&E 2005A). As category 1 remediation work, development consent is required.

Clause 12 of SEPP 55 states (emphasis added):

The consent authority **must not refuse** development consent for a category 1 remediation work **unless the authority is satisfied that there would be a more significant risk of harm to**

human health or some other aspect of the environment from the carrying out of the work than there would be from the use of the land concerned (in the absence of the work) for any purpose for which it may lawfully be used.

Clause 17 of SEPP 55 states that all remediation work must be carried out in accordance with:

- (a) *the contaminated land planning guidelines,*
- (b) *the guidelines (if any) in force under the Contaminated Land Management Act 1997, and*
- (c) *in the case of a category 1 remediation work – a plan of remediation, as approved by the consent authority, prepared in accordance with the contaminated land planning guidelines.*

The Project objective to reduce the potential human health and ecological risks posed by the contaminated sediment in Kendall Bay accords with SEPP 55. Remediation activities should provide significant social benefit by restoring safe recreational use, visual and public amenity and site aesthetics to the Project area, particularly the beach and mangrove area. The remediation activities will be carried out in compliance with a Remediation Action Plan approved by the EPA and in accordance with all relevant legislation, policies and guidelines and best practice.

5.5.3 HARBOUR SREP

The Harbour REP covers the area of Sydney Harbour, including the Parramatta River and its tributaries, and the Lane Cove River. The Harbour REP relevantly applies to the area within Kendall Bay which is to be remediated and to the jetties located at the Tennyson Road Staging Site. The aim of the plan is to establish a balance between a prosperous working harbour, maintaining a healthy and sustainable waterway environment and promoting recreational access to the foreshore and waterways. It establishes planning principles and controls for the catchment as a whole.

Implications for the Project

Kendall Bay is located within the W1-Maritime Waters Zone, which encompasses the main navigation channel between Sydney Heads and Parramatta (refer Figure 3-4 Chapter 3 Project Location and Context). Clause 18(1) and the table in clause 18 identify development that is permitted without development consent, development that can be carried out only with development consent and development that is prohibited. Dredging (which is ancillary to the Project works) is listed as 'permissible with consent' in the W1 zone. Development for the purposes of remediation works is not identified in the table. Clause 18(2) of the Harbour SREP states that where development is not referred to in table, development is permitted with consent provided the consent authority is satisfied that the development:

- (a) *is not inconsistent with the aims of the Harbour SREP or the objectives of the zone in which it is proposed to be carried out, and*
- (b) *is not inconsistent with any other environmental planning instrument that applies to the land, and*
- (c) *will not otherwise have any adverse impacts.*

The W1 Zone objectives address effective and efficient movement of commercial shipping, public water transport and maritime industrial operations and promote equitable use of waterways including by passive recreation craft. Navigation and safety impacts from the Project on other water-based traffic and ferry commuter services are addressed in the Navigational Study (refer Appendix 15). Any waterway navigation impacts will be limited to the duration of the Project. Although there are some navigation impacts for the duration of the Project, when viewed as a whole, the remediation works are not inconsistent with the aims of the Harbour SREP or the objectives of the zone. Carrying out and

completing the Project is also consistent with key aims of the Harbour SREP, including ensuring a healthy waterway environment and promoting recreational access.

Accordingly, development for the purposes of remediation works are permitted with consent under the Harbour SREP.

The area of mangroves within Kendall Bay is designated as a Wetlands Protection Area (WPA) under the Harbour SREP (refer Figure 3-5 Chapter 3 Project Location and Context). Clause 62 of the Harbour SREP provides that development within a WPA may only be carried out with development consent, while Clause 63 identifies the matters to be considered in consent for works to be carried out within a WPA. The matters relevant to the Project include environmental effects of the development, demonstration of how impacts will preserve and enhance the wetland area, safeguards to protect the environment and rehabilitation.

The matters for consideration set out in the Harbour SREP for assessment of the development application are addressed in the EIS in particular the chapters addressing hydrology, water quality and sediments and biodiversity. The assessment in Chapter 12 Biodiversity demonstrates impacts to the mangrove area of Kendall Bay from remediation activities will be temporary with positive long-term impacts to habitat and beach quality expected as a result of the Project.

5.6 LOCAL PLANNING CONTROLS

5.6.1 CANADA BAY LOCAL ENVIRONMENT PLAN 2013

The Canada Bay Local Environmental Plan (LEP) has been made under Part 3 of the EP&A Act.

The aims of the *Canada Bay Local Environmental Plan 2013* are to:

- Create a land use framework for controlling development in the City of Canada Bay that allows detailed provisions to be made in any development control plan made by the Council.
- Maintain and enhance the existing amenity and quality of life of the local community by providing for a balance of development that caters for the housing, employment, entertainment, cultural, welfare and recreational needs of residents and visitors.
- Achieve high quality urban form by ensuring that new development reflects the existing or desired future character of particular localities.
- Promote sustainable transport, reduce car use and increase use of public transport, walking and cycling.
- Provide high quality open spaces and a range of recreational facilities.
- Conserve the environmental heritage of the City of Canada Bay.
- Promote ecologically sustainable development.
- Facilitate public access to foreshore land.

Kendall Bay

The bed of Kendall Bay, the area requiring remediation and the jetties that extend into the Sydney Harbour Catchment are under the authority of the RMS and are therefore subject to the Harbour SREP. The Canada Bay LEP does not apply to these areas.

Staging Site

Other than the jetties that extend into the Sydney Harbour Catchment, the Staging Site at 140 Tennyson Road is included within the land to which the Canada Bay LEP applies. The staging site is zoned R1 General Residential (refer Figure 3-3 Chapter 3 Project Location and Context). The objectives of Zone R1 are to:

- Provide for the housing needs of the community.
- Provide for a variety of housing types and densities.
- Enable other land uses that provide facilities or services to meet day to day needs of residents.

The land use table for Zone R1 General Residential does not identify development for the purposes of remediation works as development permitted without consent or development permitted with consent. Accordingly, development for the purposes of remediation works are prohibited by the Canada Bay LEP at the Staging Site. However, as discussed above, development for the purpose of remediation works is expressly permitted by clause 8 of SEPP 55. In accordance with section 3.28 of the EP&A Act, there is a general presumption that a State environmental planning policy prevails over a local environmental planning policy. In addition, section 4.38 of the EP&A Act (which applies to SSD only), states that development consent for SSD can be granted despite the development being partly prohibited by an environmental planning instrument.

An assessment of the works to be undertaken at the Staging Site against other relevant provisions of the Canada Bay LEP is provided in Table 5-4. It is concluded that the proposed remediation works occurring at the Staging Site accord with the relevant provisions.

Table 5-4: Assessment of the staging site against Canada Bay LEP 2013

Relevant LEP Clause	Proposal
Clause 4.3 Height of buildings – The height of a building on the subject site is not to exceed 12m.	Notwithstanding that water holding tanks will be temporary, the proposed structure will not exceed a maximum height of 10 m.
Clause 5.10 Heritage conservation	Heritage matters are addressed in the Cultural Heritage Chapter of the EIS. No impact is expected on heritage values.
Clause 6.1 Acid Sulfate Soil (ASS)	The Staging Site is identified as Class 5 land. This classification has the lowest potential for experiencing ASS, with ASS not typically found in Class 5 areas. Measures for managing any ASS are addressed in Chapter 8 of the EIS.
Clause 6.4 Limited development on foreshore area	An area of the Staging Site is located within the foreshore area. The Project involves temporary works to facilitate the remediation of Kendall Bay and is not expected to impact on natural foreshore processes beyond the duration of the Project.

6. STAKEHOLDER ENGAGEMENT

This chapter summarises the consultation activities undertaken with key external stakeholders including the local community, government agencies and local industry throughout the Project assessment phase. The communication activities were planned as part of the process to inform the stakeholders and the community of the Project and provide opportunity for input from key stakeholders at the early stages of the project planning process.

6.1 OBJECTIVES AND SCOPE

Jemena is committed to consulting with the key stakeholders and the community. The aim of stakeholder and community consultation is to raise awareness of the proposed remediation works and its merits, and to obtain the input of key stakeholders throughout the planning process and the preparation of the EIS.

Given the nature of the remediation works, the issues involved and the potential for community interest and concern, an open and responsive communications and consultation program with all stakeholders has been established. An overview of the stakeholder engagement process undertaken to date is provided in this chapter, with further detailed information provided in Stakeholder Management Plan provided in Appendix 5.

This chapter addresses the following SEARs:

SEARs Requirement – Consultation

During the preparation of the EIS, there must be consultation with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners.

In particular there must be consultation with:

- Environment Protection Authority
- City of Canada Bay Council
- NSW Health
- SafeWork NSW
- Department of Primary Industries (DPI) including the DPI Water and DPI Fishing
- NSW Roads and Maritime Services
- Office of Environment and Heritage
- Transport for NSW (Sydney Ferries); and
- Local community and other stakeholders.

The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.

6.1.1 STAKEHOLDER ENGAGEMENT OBJECTIVES

Open communication and providing all stakeholders with access to relevant information is necessary during the planning and delivery phase of the remediation works. It is also essential that stakeholders have a means of providing feedback and having any questions responded to in a timely manner.

The key goal of the process is to disseminate clear and factual information that meets the needs of the various stakeholders in order to minimise generation of misinformation, to encourage and respond to

feedback and to reduce the potential for uninformed objections to the works. The following objectives have been identified:

- identify key stakeholders and community likely to have an interest in or be potentially impacted by the remediation Project;
- build positive relationships between Jemena, stakeholders and the local community;
- achieve Project outcomes that align with community values and expectations;
- ensure timely and accurate information is accessible to stakeholder and community members;
- reduce the potential for stakeholder and community disaffection as a result of a misunderstanding of the Project or any aspect of it;
- inform key stakeholders (community action groups, political stakeholders, business and the broader community) of the current status of the Project;
- provide a diverse range of opportunities to participate in the engagement, in order to reach both the immediately affected and interested, as well as the broader community;
- discuss and consider key stakeholders' ideas regarding the Project;
- provide accurate, useful and relevant information to enable meaningful input;
- provide timely information and proactive responses – that anticipate issues and offer prompt and transparent responses;
- manage stakeholder and community expectations and contain the consultation process to areas that Jemena can control; and
- encourage relevant technical agencies to take part in the consultation process as providers of information (NSW Government departments and agencies).

The scope of information provided includes the following:

- progress of remediation works;
- any changes in key components of the site works proposed during the course of the remediation works;
- communication where the design of the Project has been amended in response to stakeholder concerns, and where amendments have not been made, an explanation provided to the relevant stakeholder;
- any changes in the timetable and timeframes proposed over the course of the remediation works;
- expected impacts of the proposed works on the surrounding community;
- measures to be taken to manage and mitigate these impacts; and
- realistic Project outcomes.

6.1.2 KEY STAKEHOLDERS

For the purposes of this document, 'stakeholder' refers to an individual, group, organisation or other entity that may be interested in, or affected by, the remediation works. Stakeholders may include residents, property owners, public health officials, government agencies, businesses at or around the site, media, environmental or other action / interest groups and staff and contractors working on the Project. Key stakeholders for the Project area presented in Table 6-1.

Table 6-1: Key stakeholders identified for the Project

Stakeholder	Interest
Members of Parliament	Includes Mr John Sidoti MP (State Member for Drummoyne) and Mr Craig Laundy MP (Federal Member for Reid). It is expected that the MPs will be interested in the potential amenity impacts on residents and businesses (noise, odour, visual traffic management), resident or business complaints and successful completion of the remediation Project.
Local Government – City of Canada Bay	SEARs require consultation with the City of Canada Bay. The Declared Area is located adjacent to the City of Canada Bay ('Council') Local Government Area (LGA). Council's requirements for the management of contaminated land are described in the City of Canada Bay (June 2016) 'Contaminated Land Policy'. Council will be interested to see that remediation is undertaken in accordance with these requirements. Council will also be interested in potential amenity impacts on residents and businesses such as noise, odour, visual, traffic management and resident or business complaints and successful completion of the remediation Project.
NSW Health	NSW Health will be interested in potential long-term health benefits associated with completion of the Project and minimisation of health impacts during works. A particular point of interest for NSW Health will be water quality in Kendall Bay and Project impacts on the long term recreational water quality goal to have the river meet recreational water guidelines by 2025. The NSW Health has also been involved with the determination of final remediation zones and methodologies for the HHRA.
NSW Environment Protection Authority (EPA)	EPA has the legislative oversight of the remediation of the site and is empowered to issue orders for remediation under the <i>Contaminated Land Management Act 1997</i> and <i>Protection of the Environment Operations Act 1997</i>. The EPA will have an interest in the resolution of the VRA and the minimisation of environmental and health impacts during works. The EPA will also be responsible for providing an Environment Protection Licence (EPL) for the work.
NSW Department of Planning and Environment (DP&E)	The Project has been classified as a State Significant Development (SSD) for assessment by the DP&E, with SEARs having been issued (and then revised) for the Project. The DP&E will be primarily interested in the environmental planning approval process for the Project, including assessment of Jemena's development application and EIS. As the relevant planning approval authority, the DP&E will be primarily interested in the project in the period leading up to submission and approval of the SSD application.
Transport for NSW – Roads and Maritime Services	RMS is the development consent authority for the remediation trials in the bay and will therefore be interested in the remediation of contamination within the bay as well as potential impacts on the Mortlake Ferry and local roads. Local Owners of the river bed subject to remediation as well as road and ferry infrastructure will be interested in the outcomes of the Project including any changes in scope or works timeframes.
Transport for NSW – Harbour City Ferries (Sydney Ferries)	Consultation with Harbour City Ferries is required regarding maritime issues such as barge movements in and around existing ferry routes. Consultation is also required on potential impacts on local ferry services along the Parramatta River and surrounding main roads.
NSW Office of Environment and Heritage (OEH)	OEH is generally responsible for protection of NSW's environment and heritage.

Stakeholder	Interest
	It provides scientific evidence and knowledge to underpin environmental decision making, regulation and service delivery and technical advice to the EPA. It may be interested in potential impacts to threatened species, native vegetation and the preservation and management of heritage values should they be encountered during project works.
NSW Department of Primary Industry – Fisheries branch	DPI Fisheries is responsible for administering laws relating to protection of fishing habitat. It has an approval role, both for the trial and the main phase remediation works. It will be interested in ensuring that remediation works do not impact significantly on marine ecosystem health. Completed remediation works will provide increased amenity for marine ecosystem of Kendall Bay.
Local residents and community groups	Local residents and community groups in Cabarita / Breakfast Point – including Bay and Park Communities Alliance (BAPCA), the Mortlake and Majors Bay Resident Action Group (MMBRAG), the Friends of Cabarita Park and Wharf and the various strata groups and community associations (e.g. Kendall Inlet, Breakfast Point, Edgewood) are interested in a range of potential impacts associated with remediation works including: • amenity and environmental impacts (noise, odour, visual, traffic etc.); • health impacts (perceived and real); • impacts on property values (perceived and real); • preservation of integrity of seawall in proximity to Remediation Areas; and • impacts on access to waterfront during works. Consultation is ongoing through the Community Liaison Group (CLG) meetings and website updates.
Local businesses	Local businesses will have a key interest in the potential impacts of the project and works on patronage (both positive and negative impacts), including potential amenity impacts (noise, odour, visual, traffic etc.).
Media	Includes TV, radio and newspapers. Local newspapers include: • Inner West Courier; and • Burwood Scene. Social media that includes Twitter, Facebook, blogs, forums is not being used currently but is identified if required in future. The media will have an interest in reporting project progress, coverage of issues of interest to or affecting the local community.

6.2 STAKEHOLDER ENGAGEMENT METHODS

Jemena has been communicating and consulting with stakeholders and the community regarding the Project since late 2012. A range of methods have been used for the ongoing engagement that include:

- creating project web pages;
- undertaking intercept surveys;
- establishing a mailing list and providing email updates;
- establishment of a local project office (at 140 Tennyson Road between mid-2015 and early 2016);

- providing a project 1800 number and project email address;
- maintaining an Issues and Response Log;
- publication and distribution of Community Newsletters;
- conducting community information and feedback sessions (CIFS);
- establishing a Community Liaison Group (CLG);
- holding community information stalls;
- undertaking stakeholder briefings; and
- engaging with local media outlets.

6.3 PRE-REMEDATION STAKEHOLDER ENGAGEMENT

6.3.1 CONSULTATION ACTIVITIES - COMMUNITY

The focus of pre-remediation communications and consultation has been on providing updates to stakeholders on the progress of remediation planning and seeking feedback relating to proposed remediation strategies. Specific consultation activities are listed in Table 6-2 below.

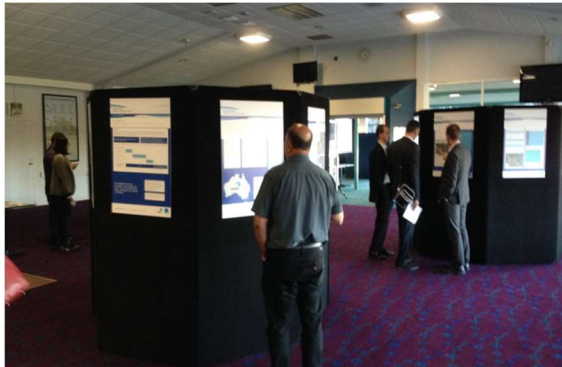
Table 6-2: Consultation Activities – Community

Communication Techniques	Description	Comment
Website	Jemena corporate website contains information about this remediation project. The website (www.jemena.com.au) is updated regularly with project information. Jemena website provides quick access to information about the Project and Jemena's remediation activities. There are links to the latest fact sheets, a contact phone line and an email address to request further information about the project.	There are links to relevant technical documents, frequently asked questions (FAQs), all newsletters distributed during the Project, CLG meeting minutes, recent project updates, contact phone number and an email address to provide feedback or request further information about the Project.
Mailing list and email updates	A mailing list to which stakeholders can subscribe can be accessed via the website. Newsletters are sent out to people who have subscribed. The Project update emails have assisted with keeping the community informed of the Project progress.	Twenty email updates have been sent to subscribers during the life of the Project, in line with the timing and content of each Community Newsletter (see below).
Surveys	Surveys and 'door-stepping' provide an opportunity for local people and business owners not currently aware of or engaged in the Project to understand more about the remediation process and some of the key issues / dates associated with it. Intercept surveys of residents and businesses in the local area have been undertaken to gain feedback on the Project and highlight key issues for consideration.	Three intercept surveys were undertaken. In total, 74 responses have been collected to date. • Survey 1 – November 2013 • Survey 2 – April 2014 • Survey 3 – January 2015 Survey responses are summarised in Table 6-3 below.

Communication Techniques	Description	Comment
	Feedback collected during surveys is available on the website.	
Local Project office	A Project office was established in mid-2015 at 140 Tennyson Road, Mortlake to manage site investigation and remediation design phase work for the Project. Members of the Project team were based at this location until February 2017.	The Project office will re-open during the remediation construction phase of the Project.
1800 number, Project email address	The 1800 number and email address are an ongoing avenue for the community to provide feedback and ask questions about the Project. They are monitored by the consultation team, and questions are often referred to technical Project team members to ensure the accuracy of responses.	A 1800 number and project email address are available for stakeholders to ask questions and or provide feedback. Phone: 1800 571 972 Email: kendallbay@jemena.com.au
Issues and Response Log	The Issues and Response Log collates all feedback received through the 1800 number and email address, as well as responses provided.	This is available (in a de-identified version) on the website.
Community Newsletters	A series of community newsletters have been issued to provide Project updates as they have become available. The updates have been delivered to residences and commercial premises in an identified local catchment area (approx. 4,500 dwellings) and are also made available on the website. The following newsletters have been produced: • Newsletter 1 – March 2013 • Newsletter 2 – July 2013 • Newsletter 3 – September 2013 • Newsletter 4 – October 2013 • Newsletter 5 – November 2013 • Newsletter 6 – December 2013 • Newsletter 7 – February 2014 • Newsletter 8 – May 2014 • Newsletter 9 – July 2014 • Newsletter 10 – October 2014 • Newsletter 11 – December 2014 • Newsletter 12 – March 2015 • Newsletter 13 – April 2015 • Newsletter 14 – June 2015 • Newsletter 15 – September 2015 • Newsletter 16 – November 2015 • Newsletter 17 – February 2016 • Newsletter 18 - August 2016 • Newsletter 19 - December 2016	Issues covered in newsletters include: • updates on the planning process; • updates on community consultation next steps; • invitations to and reports on outcomes of CIFS (see below); • information regarding recent CLG meetings; • information regarding community information stalls; and • website updates. Specific project issues addressed include: • the required process if Cabarita Park was to be used to access Kendall Bay; • investigation of alternative options to the use of Cabarita Park; • investigation of 140 Tennyson Road, Mortlake as an alternative option to the use of Cabarita Park; • opening of the site office at 140 Tennyson Road, Mortlake, site works and the Project team; • declaration of the Project as SSD and release of the SEARs; • the RAP, HHRA and ERA; • impacts to mangroves;

Communication Techniques	Description	Comment
	Newsletter 20 - December 2017 Further newsletters will be distributed as the project goes through the statutory approvals phase, prior to the commencement of remediation.	- technical assessments being prepared; - sediment investigations and sampling; and - dredging trial.
Community information and feedback sessions	CIFS have been undertaken at key points in the Project to allow community members to view technical information, ask questions of the project team one-on-one, and provide feedback. The format has included two parts: a 'drop-in-display' and a formal presentation from Jemena. CIFS were advertised in local newspapers (<i>The Burwood Scene</i> and <i>The Inner West Courier</i>) as well as the community newsletters. All feedback from these events was collected via note-taking and formal feedback forms. Materials presented at these sessions are accessible through the website.	The following CIFS have been held: - CIFS 1 – November 2013 (21 attendees) - CIFS 2 – February 2014 (58 attendees) - CIFS 3 – July 2014 (24 attendees) A fourth CIFS is planned to be held during the statutory approvals phase.
Community Liaison Group Meetings	The CLG was established in 2013, to maintain regular dialogue between Jemena and the community during the remediation Project. Interested members of the community were invited to apply to the CLG through a publicly advertised expression of interest process. Nominations were also put forward by the BAPCA) and MMBRAG. All community members who applied were appointed to the group. The group operates under established terms of reference, which is available on the website. The CLG meetings were previously hosted at the Massey Park Golf Club however the venue shifted to Project office (140 Tennyson Road, Mortlake). Meeting format usually includes a formal presentation from the project team, followed by a discussion. CLG members act as conduits between the community and Jemena – bringing questions into the group from their networks, and updating their networks with information from the meetings. CLG meeting minutes are also available on the website. - CLG 1 – October 2013 - CLG 2 – November 2013 - CLG 3 – December 2013 - CLG 4 – March 2014 - CLG 5 – July 2014 - CLG 6 – August 2014	Issues addressed at the CLG meetings include: - role and purpose of the group; - presentations by EPA, NSW Health and most recently by Jemena civil contractor Ventia; - information about 140 Tennyson Road; - presentations from consultants on studies and technical; investigations being undertaken - presentations on the RAP; - updates on the EIS, the SEARs and the planning process; - update on discussions with NSW Government regulators; - discussion of impacts to mangroves; - presentations on sampling undertaken; and - presentation on proposed methods of remediation (ISS).

Communication Techniques	Description	Comment
	• CLG 7 – December 2014 • CLG 8 – March 2015 • CLG 9 – June 2015 • CLG 10 – December 2015 • CLG 11 – August 2016 • CLG 12 – December 2016 • CLG 13 – May 2017 • CLG 14 – February 2018 The CLG meetings will continue as the statutory approvals phase continues and through the remediation works.	
Community information stalls	The stalls have provided opportunity for community members to ask questions and provide feedback about the project. The stalls included presentation of technical information about the project which people could view on information boards.	Six community information stalls have been set up at the Concord Farmers Markets: • Community information stalls 1 & 2 – May 2014 • Community information stalls 3 & 4 – December 2014 • Community information stalls 5 & 6 – February - March 2015 On 10 September 2017, Jemena set up an information stall at the Breakfast Point Spring Fair at the Breakfast Point Oval. The event was organised by the local community organisation. Jemena's stall presented a perfect opportunity for visitors to learn about the Kendall Bay remediation project.
Stakeholder Briefings	A number of stakeholder briefings have been undertaken with community groups, Canada Bay Council and State Government Agency stakeholders throughout the remediation planning process. This has allowed information and updates to be provided, and feedback to be received. Additional one-on-one stakeholder briefings with community groups have been undertaken as part of continuing engagement or as requested throughout the communications and consultation program.	Four initial discussions with various community groups were held in the first consultation phase between December 2012 and March 2013. Briefings to State Government agencies are summarised at Section 6.3.3 below.
Media	Local media have been engaged at key stages during the Project. Invitations to Community Information and Feedback Sessions have been published in the Burwood Scene and Inner West Courier.	



CFIS Massey Park Golf Club February 2014



Community information stall Concord Farmers Market May 2014

Kendall Bay Sediment Remediation Project Newsletter Issue 18, August 2016



This newsletter provides the latest updates on the Kendall Bay Sediment Remediation Project. All newsletters are available on the project website www.kendallbayremediation.com.au

Project Updates

Since the last newsletter in February this year, the Jemena team has been busy undertaking further scientific investigations and sampling in Kendall Bay.

This additional work was commissioned in response to an Environment Protection Authority (EPA) request to further assess the nature and extent of contamination in specific parts of Kendall Bay. The results were also required to inform a more refined remediation approach.

Since March 2015, additional sediment sampling has been undertaken in different locations across the Bay. Detailed analysis of contaminants in the sediments was also carried out, as was an assessment of the mangroves and benthic organisms (organisms that live in and on the sea/river bed) in comparable locations.

Results were recently discussed in a workshop with key government agencies, including the EPA, Department of Planning and Environment (DP&E), Roads and Maritime Services, Fisheries and Canada Bay Council. This was the latest in a series of ongoing discussions with the key agencies over the last 12 months.

Upcoming Dredging Trial

On 22nd September Jemena will be undertaking a dredging trial in the Bay at the location marked on the map. The aim of the trial is to collect bulk samples for sediment stabilisation trials and to allow odour and contaminant sampling.

Jemena has been advised by local residents that, during certain hot weather conditions, there are noticeable odours from the Bay in that area. The sampling will assist to determine the specific nature of contamination there and the preferred remediation method.

The Project Team will be available from 9:30am to 11:30pm on location for all who would like to come along, observe and ask questions.



email: kendallbay@jemena.com.au • phone: 1800 266 863 • web: www.kendallbayremediation.com.au

Sample newsletter front cover: Newsletter 18
August 2016



Community information stall Concord Farmers Market March 2015



Jemena stall - Breakfast Point Spring Fair 2017

6.3.2 CONSULTATION OUTCOMES - COMMUNITY

This section summarises the outcomes of consultation activities undertaken.

Table 6-3: Outcomes of communications and consultation - community

Communication Methods	Feedback received
Website	N/A
Mailing list and email updates	Email updates have been appreciated by the community.
Surveys	<u>Survey 1 – November 2013</u> • Most respondents (21/31) had heard about the Project. • Newsletters were the most common source of Project information, followed by family and friends, local networks and community groups. • Respondents were aware that remediation was required, of discussion over impacts to local residents, and that a Staging Site had not yet been selected. • Impacts to local residents (access, noise, traffic, odour, visual), human health risks and the need for an efficient and effective remediation methodology were identified as key issues. • Issues identified where more information was needed included the rationale and proposed methodology for remediation, Council's position, who will be impacted during works, how long it will take and benefits to local residents from the Project. • Respondents offered a range of ideas for ongoing consultation including a Project newsletter, a Project website, updates in the Inner West Courier and face to face community or smaller group meetings. <u>Survey 2 - April 2014</u> • Most respondents (18/22) had heard about the Project. • Community groups, newsletter and local media were the most common sources of information. • When asked, most respondents agreed that remediation should proceed and that contaminated sediments be remediated and removed. Other respondents thought contaminants should be left in the bay and that remediation was not necessary. • Most respondents thought remediation would be good for the community if Kendall Bay becomes cleaner and an active area for local respondents. Other respondents were less sure why remediation was necessary. • When asked, most respondents did not understand how the remediation process was likely to be undertaken or would like more information. Other concerns included leaching of contaminants back in to Kendall Bay, uncovered trucks transporting contaminants, impacts on the local road network and the speed at which trucks would be travelling through residential areas. • Most respondents thought traffic impacts (15/22), air quality issues (9/22), noise and acoustic impacts (9/22) and impacts on the community (8/22) were the most important issues to consider in the EIS. • Most respondents wanted to be kept informed about the progress of the remediation Project. Important information included when the remediation Project was likely to start and how long remediation is likely to take, more

Communication Methods	Feedback received
	information about the remediation process and information outlining why remediation is necessary. - Most preferred forms of engagement were Project newsletters, website updates, local media, direct emailing, face-to-face engagement including public meetings, community pop-up stalls, direct briefings, bill posters. <u>Survey 3 - January 2015</u> - Just over half of all respondents (12/22) had heard about the Project. - Most common sources of information about the Project were community groups, newsletters, family and friends and local media. - When asked, most respondents thought that the contaminated sediment should be removed. Other respondents were not sure or thought that remediation was not necessary. Their reasons included concerns about increasing the spread of pollution by disturbing the river bed and the need for more information about how the Project would benefit the community. - Most respondents thought that air quality (5/22), marine ecology (5/22), the mangroves (4/22), soil and water (4/22) and community impacts (4/22) were the most important issues to consider in the EIS. - Most preferred forms of engagement were Project newsletters, website updates, local media, direct emailing and Facebook (3).
Local Project office	N / A
1800 number, Project email address	See Issues and Response Log below.
Issues and Response Log	A wide range of questions and feedback have been received through the 1800 number and email address, and the focus of these has changed as the Project has progressed. Issues have included the requirement to remediate, selection of a staging site, remediation methodology, impact of the remediation works on local residents (e.g. noise, odour, dust, visual, access and traffic), impact of the Project on the mangroves in Kendall Bay, benefits of remediation (e.g. human health), and Project timing. The (de-identified) Issues and Response Log is available on the website.
Community Newsletters	N / A
Community information and feedback sessions	<u>Issues raised at CIFS 1 – November 2013 (21 attendees)</u> - Some attendees supported remediation to address human health and environmental risks while others questioned the need and sought further information on the rationale and requirements and potential impacts of the Project. - Key concerns included traffic generation, road impacts, potential negative impacts from dust, odour and noise, and impacts on the mangroves in Kendall Bay. - Further information was sought on risks associated with contaminants, impacts from remediation works at 140 Tennyson Road and future of the mangroves. - Other issues raised: why had remediation not happened in the past; absence of contamination warning signs in the local area; monitoring by the EPA of remediation activities; and access to specialist reports. <u>Issues raised at CIFS 2 – February 2014 (58 attendees)</u> - Some attendees supported remediation to address human health and environmental risks while others questioned the need and sought further

Communication Methods	Feedback received
	information on rationale and requirements and potential impacts of the Project. • Key concerns included traffic generation and truck movements, road impacts, potential negative impacts from dust, odour and noise, and impacts on the mangroves in Kendall Bay. • Further information was sought on risks associated with contaminants, impacts from remediation works at 140 Tennyson Road and future of the mangroves in Kendall Bay. • Other issues raised: why remediation was not undertaken during development of Breakfast Point; why the remediation involved treatment onsite and transport out by road (rather than barge out and treat elsewhere); monitoring by the EPA of remediation activities; consideration of cumulative impacts; risk management at 140 Tennyson Road; and access to specialist reports. <u>Issues raised at CIFS 3 - July 2014 (24 attendees)</u> • Some attendees questioned need for remediation and wanted more detail on the proposed timing of the Project. • Concerns included: functionality and appearance of the Bay and the Tennyson Road site at Project conclusion; providing site security, facilitating scout involvement in mangrove remediation and potential remediation of nearby residential land. • Other issues raised: operation of the Water Treatment Plant; when did the Tennyson Road site become available; how will Tennyson Road site be used after Project completion; number of trucks and the traffic counts; options for mangrove remediation; when the Project works will commence; hours of work and effects on noise and traffic modelling; justification of the chosen treatment site and how this was determined during assessment of alternative sites; options for barging treated sediment to other locations before using road transport; the condition, appearance and functionality of the Project area at Project completion; noise generation; operation of silt curtains and how posts will be driven into the sediment.
Community Liaison Group (CLG) meetings	N / A
Community information stalls	Community information stalls have been greatly appreciated by the local community as these present a perfect opportunity for visitors to learn about the remediation project.
Stakeholder briefings	N / A
Media	N / A

Regular community communication and consultation has enabled the stakeholders to develop an understanding of the Project objectives and benefits of the works proposed. It has also provided opportunities for all stakeholders to respond with feedback and raise any concerns during the course of the Project. Any concerns are passed on to the Jemena Remediation Project team so that they can be adequately addressed in a timely manner. Where concerns have been raised, further information has been provided and the concerns addressed.

6.3.3 CONSULTATION ACTIVITIES - STATUTORY REGULATORS

There has been periodic ongoing consultation with applicable statutory authorities since the completion of the land-side remediation in 2002.

As part of ongoing consultation, regulators have been advised of the remediation planning progress. The following table summarises specific Project consultation activities with statutory authorities conducted to date.

Table 6-4: Communication with Statutory Authorities to date

Stakeholder	Date	Engagement detail	Engagement approach
- EPA - DP&E - OEH - RMS - City of Canada Bay Council - Fisheries	4 Dec 2015	A presentation on the Project was given at the Tennyson Road project office to representatives of these statutory authorities regulating the Project, or who will be reference agencies in the approval process	Face to face
- EPA .	20 Jun 2016	A further update was provided to the staff.	Face to face
State MP	28 Jul 2016	A briefing was given to John Sidoti, State Member for Drummoyne on 28 July 2016 at his office to provide an update on the remediation work progress.	Face to face
- EPA - DP&E - OEH - RMS - City of Canada Bay Council - Fisheries	29 Jul 2016	A presentation was made to the stakeholders.	Face to face
NSW Health	3 Aug 2016	NSW Health official visited the Tennyson Road project office to discuss the Project - a copy of the July 2016 presentation was provided to the Health representative earlier.	Face to face
NSW Health	22 Sep 2016	A trial dredging exercise was held on Kendall Bay, to which all the regulators were invited - it was attended by two representatives of NSW Health.	Face to face
State MP	28 July 2016	A briefing was given to John Sidoti, State Member for Drummoyne on 28 July 2016 at his office to provide an update on the remediation work progress.	Face to face
EPA	31 Jan 2017	RAP was forwarded to EPA. There has been a number of subsequent meetings held with EPA staff regarding the RAP and related matters.	Email and face to face follow up discussions
- EPA - RMS	26 May 2017	Jemena representatives met with EPA and the RMS staff to discuss the approvals	Face to face

Stakeholder	Date	Engagement detail	Engagement approach
		required for in-situ stabilisation trials planned for Kendall Bay.	
EPA	11 Jul 2017	Jemena representatives met with EPA staff to discuss matters relating to EPA feedback on Jemena RAP.	Face to face
City of Canada Bay	6 Feb 2018	A meeting with Council staff was held on to provide an update on the Project progress.	Face to face
- EPA - RMS - Fisheries	Jan-June 2018	Regular communication has occurred with EPA, RMS and Fisheries regarding approvals for a limited field trial within Kendall Bay	Combination of email and face to face
- Sydney Harbour Ferries - NSW Health - SafeWork NSW	4 May 2018	Project update letters were sent to Sydney Harbour Ferries, NSW Health and SafeWork NSW.	Letters via email
City of Canada Bay	23 May 2018	A meeting with Council staff was held to provide an update on the Project progress.	Face to face
NSW Health	23 May 2018	A meeting was held with the NSW Health team to provide a general project status update. This included an update on the progress of the trial, EIS, recent communication with the EPA, RAP and the expected timing of the full scale works.	Face to face

6.3.4 COMMUNICATIONS OUTCOMES – REGULATORS

The ongoing consultations with regulatory authorities include the RAP approval, discussions around the timing of the activities required for the remediation work and the remediation methodology. A summary of the outcome of communication with regulators is provided below;

- Update on the project was provided to MP John Sidoti during the meeting. The MP acknowledged the community consultation that is taking place and the fact that Jemena is being open and transparent with the community, which holds Jemena in good stead. John Sidoti has attended a number of community engagement sessions and acknowledged the fact that the project office at 140 Tennyson Road allowed the community and relevant stakeholders to contact Jemena quickly.
- City of Canada Bay is interested to see that remediation is undertaken in accordance with the Council's requirements for the management of contaminated land described in the City of Canada Bay 'Contaminated Land Policy'
- Council is interested in potential amenity impacts including noise, odour, vehicle movements and visual impacts. They are also interested in impacts on residents and businesses (potential complaints) and how the works are to be carried out.

- DP&E and EPA are consenting authorities. The Project has been classified as a State Significant Development (SSD) for assessment by the DP&E, with SEARs having been issued (and then revised) for the Project. The DP&E is providing advice about the environmental planning approval process for the Project, including assessment of Jemena's development application and EIS.
- EPA has primary regulatory oversight of the remediation of the site and is empowered to issue orders for remediation and contamination management (for example, where voluntary remediation is not being satisfactorily progressed). The EPA is involved in the resolution of the VMP, and the minimisation of environmental and health impacts during works. They will also provide approvals for the work, including an Environment Protection Licence (EPL).
- NSW Health has commented about the in-situ stabilisation process and the water quality in the Bay and the minimisation of human health impacts during the works.

6.4 SUMMARY OF KEY PROJECT ISSUES RAISED

The issues raised during consultation with stakeholders and references to where these issues are addressed in the EIS are outlined in Table 6-5. Issues attributed to the community stakeholder group comprised questions and feedback raised in surveys, on the 1800 number and Project email, community feedback and information sessions and the Community Liaison Group (see Table 6-2 and Table 6-3 above).

The RAP prepared for the Project also addresses specifically many of the issues that were raised by community consultation, in particular:

- Contamination and the resulting odours along the foreshore
- the human health of those who use the bay, beach and mangrove area
- the amenity of the beach
- preservation of the mangroves; and
- odour generation during remediation.

A summary of the views of stakeholders is also provided in each relevant chapter of the EIS where issues have been raised during stakeholder engagement.

Table 6-5: Issues raised during stakeholder consultation

Stakeholder group	Issue raised	Response	Reference in the EIS
Community	Traffic impacts and truck movements	Assessed as part of the traffic impact assessment	Chapter 16 and Appendix 14
	Impacts to roads	Assessed as part of the traffic impact assessment	Chapter 16 and Appendix 14
	Dust impacts	Air quality assessed, hazard and risks assessed	Chapter 8 and Appendix 6
	Odour impacts	Assessed as part of the air quality assessment	Chapter 8 and Appendix 6
	Noise impacts	Noise impacts assessed	Chapter 9 and Appendix 7
	Impacts to health	Hazards and risks assessed in Human Health Risk Assessment	Chapter 14 and Appendix 3

Stakeholder group	Issue raised	Response	Reference in the EIS
	Impacts to mangroves	Original remediation methodology raised the possibility of removal of most / all of the mangroves which was an issue for many community members. The revised methodology will require minimal removal (potentially one mature mangrove and some small offshoots). Impacts are assessed as part of Ecological Risk Assessment.	Chapter 12 and Appendix 4
	Impacts to the sea wall	The remediation approach for the area defined as S2 has been designed to protect the sea wall.	Chapter 10 and Appendix 8
	Visual impacts	Assessed as part of landscape and visual impact assessment	Chapter 15 and Appendix 13
	Access to the waterfront and beach	Access to the beach some parts of the bay will be temporarily restricted to protect public safety. Access to the promenade will not be affected.	Chapter 4 and Chapter 14
	Need for remediation	Options assessed in the Remediation Action Plan	Chapter 2 and Appendix 2
	Selection of the Staging Site	A planning proposal to temporarily reclassify a portion of Cabarita Park from 'community land' to 'operational land' for the purpose of a Staging Site was not supported by the Canada Bay Council and consequently an alternative location was identified.	Chapter 2 and Appendix 2
	Spread of contamination	Assessed in RAP	Chapter 11, Appendix 8 and Appendix 9 (RAP at Appendix 2)

6.5 STAKEHOLDER ENGAGEMENT - EIS PUBLIC EXHIBITION PERIOD

The exhibition of the EIS is managed by the Department of Planning and Environment. A copy of the EIS document and appendices will be available on the DP&E website.

The following activities are planned during the EIS exhibition period:

- A community information session at the Project office - an information session will be organised at the Project office (140 Tennyson Road, Mortlake) during the EIS exhibition and project team members will be available to respond to any queries raised.
- Website updates – Updates will be made to ensure members of the community and stakeholders not able to be present at the community information session have access to the latest information available.

- Community newsletter – a newsletter will provide timely, clear and factual information to the community and stakeholders.
- Community notification – Notification will advise the community and stakeholders around the site of the progress of the works.
- 1800 number and email address (published on website, newsletters, notifications and site signage) – This will provide ongoing opportunity to the community members and stakeholder to get in touch as required; and
- Advertising and media coverage (print and electronic media) informing the community of key aspects of the EIS public exhibition period and opportunities for involvement (submissions).

The exhibition of the EIS is managed by the Department of Planning and Environment, as summarised in the flow chart below:

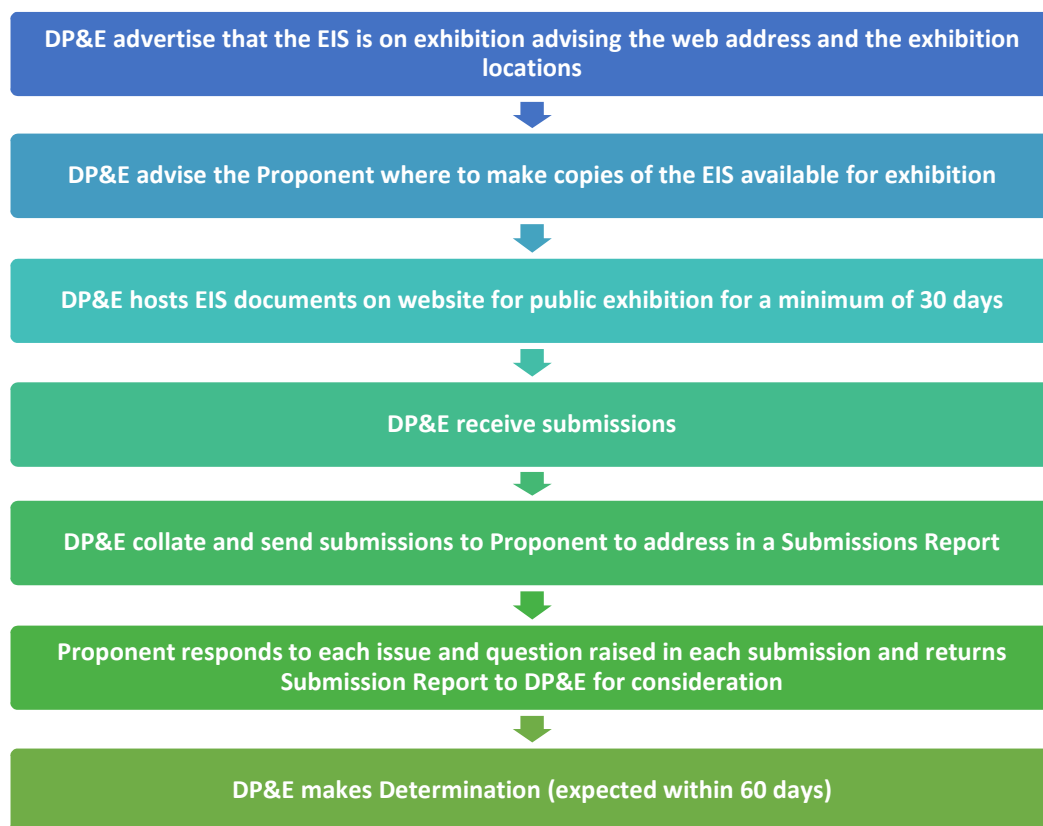


Figure 6-1: Flowchart of EIS exhibition process

6.6 STAKEHOLDER ENGAGEMENT - REMEDIATION OPERATIONS

The program of stakeholder engagement will be continued for the duration of the remediation works and, where applicable, in the period following completion of those works. Communications and consultation with the community during remediation works will be implemented considering:

- the location of the remediation works and the neighbouring community

- the need for the general public and the regulators to be informed of the progress of the remediation works and to have their questions and concerns responded to in a timely manner; and
- to communicate where changes have occurred during the remediation works in response to stakeholder concerns.

6.6.1 CONSULTATION ACTIVITIES - COMMUNITY

Jemena will continue to engage with the local community and all relevant stakeholders. During the remediation period, a complaints management protocol will be established and will include an emergency contact phone number and email address.

Consultation activities will include:

- presence of a community relations representative at the Project office
- regular Community Liaison Group (CLG) meetings
- website updates
- regular community newsletters (print and email)
- targeted works notifications (as required)
- 1800 number and email address (published on website, newsletters, notifications and site signage); and
- established complaints recording and handling system, including agreed timeframes and responsibilities for responding.

6.6.2 CONSULTATION ACTIVITIES – REGULATORS

Jemena will hold communication sessions with the statutory regulators as required during the remediation works.

It is expected that the EPA and DP&E will also require formal and frequent reporting. The following table shows an overview of the planned communication with statutory authorities.

Table 6-6: Overview of planned consultation with statutory authorities

Statutory Authority	Planned Consultation
Environment Protection Authority (EPA) – Contaminated Sites	• Monthly updates with EPA Contaminated Sites Unit staff • Quarterly meeting with Jemena Senior Management and EPA Unit Heads / Officers
City of Canada Bay Council	• Update as project milestones achieve
MP – John Sidoti	• Meeting with John Sidoti to be scheduled for late 2018, • An offer will be made to provide updates to the MP as project milestones are achieved. This could be via emails or in a face to face setting if preferred by the MP.
Department of Planning and Environment (DP&E)	• A meeting with DP&E following EIS submission, • Quarterly updates will be provided to the DP&E.
Roads and Maritime Services (RMS)	• Monthly updates will be provided during the field trial phase and full scale remediation works

Statutory Authority	Planned Consultation
NSW Health	Quarterly updates will be offered to the NSW Health
Office of Environment and Heritage (OEH)	Quarterly updates will be offered to the OEH
SafeWork NSW	Quarterly updates will be offered to SafeWork NSW
Department of Primary Industries - Fisheries	Quarterly updates will be provided to the DPI.

6.7 POST REMEDIATION STAKEHOLDER ENGAGEMENT

6.7.1 CONSULTATION ACTIVITIES - COMMUNITY

Detailed requirements are expected to be outlined in the post remediation Site Management Plan, to be agreed with the EPA. At this stage it is anticipated that the following activities will be undertaken:

- meeting with the Community Liaison Group
- community newsletter; and
- website update and publishing contact details for communication going forward.

6.7.2 CONSULTATION ACTIVITIES - REGULATORS

Jemena will hold a communication session with interested statutory regulators after the remediation works are complete to discuss the Project outcomes and any future remediation management requirements.

7. PROJECT ENVIRONMENTAL RISKS

This chapter describes the approach and outcome of the Environmental Risk Assessment (ERA) undertaken to consider the Project's environmental risks. The SEARs and Jemena's risk management system includes requirements for risks to be identified early in the Project lifecycle to ensure that appropriate controls can be applied to the planning and design of the Project to manage and mitigate the identified risks.

7.1 OBJECTIVES AND SCOPE

The primary purpose of the Environmental Risk Assessment is to identify risks associated with the potential impacts of the environmental issues identified, with particular attention to be given to those categorised as medium or high risk.

The ERA addresses the following SEARs:

SEARs Requirement – Environmental Risk Assessment

- Risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment

An ERA was initially undertaken in 2014 by ERM based on the original Project proposal, and informed the early development of the EIS and the supporting technical studies. As previously noted, since 2014, there has been refinement to the Remediation Areas and the details of the remediation approach, with updates to the Ecological Risk Assessment, Human Health Risk Assessment and Remediation Action Plan. There has also been a subsequent review of the environmental risks, and the ERA presented in this chapter takes account of the outcomes from that analysis and the refinement of the scope of the Project.

7.2 RISK ASSESSMENT METHODOLOGY

The risk assessment methodology is based on the Australian Standard AS/NZS ISO 31000:2009 *Risk Management – Principles and Guidelines* (Standards Australia 2009a) and the accompanying handbook HB 203:2013 *Risk Management Guidelines – Companion to AS/NZS ISO 31000:2009* (Standards Australia 2009a). The Australian Standard risk assessment methodology is set out in Table 7-1.

Table 7-1: Australian Standard risk assessment methodology

Risk Assessment Methodology	Addressed in the EIS
1. Establishment of context:	Addressed in Chapters 3-5 of this EIS
2. Risk identification	Risks were identified through the 2014 ERA, 2018 ERA and through stakeholder consultation
3. Risk analysis	Summarised in this chapter
4. Risk evaluation	Risks were considered as follows: a) <u>Intolerable risks</u> : Chapter 2 describes the studies undertaken and the alternatives considered in formulating the preferred Project design. Alternatives that presented intolerable risks that could not be appropriately managed were not considered further.

Risk Assessment Methodology	Addressed in the EIS
	b) <u>Medium and high risks</u> : these were identified as requiring specific treatment measures to reduce the risk to as low as reasonably practicable. c) <u>Low risks</u> : these do not require specific treatment measures but will still be addressed through standard environmental management practices.
5. Risk treatment	Mitigation measures to reduce the likelihood and / or magnitude of an adverse environmental impact are described in the relevant chapters for each environmental issue.
6. Monitoring and review	This is integrated into all of the above steps but is described for each environmental issue in the relevant chapters.
7. Communication and consultation	This is also integrated into all of the above steps and summarised in Chapter 6.

The ERA categorised the level of risk for a given event based on the consequences of an event occurring and the associated likelihood of occurrence, assuming that no mitigation measures had been applied. The consequence and likelihood categories used in the ERA are shown in Table 7-2 and Table 7-3 respectively. Each negative environmental risk was then ranked as low, medium, high or very high using the risk matrix in Table 7-4. Positive outcomes were also ranked using the risk matrix in Table 7-5.

Table 7-2: Consequence categories for ERA

Rank	Consequence	Description
Negative consequences		
1	Extreme	Permanent and catastrophic impacts on the environment; large impact area: reportable incident to external agency; substantial community concern.
2	Major	Permanent and detrimental impacts on the environment; large impact area: reportable incident to external agency; high level of community concern.
3	Moderate	Substantial temporary or minor long term detrimental impacts on the environment; moderate impact area; reportable incident to external agency; some community concern.
4	Minor	Limited detrimental impacts on the environment; small impact area; not reportable incident; limited community concern.
5	Low	Nil or temporary impacts to the environment, small or isolated impact area; not reportable incident; no community concern.
Positive consequences		
1	Major	Permanent beneficial impacts on the environment or population; large impact area.
2	Moderate	Substantial temporary or minor long term beneficial impacts on the environment or population; moderate impact area.
3	Minor	Limited beneficial impacts on the environment or population; small impact area.

Table 7-3: Likelihood categories for ERA

Rank	Likelihood	Description
A	Almost Certain	Happens often and is expected to occur
B	Likely	Could easily happen and would probably occur
C	Possible	Could happen and has occurred elsewhere
D	Unlikely	Unlikely to happen but may occur
E	Rare	Could happen, but only in extreme circumstances

Table 7-4: Risk matrix for ERA – negative consequences

Negative Consequences					
Likelihood	1 Extreme	2 Major	3 Moderate	4 Minor	5 Low
A. Almost certain	VH	VH	H	H	M
B. Likely	VH	H	H	M	M
C. Possible	H	H	M	M	L
D. Unlikely	H	M	M	L	L
E. Rare	H	M	L	L	L

VH = very high; H = high; M = medium; L = low

Table 7-5: Risk matrix for ERA – positive consequences

Positive Consequences			
Likelihood	1 Major	2 Moderate	3 Minor
A. Almost certain	H	H	M
B. Likely	H	M	M
C. Possible	M	M	L
D. Unlikely	M	L	L
E. Rare	L	L	L

H = high; M = medium; L = low

7.3 FINDINGS OF THE ENVIRONMENTAL RISK ASSESSMENT

All potential impacts regardless of the level of risk were considered and addressed in this EIS, however a higher degree of assessment was undertaken for the environmental issues with risk levels ranging from medium to high¹. The full ERA is provided in Table 7-6. The key issues identified were air quality, noise, and social risks.

Table 7-6: Environmental Risk Assessment

Environmental Issue	Potential Impacts	Consequence	Likelihood	Potential risk without mitigation measures
Air Quality and Odour	Elevated odour concentrations during remediation works at sensitive receptor locations causing potential amenity impacts	3	C	M
	Capping and removal of contaminated sediments leading to less odour during low tide	3	B	M+
	Odour emissions during transport of excavated materials	4	D	L
	Emissions from plant and machinery	5	D	L
Noise and Vibration	Noise levels and vibration generated during construction and remediation activities exceeding noise management levels and vibration criteria at sensitive receptor locations	3	B	H
	Traffic noise generated by heavy vehicle use exceeding noise management levels	3	C	M
Hydrology	Alteration to the morphology of Kendall Bay	3	C	M
	Seabed disturbance outside of the Remediation Areas	3	C	M
	Changes to sediment transport processes	3	C	M

¹ There were no risk levels identified as Very High.

Water Quality and Sediments	Disturbance to bed sediments during the installation of piles and anchors to support the sedimentation barriers causing the mobilisation of contaminants into the water column	4	B	M
	Vessel movements causing the potential mobilisation of sediments in the shallow areas of Kendall Bay	5	C	L
	Surface water run-off at the Staging Site entering the adjacent marine environment	4	C	M
	Potential failure / damage (unplanned event) to the sedimentation barriers (sheet piles, silt curtains) causing the release of contaminated sediment outside of the Remediation Areas	2	D	M
	Accidental release of excavated material (unplanned event) into marine environment outside of the Remediation Areas during loading of barges; and transport from Kendall Bay to the Staging Site	3	C	M
	Potential disturbance to Potential Acid Sulfate Soils (PASS) during the removal of sediments within Southern Remediation Area	3	D	M
	Off-site discharge of water via stormwater drainage at the Staging Site which exceeds the adopted water quality criteria	4	C	M
Biodiversity	Impacts on threatened or protected species through loss of preferred habitat	5	E	L
	Disturbance to fish and benthic organisms during the removal of sediment from the Remediation Areas	5	C	L
	Disturbance to marine fauna from underwater noise generated during the installation and subsequent removal of piles, pumps and dredges	5	D	L
	Altered water quality as a result of the re-suspension of sediments during excavating within the Remediation Areas causing adverse impacts to marine species (impact limited to the Remediation Areas due to the presence of the silt curtains and sheet piles)	5	A	M
	Potential decline in water quality resulting in adverse impacts on the marine ecology caused from accidental hydrocarbon spills into the marine environment from plant and equipment used during the Project	3	D	M

	Removal of contaminated sediments and re-establishment of the seabed / bathymetry in the Remediation Areas leading to an improvement in the ecological health of the localised marine area	1	B	H+
Social	Physical presence of the Project causing a loss in visual amenity experienced by recreational users of Kendall Bay and nearby residents	4	B	M
	Perceived impacts on human health and wellbeing from the accidental release of contaminated material or wastewater discharge to land or water	4	E	M
	Loss of amenity from nuisance impacts caused by elevated odour concentrations, noise levels and traffic disruptions	3	B	H
	Positive impacts to recreational users of Kendall Bay resulting from the remediation undertaken to target sediments associated with potential human health risks.	3	B	M+
Cultural Heritage	Potential impacts to heritage listed items within and near to the Project Area caused from Project activities. Heritage listed items include: • Mortlake Punt • Cabarita Park and Federation Pavilion; and • 'Lady Edeline' wreck.	3	D	L
	Potential damage to previously recorded and/or unrecorded Aboriginal heritage items or places	4	D	L
Public Health and Safety	Impacts on the health of workers, residents and recreational receptors from vapour released from the contaminated sediment	3	D	M
Traffic and Transport (Land based)	Increase in heavy vehicle movements result in operational and / or safety impacts to the surrounding road network	3	C	M
	Potential disruptions to bus services in the vicinity of the Staging Site and wider area	4	D	L
	Reduction in the availability of car parking supply within the road network surrounding the Staging Site	4	C	M
Traffic and Transport	Potential disruptions to local transport services in the vicinity of the Staging Site and wider area including:	4	D	L

(Marine based)	- pedestrian and cycleway access to Kendall Bay - access to Cabarita Ferry Wharf; and - access disruptions to the Mortlake Punt.			
	Physical presence of the Project affecting the use of the local marine area by powered vessels and sailboats	5	C	L
	Physical presence of the Project affecting the use of recreation unpowered vessels such as kayaks within Kendall Bay	4	B	M
	Potential temporary relocation of swing moorings to facilitate marine vessel access to the Remediation Areas from the Staging Site	5	B	M
Waste Management	The generation of various types of waste streams which, if not managed appropriately could have potential, adverse amenity and health impacts on the Staging Site and the surrounding locality.	3	D	M

8. AIR QUALITY AND ODOUR

This chapter discusses the potential air quality impacts, including odour impacts, of the Project on receptors in the surrounding area and describes measures that will be used by Jemena to mitigate those impacts.

The activities associated with the proposed remediation works have the potential to emit a range of odorous and volatile substances due to the nature of the contaminated materials. Primary sources of odour include excavation of contaminated sediments in the bay and conveying of sediments on a barge to the Staging Site.

As noted in Chapter 7 (Project Environmental Risks), emissions from plant and machinery represent a low risk and are not considered further.

8.1 OBJECTIVES AND SCOPE

This chapter is based on the Air Quality Assessment Kendall Bay Remediation Project report prepared by Todoroski Air Sciences (Appendix 6).

This chapter addresses the following SEARs:

SEARs Requirement – Air Quality and Odour
Assessment of odour from the excavation, dredging, transport, treatment and storage of contaminated sediments
An air quality impact assessment of each stage of the remediation works and treatment facility including details of the emission control measures at the treatment facility, odour / dust suppressants and stockpile management
Details of the proposed odour and air emission controls for each stage of the remediation processing, including the proposed treatment site at 140 Tennyson Road
Details of an air quality monitoring program including the identification of air quality criteria
Cumulative impacts – particularly in relation to air, noise and traffic associated with other nearby industrial or commercial operations

8.2 ASSUMPTIONS REGARDING REMEDIATION METHODOLOGY

For the purposes of the modelling, the following remediation methods have been assumed:

- The excavation of contaminated sediments using a floating barge-mounted excavator
- The excavator will place material directly into bins positioned on a separate floating barge
- Small bins will be used to minimise the exposed surface area of contaminated material at any one time (approx. 2.5m²)
- Care will be exercised in placing the material carefully in bins to avoid spillage
- All bins will have tight-fitting, essentially airtight lids

- The sealed bins will be transported on the barge to the Staging Site and then transferred to land
- The outside surface of the bins will be washed down on the barge and any wash water collected within the bunds of the barge
- Wash water will be periodically removed by vacuum tanker and transported off-site to a licenced water treatment plant
- Sealed bins containing the contaminated material will be transferred to trucks at the Staging Site for transport off-site to a licenced facility for further treatment (if required) and disposed at an EPA licenced landfill facility
- Remediation works only occur from 7:00am to 5:00pm Monday to Friday and 8:00am to 1:00pm on Saturday.

8.3 IDENTIFICATION OF SENSITIVE RECEPTORS

Sensitive receptor locations were identified through site assessment, and through the ongoing public consultation process. Receptors that have been identified within the zone of influence of the project that have been considered as part of this study are shown in **Figure 8-1**.



Figure 8-1: Project location and receptors

8.4 SAMPLING

Odour sampling from various sensitive receptor locations was undertaken, and core samples of the contaminated sediments were also taken to provide data inputs to the various modelling tools utilised as part of this study

Site specific sampling was undertaken as follows:

- Odour sampling using isolation hoods during February / March 2016. The odour sampling included sampling of the water surface, the exposed shoreline before and after disturbance and of core samples extracted from the contaminated areas as shown in **Figure 8-2**.
- Additional core sampling (594 samples) for air pollutants undertaken between April 2015 and April 2016
- Analysis of some of the March 2016 sediment samples to determine the pollutants that may escape as a vapour
- Measurement of odour and solvent extract concentration to provide an indication of the potential ratio between odorous substances in the sediment and the level of odour in the vapour from the core.

The results obtained from the sampling activities have been utilised as inputs to the various assessment tools as described in detail in Appendix 6, and summarised below.



Figure 8-2: Sampling locations

8.5 ASSESSMENT METHODOLOGY

The assessment methodology followed the approach set out in the following documents:

- NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2017), which lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources.
- *Technical Framework – Assessment and management of odour from stationary sources in NSW* (Technical Framework) (DEC 2006a); and
- *Technical Notes – Assessment and management of odour from stationary sources in NSW* (Technical Notes) (DEC 2006d).

8.5.1 ODOUR MODELLING METHOD

Odour modelling is a complex subject, and is complicated further by the variation in an individual's ability to detect an odour. An odour generally refers to a mixture of odours, and not a single "pure" odour from a single chemical. Predictive modelling is thus utilised to assist in the calculating the likelihood that a particular chemical will be released to the air. Further the modelling calculates the level of dilution that occurs from the source before it reaches the receptor. The outputs from this model produces results in terms of odour units (OU).

The NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2017) outlines acceptable ranges of odour from 2 to 7 OU dependent on whether the source and receptors are located within an urban, densely populated area, or a more rural, sparsely populated area as shown in **Table 8-1** below:

Table 8-1: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban ($\geq \sim 2000$) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence ($\leq \sim 2$)	7.0

Volatile chemicals within the contaminated material were sampled and compared to the impact assessment criteria as outlined in NSW EPA, 2017, which are summarised in **Table 8-2** below:

Table 8-2: Impact assessment criteria for other pollutants

Substance	Averaging period	Impact assessment criteria ($\mu\text{g}/\text{m}^3$)
Benzene	1 hour	29
Ethylbenzene	1 hour	8000
Toluene	1 hour	360
Xylenes	1 hour	190

Source: NSW EPA, 2017

8.6 SAMPLING RESULTS

Measured odour sampling results showed high variability possibly due to heterogeneity of the sample materials, and the challenges in sampling the very soft sediment in some areas. It was noted during sampling that the contaminated material had a mothball-like odour that was pungent. At times, this odour could be detected at low tide when contaminated material was exposed, without any excavation activity being undertaken. The high degree of variability is shown in **Figure 8-3** below.

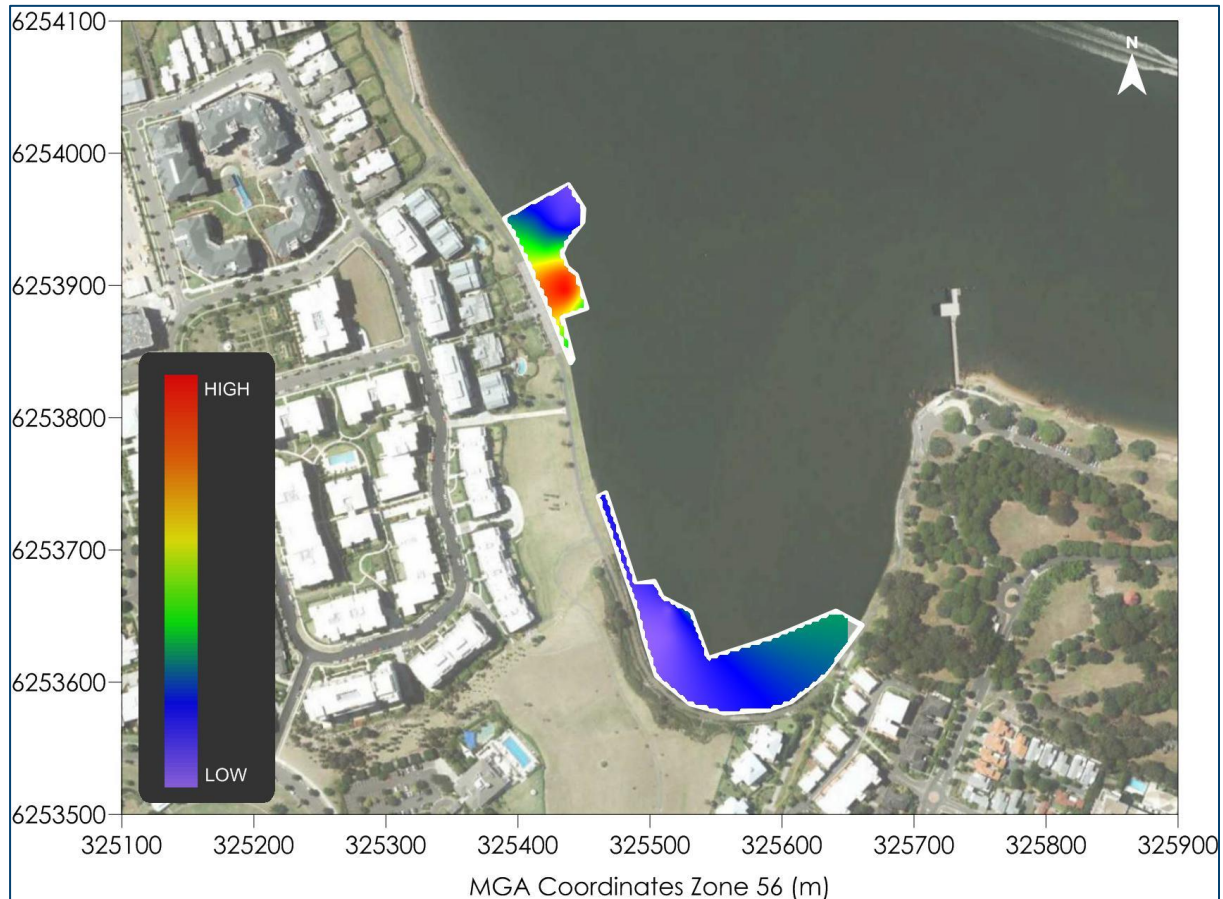


Figure 8-3: Estimated spatial variation in the measured odour concentrations (sediment only).

Measured odour sampling data is presented in **Table 8.3** below which shows the sampling results for variety of samples.

Table 8-3: Odour sampling data for the remediation areas

Sample ID	Sample location	Type	SOER (OU.m ³ /m ² /s)
15201A	Southern	Water surface	0.099
16206A	Southern	Shoreline – undisturbed	0.1
16207A	Southern	Shoreline – disturbed	0.46
09303A	Southern	Sediment	1.3
09304A	Southern	Sediment	0.59
09305A	Southern	Sediment	0.3
09306A	Southern	Sediment	3.4
09307A	Southern	Sediment	0.25
15203B	Northern	Sediment	3.1
15202Bw	Northern	Water surface	0.17
15204Bw	Northern	Water surface	0.26

15205B	Northern	Sediment	0.43
9301B	Northern	Sediment	0.93
9302B	Northern	Sediment	2.0
09308B	Northern	Sediment	0.16
10309B	Northern	Sediment	8.9
10310B	Northern	Sediment	8.1

SOER = specific odour emission rate

Volatile pollutants were also sampled within the core materials as shown in **Table 8.4** below.

Table 8-4: Summary of other pollutant sampling (mg/kg of sediment)

Pollutant	Average Concentration (mg/kg)
Benzene	0.8
Toluene	1.5
Ethyl Benzene	1.4
m, p - Xylene	2.7
o - Xylene	1.6

8.7 EXISTING ENVIRONMENT

8.7.1 CLIMATE

Kendall Bay is located in an urban area, with medium to low density residential housing to the west and south including the Breakfast Point development. The parkland area of Cabarita Park is located to the east of Kendall Bay. The Parramatta River is located to the north.

Local meteorology is influenced by:

- airflow along the Parramatta River
- insolation and heating of the land surface; and
- synoptic conditions.

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Sydney Olympic Park (Site No. 066195) was analysed to characterise the local climate in the proximity of the Project (BOM 2017). The Sydney Olympic Park weather station is located approximately 5 km west-southwest of the Project.

The long-term average statistics indicate that Sydney has a temperate climate with warm summers and mild winters, where:

- January is the hottest month with a mean maximum temperature of 28.4 °C and July is the coldest month with a mean minimum temperature of 7.8 °C.
- Rainfall peaks during the first half of the year declines in late winter and early spring, with an annual average rainfall of 911.8 mm over 82.3 days. The data indicate that February is the wettest month with an average rainfall of 109.8 mm over 7.7 days and September is the driest month with an average rainfall of 52.7 mm over 5.5 days.
- Relative humidity exhibits little variability across the year. Mean 9 am relative humidity ranges from 56% in October to 72% in February and March. Mean 3 pm relative humidity levels range from 41% in August to 55% in February; and

- Wind speeds during the warmer months have a greater spread between the 9 am and 3 pm conditions compared to the cooler months. Mean 9 am wind speeds range from 8.4 km/h in March to 11.9 km/h in September. Mean 3 pm wind speeds range from 12.5 km/h in June to 19.4 km/h in December.

Annual and seasonal wind roses for the Sydney Olympic Park weather station during the 2012 calendar period (considered representative data based on analysis of long term data trends in the project area) are presented in **Figure 8-4** below.

On an annual basis, the highest portion of winds originate from the west-north-west and north-west, followed by winds from the east. In summer, winds are typically from the east and south-east quadrant. The autumn and winter distributions are similar to the annual distribution with predominate winds from west-north-west and north-west. During spring, winds occur from the west-north-west and east, with fewer winds from the south-east.



Figure 8-4: Annual and seasonal wind roses for Olympic Park. (Source: BOM)

8.8 DISPERSION MODELLING

Modelling was undertaken using a combination of industry standard software: The Air Pollution Model (TAPM) and the CALPUFF Modelling System. The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets. The modelling software is described further in **Appendix 6**.

Modelling was conducted for the Northern and Southern Remediation Areas, which considered the average odour emission rate as well as the maximum measured odour emission rates.

The modelling assumed the following exposure of contaminated material:

- Odour is emitted from a 400m² (20m x 20m) area source representing the active working area and barge
- Volume source approximately 13m x 8m x 8m high representing the working excavator on a barge and another volume source representing the barge at the Staging Site
- These assumptions are considered conservative as only approximately 2.5m² of odorous sediment material surface area would be exposed to the air at any one time (given lids are to be closed on individual bins following filling).

8.8.1 ODOUR EMISSIONS

Odour emission rates were estimated based on the assumption that the following areas would be sources of odour:

- The excavation of the contaminated material from the bay sediments
- The volatilisation from the exposed material excavated, from any soiling of the work area
- From the equipment at the Staging Site.

A summary of the emissions utilised in the modelling is summarised below in **Table 8-5**:

Table 8-5: Summary odour emissions applied in modelling scenarios

Area	Source	Maximum level	Average level	Units
Southern Remediation Area	Working area	0.1	0.1	OU.m ³ /m ² /s
	Excavator and barge	926	255	OUV/s
	Barge at Staging Site	93	26	OUV/s
Northern Remediation Area	Working area	0.3	0.2	OU.m ³ /m ² /s
	Excavator and barge	926	255	OUV/s
	Barge at Staging Site	93	26	OUV/s

In addition, the following emission rates were assumed for other pollutants as detailed and explained further in **Appendix 6**, and summarised in **Table 8-6** below:

Table 8-6: Estimated emission rates for the other pollutants

Pollutant	Estimated emission rate (g/s)
Benzene	6.1E-04
Toluene	1.1E-03
Ethyl Benzene	1.1E-03
m, p - Xylene	2.1E-03
o - Xylene	1.3E-03

8.9 DISPERSION MODELLING RESULTS

8.9.1 ODOUR MODELLING RESULTS

The worst case dispersion modelling predictions are represented as the 99th percentile nose-response to odour at ground level. The results have been modelled from each of 28 receptor locations as shown in the figures below which represent the maximum, and average concentrations in the Northern and Southern Remediation Areas.



Figure 8-5: Predicted 99th percentile nose-response average ground level odour concentrations – Northern Remediation Area (Maximum)



Figure 8-6: Predicted 99th percentile nose-response average ground level odour concentrations – Northern Remediation Area (Average)



Figure 8-7: Predicted 99th percentile nose-response average ground level odour concentrations – Southern Remediation Area (Maximum)



Figure 8-8: Predicted 99th percentile nose-response average ground level odour concentrations – Southern Remediation Area (Average)

The results of the odour modelling for each receptor are summarised in **Table 8-7** below:

Table 8-7: 99th percentile nose-response average ground level odour concentrations (OU)

Receptor ID	Southern Remediation Area		Northern Remediation Area		Criteria (OU)
	Maximum	Average	Maximum	Average	
R1	0.0	0.0	0.0	0.0	2
R2	0.0	0.0	0.0	0.0	2
R3	0.0	0.0	0.1	0.0	2
R4	0.0	0.0	0.0	0.0	2
R5	0.0	0.0	0.0	0.0	2
R6	0.1	0.0	0.3	0.2	2
R7	0.1	0.0	0.4	0.2	2
R8	0.1	0.0	0.7	0.3	2
R9	0.1	0.0	0.9	0.3	2
R10	0.1	0.0	1.0	0.3	2
R11	0.1	0.0	1.2	0.4	2
R12	0.1	0.0	0.4	0.1	2
R13	0.1	0.0	0.3	0.1	2
R14	0.1	0.0	0.2	0.1	2
R15	0.1	0.0	0.1	0.1	2
R16	0.1	0.0	0.1	0.0	2
R17	0.1	0.0	0.1	0.0	2
R18	0.1	0.0	0.1	0.0	2
R19	0.4	0.1	0.1	0.0	2
R20	0.7	0.2	0.1	0.0	2
R21	0.4	0.1	0.1	0.0	2
R22	0.5	0.2	0.1	0.0	2

R23	0.7	0.2	0.1	0.0	2
R24	1.5	0.4	0.1	0.0	2
R25	2.0	0.6	0.2	0.1	2
R26	0.0	0.0	0.0	0.0	2
R27	0.0	0.0	0.1	0.0	2
R28	0.0	0.0	0.0	0.0	2

8.9.2 OTHER CONTAMINANT MODELLING RESULTS

Table 8-8 below shows the maximum predicted impact of the worst-affected receptors for the Northern and Southern Remediation Areas based on modelled emissions of a range of volatile compounds present in the contaminated sediments. The modelled air pollutant levels are compared to the impact assessment criteria set out in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2017) and are noted to fall well below the relevant criteria.

Table 8-8: Predicted maximum impact at the worst affected sensitive receptor for other pollutants ($\mu\text{g}/\text{m}^3$)

Pollutant	Averaging period	Maximum impact at the most affected receptor ($\mu\text{g}/\text{m}^3$)		Criteria ($\mu\text{g}/\text{m}^3$)
		Southern Remediation Area	Northern Remediation Area	
Benzene	1-hour	0.9	0.7	29
Toluene	1-hour	1.7	1.4	360
Ethyl Benzene	1-hour	1.6	1.3	8000
m, p - Xylene	1-hour	3.2	2.5	190
o - Xylene	1-hour	1.9	1.5	190

8.10 POTENTIAL IMPACTS

8.10.1 ODOUR AND OTHER AIRBORNE IMPACTS

The modelling undertaken of the worst-case scenario has demonstrated that the air quality impacted from the proposed remediation of the contaminated materials in the sediments are low, and fall below the relevant air quality criteria for the assessed air pollutants at the receptor locations. No significant air impacts are likely as a result of the remediation works, however, the mothball-like odour is likely to be detectable, but not harmful.

There is only potential for dust generation during processing given sediments will be saturated when placed on the barge and transported to the Staging Site. No treatment of the sediment is to occur at the Staging Site. Sediment will remain in the sealed containers and transported from the Staging Site to EPA licenced facility for further treatment (if required) and disposed. Appropriate housekeeping and spillage control systems will be present at the Staging Site. Dust impacts on surrounding receptors are therefore expected to be negligible.

8.11 CUMULATIVE IMPACTS

Sydney's air pollution is variable and can reach hazardous levels. An Air Quality Index, based on ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, particles and visibility monitoring, is updated hourly (see: <http://www.environment.nsw.gov.au/aqms/aqi.htm>). The Project will not generate any of these pollutants.

Given the very low levels of pollutants generated as a result of the Project, cumulative impacts on air quality are expected to be negligible.

There are no developments in the vicinity of the Project that Jemena is aware of that would result in cumulative air quality impacts to receptors for the Project.

8.12 STAKEHOLDER VIEWS

Odour is a concern that has been consistently raised in meetings with the Community Liaison Group and in broader consultation. While community members are concerned about potential odour from the Project, they also note that odour is already present at low tide (i.e. when sediments in the bay are exposed). More generally, community surveys have identified air quality as one of the most important issues for the EIS.

While the community is concerned about odour impacts during the Project, there is an over-riding desire in the community to ensure the bay is appropriately remediated to reduce long-term odour impacts.

8.13 MITIGATION MEASURES

This section describes the mitigation measures to address potential odour impacts. Mitigation in relation to dust and other air pollutants was not deemed necessary as the potential for impact is negligible.

Key mitigation measures to manage odours comprise:

- Restricting remediation activities to daytime hours
- Where possible, consider restricting remediation activities on highly impacted areas to periods when the wind blows from the western quadrant to mitigate impacts on the residential receptors to the west of the Northern and Southern Remediation Areas
- Managing excavation activities to expose the minimum area of sediment material necessary at any one time
- Ensuring that each bin of excavated material is covered immediately once filled
- Minimising the drop height of the excavator to limiting the height from which contaminated material is dropped into the bins
- Regular cleaning of all surfaces soiled with contaminated material
- Washing of the outside of the filled bins at the Staging Site, as required, prior to removal to mitigate odour during transport offsite
- Maintenance of a complaints register, which includes to attend the site at short notice to investigate any odour complaint.

8.14 RECOMMENDED MONITORING

The Environmental Management Plan for the remediation will include requirements for ambient monitoring for odour.

Monitoring will either use an independent contractor or remediation employees who have undergone calibration of their nose at a NATA accredited laboratory.

At appropriate stages of the remedial work the staff member will undertake odour surveys early in the morning at the start of work and in the early evening before work finishes for the day. The odour surveys will be undertaken at the nearest sensitive receptors downwind of the active Remediation Areas and the Staging Site. Odour surveys will be undertaken generally following the guidance provided in VDI 3940 '*Measurement of Odour Impact by Field Inspection*' (VDI 3940 2006). This standard provides methods by which odour at ground level can be determined, defined and documented by assessors.

Where assessors document odour impact with a hydrocarbon characteristic, further mitigation of odour will be undertaken in accordance with the measures outlined in Section 8.13. Additional monitoring will be undertaken if necessary to respond to complaints.

8.15 CONCLUSION

The Project is not expected to result in adverse health impacts for surrounding residents or any other receptors (and the remediation will have beneficial impacts).

Odours have been predicted to be present, particularly under worst case dispersion conditions, if no odour control measures are used, assuming that remediation occurs via bulk excavation. The proposed remediation includes excavation and disposal of contaminated sediment offsite, however it is noted that sediment from SA1 and NA2+NA3, considered to contain the highest impacted sediment, will be removed following treatment by in situ solidification. The treatment prior to excavation is expected to further reduce the potential for air quality and odour issues. Limiting the excavation area where practical and implementing a range of other odour control measures will limit odour to levels that are expected to remain below the NSW criteria for acceptable levels of odour. It is likely that odour will be noticeable at times but only for short periods.

The emissions will be limited as only a small area of contaminated material will be exposed at any one time. The Project involves in situ treatment and targeted offsite disposal of contaminated sediment, which will result in a safer and more appealing environment for the local community.

With these mitigation measures in place, it is expected that odour from the remediation activities will be well within the NSW criteria for acceptable levels of odour.

9. NOISE AND VIBRATION

This chapter discusses the potential noise and vibration impacts of the Project on receptors in the surrounding area and describes measures that will be used by Jemena to mitigate those impacts.

The activities associated with the proposed remediation works have the potential to generate clearly audible levels of noise. These noise levels are expected to vary on a day-to-day basis and during the various phases of the Project. Primary sources of noise during construction and remediation works will include small to medium sized excavators, mobile cranes, drill rigs, cement silo vibrators, general hand tools, work boats / small vessels, small to medium sized mobile barges with fixed hopper barge systems, and various light and heavy vehicles used for the transportation of equipment and materials to, and contaminated material from, the Staging Site. Sheet piling is proposed in certain areas of the remedial works to control turbidity plumes and as a result, the installation of the piling may also contribute to noise impacts.

Site establishment and construction, sediment remediation, capping and site demobilisation works have limited or no potential to generate perceptible levels of ground-borne vibration. With the exception of sheet piling, the type of plant and equipment in use and / or activities that are to be undertaken are not of a type associated with vibration-generating events. Heavy vehicle haulage also has limited or no potential to generate perceptible levels of ground-borne vibration.

The potential for underwater noise impacts to marine fauna is also considered in this chapter.

9.1 OBJECTIVES AND SCOPE

This chapter is based on the Kendall Bay Remediation Project Noise Impact Assessment report prepared by Resonate Acoustics (2018) (Appendix 7). The objectives of the assessment were to identify, quantitatively assess and address potential noise and vibration impacts in accordance with applicable NSW noise policy, regulations and guidelines. This included assessment of construction and remediation noise and vibration, and heavy vehicle haulage (road traffic) noise impacts through:

- quantifying existing noise levels via measurement at a number of locations in the vicinity of the Project Area and development of management levels in accordance with relevant standards and guidelines. Noise management levels were determined with due regard to the existing noise levels
- prediction of noise levels (via modelling and calculation) at closest and / or potentially most affected receivers in the vicinity of the Project Area
- comparison of resultant levels to the Project-specific management levels to determine any exceedances; and
- based on the assessment findings, identification of appropriate noise control mitigation, management and / or monitoring measures.

This chapter addresses the following SEARs:

SEARs Requirement - Noise and Vibration

- Include an assessment of construction and operational noise from excavation, dredging, traffic and operation of the treatment facility.

9.2 ASSESSMENT METHODOLOGY

9.2.1 POLICY SETTING

Acoustics Policy and Guidelines

Noise pollution is regulated through the POEO Act as the primary environment protection legislation in NSW. Noise pollution is defined under the POEO Act as:

‘the emission of offensive noise, which means noise that by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances, is harmful (or is likely to be harmful) to or interferes unreasonably (or is likely to interfere unreasonably) with the comfort or repose of a person outside the premises from which the noise is emitted’.

Under the POEO Act, the *Protection of the Environment Operations (Noise Control) Regulation 2017* ('Noise Regulation') addresses common noisy activities that occur in residential situations. The Noise Regulation limits the time of day that noisy articles (such as lawn mowers, stereos and leaf blowers) are permitted to be heard in neighbouring residences, however it does not specify noise limits and an applicable approach for the assessment of new or existing developments.

In this case, various noise and vibration assessment guidelines endorsed by NSW regulators provide a guideline framework and methodology for deriving acceptable levels and standard methods for assessing and measuring impacts.

Relevant Documents Standards and Guidelines

This chapter and the report at Appendix 7 have been prepared to address the SEARs issued on 17 March 2017 and in general accordance with the following policies, standards and guidelines:

- NSW Environment Protection Authority – *NSW Environmental Noise Management – Industrial Noise Policy* (INP), January 2000 and relevant application notes¹ (NSW EPA 2000)
- NSW Department of Environment and Climate Change – *NSW Interim Construction Noise Guideline* (ICNG), July 2009 (DECC 2009)
- NSW Department of Environment, Climate Change and Water – *NSW Road Noise Policy* (the RNP), March 2011 (DECCW 2011)
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - *Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation* (ISO 1996)
- Standards Australia AS1055–1997 (AS1055) – *Description and Measurement of Environmental Noise, Parts 1, 2 and 3* (Standards Australia 1997)
- Standards Australia AS IEC 61672.1–2004 (AS61672) – *Electro Acoustics - Sound Level Meters Specifications Monitoring* (Standards Australia 2004a)
- Standards Australia AS 2436–2010 (AS2436) – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites* (Standards Australia 2010)
- Standards Australia AS2775-2004 (AS2775) – *Mechanical vibration and shock – Mechanical mounting of accelerometers* (Standards Australia 2004b)

¹ Note that since issue of the SEARs in March 2017, the INP has been superseded by the Noise Policy for Industry 2017. For the purposes of this EIS and the noise impact assessment the INP is still referred.

- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – Structural vibration - Effects of Vibration on Structures (GIS 1999); and
- NSW Department of Environment and Conversation – NSW Environmental Noise Management - *Assessing Vibration: A Technical Guide* (DEC 2006a).

Consideration has also been given to the following reports and data:

- ERM (2015). Kendall Bay Remediation Project, Kendall Bay NSW – *Draft Acoustics Assessment* (0170208RP03_D01 Acoustics Assessment), dated March 2013 (ERM 2015)
- ERM (2014). Kendall Bay Sediment Remediation Project - *Baseline Noise Assessment* (0170208-02A-10RP02_D01 - Baseline Noise), dated February 2014 (ERM 2014); and
- GTA (2018) Traffic Impact Assessment - Kendall Bay Sediment Remediation Project. (GTA 2018).

9.2.2 BASELINE NOISE

A key element in assessing environmental noise impacts is to quantify the existing ambient and background noise environment at or near the closest and / or potentially most affected noise sensitive receiver locations in the vicinity of Project noise emissions. To achieve this, two rounds of unattended logging and attended measurements were conducted by ERM. The first round was completed during September 2012 and the second was undertaken following Project design changes, completed in November and December 2013. Data and logging charts are provided in the Noise Impact Assessment at Appendix 7 and summarised in Table 9-1 and Table 9-2.

9.2.3 NOISE MODELLING

Construction and Remediation Noise

An environmental noise model of the sediment remediation works sites and surrounding area, including the noise sensitive locations, was constructed using ISO 9613-2 (1996), *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation*, as implemented in SoundPLAN software. The method predicts A-weighted sound pressure levels under meteorological conditions favourable to propagation (mild temperature inversion with slight downwind) from sources of known sound emission. The overall model accuracy is estimated to be ± 3 dBA.

The calculation of sound propagation from the source to the receiver locations was calculated with specific algorithms for the following physical effects:

- geometrical divergence
- atmospheric absorption (in accordance with ISO 9613 Part 1)
- ground effect
- reflection from surfaces
- screening by obstacles (horizontal and vertical diffraction); and
- dense vegetation (none included).

The SoundPLAN software produced noise contours by interpolation from predicted grid noise levels at 1.5 metres above local ground level. Point receptors were also utilised, at various heights ranging from 1.5 metres to 10.5 metres above ground level to ascertain the change in noise level with height. The graphical noise contours generated by the model represent the envelope of results for noise propagation

in all directions (i.e. summary of typical worst-case noise propagation in all directions relative to the noise source).

The model terrain was based on elevation data that ERM sourced from Jemena personnel and was modelled as 0% absorptive, which is conservative. Water was also modelled as 0% absorptive.

Noise emission sources deemed representative of the various assessment scenarios were placed at relevant locations within the site areas. Site terrain was taken into account and modelled using available topographical data and maps.

Twelve scenarios were considered for the purposes of the noise assessment, representing the typical highest noise emission (over 15 minutes) associated with each proposed stage of work within the overall Project Area. The noise source term data adopted for this assessment to predict construction and remediation noise levels associated with each scenario are presented in Appendix 7. These sources are expressed as overall dB(A) Sound Power Level (L_w) values for each assessment scenario, Project Area and activity, type of plant, likely quantity and emission height.

Heavy Vehicle Noise

The RAP specifies an average rate of 5.26 heavy vehicle movements (using 30t trucks) per day. This equates to 1468 movements for the duration of the Project. It was assumed that additional miscellaneous equipment and material deliveries may be required and as such a worst-case heavy vehicle quantity of 1800 movements (6.4 heavy vehicle movements per day) was utilised for the model. Works are proposed to occur between 7 am and 5 pm Monday to Friday and this is therefore representative of 3 heavy vehicles entering and then exiting the Staging Site over a ten-hour daytime period. Based on 7 daytime heavy vehicle movements (and the 10 hour works duration), a one hour average of 0.7 movements was estimated.

A conservative assumption was made that the same 7 movements may occur during Saturday works; based on 7 daytime heavy vehicle movements (although the duration of Saturday works will only be from 8 am until 1 pm) a one hour of average of 0.7 movements was estimated. During the night time assessment period (10 pm to 7 am) heavy vehicle movements were assumed not to occur.

This data has been utilised to predict road traffic noise levels for comparison to the applicable daytime RNP road traffic noise criterion for existing residences affected by additional traffic on existing sub-arterial and local roads generated by land use developments:

- Sub-Arterial: $L_{Aeq, (15 \text{ hour})}$ 60 dB (external) for the daytime (7 am to 10 pm) assessment period; and
- Local: $L_{Aeq, (1 \text{ hour})}$ 55 dB (external) for the daytime (7 am to 10 pm) assessment period.

In both cases the CoRTN (United Kingdom 'Calculation of Road Traffic Noise') calculative method has been adopted. CoRTN is an industry accepted algorithm for the calculation of road traffic noise levels.

As stated during all phases of the Project, heavy vehicle haulage is proposed to transport equipment and material to and contaminated sediment from the Staging Site. The proposed heavy vehicle haulage route utilises existing sub-arterial and potentially local public roads; prior to joining the M4 Western Motorway.

Along this haulage route a number of residential premises are situated directly adjacent the road alignment at typical distances of approximately 7.5 metres to 15 metres from traffic.

9.3 ASSESSMENT CRITERIA

9.3.1 APPLYING THE INTERIM CONSTRUCTION NOISE GUIDELINE

'Noise Affected Management Levels' as defined in the DECC's 2009 NSW *Interim Construction Noise Guideline* (ICNG) have been determined with due regard to the measurement of ambient and background noise levels.

In Table 2 of the ICNG, the Rating Background Level (RBL) is used when determining the management level by adding 10 dB to the RBL for standard hours, and adding 5 dB to the RBL for non-standard hours. The RBL is an acoustics descriptor representing the overall background noise level measured in each relevant assessment period (during or outside the recommended standard hours). Background noise is the underlying level of noise present in the area, excluding the noise source under investigation. The term RBL is described in detail in the NSW *Industrial Noise Policy* (EPA 2000) and is applied here in accordance with the ICNG to assess Project noise levels.

A summary of resultant noise management levels for all unattended noise logging locations are presented in Table 9-1.

Noise Criteria for Standard and Non-Standard Hours

As per the proposed work hours noted in Chapter 4 Description of Project Activities, all remediation works will occur between 7 am and 5 pm Monday to Friday, and between 8 am and 1 pm on Saturdays. No works are proposed for Public Holidays or Sundays. No deliveries will be allowed outside of these hours.

These proposed hours align with the recommended 'standard hours' for construction endorsed by the EPA. However, some plant may need to be operated or kept in operation to ensure control of odour or containment of materials outside of the standard hours.

Project Specific Noise Management Levels

The Project-specific noise management levels for remediation (construction) works undertaken during the ICNG recommended standard hours and the non-standard hours (any work outside these hours) are presented in Table 9-2 for each logger location. This table also includes the 'Highly Noise Affected Management Level' which applies to residential receptors during standard daytime hours.

All noise management levels are in $L_{Aeq, 15 \text{ minute}}$ noise level values.

Table 9-1: Noise affected management levels

Location	Summary RBL ¹ Values - Measured Existing Noise Levels			Noise Affected Management Levels dB L _{Aeq,15 min} (RBL + 10 dB for standard hours, RBL + 5 dB for non-standard hours)			
	Day (7am to 6pm)	Evening (6pm to 10 pm)	Night (10pm to 7am)	Day		Evening	Night
				Within standard hours ³	Outside standard hours ⁴		
L1	40	39	36	50	45	44	41
L2	35	32	30	45	40	37	35
L3	37	36	32	47	42	41	37
L4	40	39	37	50	45	44	42
L5	37	34	30	47	42	39	35
L6	39	38	30	49	44	43	35
L7	40	35	30	50	45	40	35
L8	41	38	30	51	46	43	35
1. In accordance with the INP, a minimum RBL of 30 dB(A) has been adopted to applicable data to determine the Project-specific noise criteria. 2. Note that the fixed value "Highly Noise Affected Management Level" of 75 dB(A) also applies during recommended standard hours, refer ICNG. 3. Standard ICNG hours - Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, no work on Sundays or public holidays. 4. Non-standard ICNG daytime: Saturday 1 pm to 6 pm, and Public Holidays; Evening: 6 pm to 10 pm and Night time: 10 pm to 7 am (including works before 8 am Saturdays).							

Table 9-2: Noise management levels

Noise logger data	Noise affected management level		Highly noise affected management level ¹
	Standard hours ¹	Non-Standard hours ²	
L1	50	45	75
L2	45	40	75
L3	47	42	75
L4	50	45	75
L5	47	42	75
L6	49	44	75
L7	50	45	75
L8	51	46	75
1. Standard hours - Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, no work on Sundays or public holidays. 2. Non-Standard - Saturday 1 pm to 6 pm, and Public Holidays; Evening: 6 pm to 10 pm and Night time: 10 pm to 7 am (including works before 8 am Saturdays).			

9.3.2 ROAD TRAFFIC POLICY

The Project-specific road traffic noise assessment criteria were developed with due regard to the RNP. The proposed haulage route will follow mostly sub-arterial roads, however local roads were also considered in the assessment.

The RNP road traffic noise criteria for existing residences affected by additional traffic on existing sub arterial roads generated by land use are as follows:

- $L_{Aeq, (15 \text{ hour})}$ 60 dB (external) for the daytime (7 am to 10 pm) assessment period; and
- $L_{Aeq, (9 \text{ hour})}$ 55 dB (external) for the night time (10 pm to 7 am) assessment period.

The RNP road traffic noise criteria for existing residences affected by additional traffic on existing local roads generated by land use are as follows:

- $L_{Aeq, (1 \text{ hour})}$ 55 dB (external) for the daytime (7 am to 10 pm) assessment period; and
- $L_{Aeq, (1 \text{ hour})}$ 50 dB (external) for the night time (10 pm to 7 am) assessment period.

The RNP also presents permissible increases in noise levels above the existing road traffic noise of the area. However, the relative increase criteria are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project. Relative increase criteria are therefore excluded from this assessment which deals with potential temporary impacts associated with construction and remediation work.

9.3.3 CONSTRUCTION VIBRATION

Ground vibration generated by construction can have a range of effects on buildings and building occupants. The main effects are generally classified as:

- human disturbance – disturbance to building occupants: vibration which inconveniences or interferes with the activities of the occupants or users of the building; and

- effects on building structures – vibration which may compromise the condition of the building structure itself.

In general, vibration criteria for human disturbance are more stringent than vibration criteria for effects on buildings. Building occupants will normally feel vibration readily at levels well below those which may cause a risk of cosmetic or structural damage to a structure. However, it may not always be practical to achieve the human comfort criteria. Furthermore, unnecessary restriction of construction activities can prolong construction works longer than necessary, potentially resulting in other undesirable effects for the local community. Construction vibration criteria have been adopted from the following sources:

- Cosmetic and structural damage to buildings: German Standard DIN 4150-3 (German Institute for Standardisation 1999); and
- Human comfort: *Assessing Vibration – A Technical Guideline* (the Vibration Guideline) (DEC 2000a).

Cosmetic and Structural Damage

DIN 4150-3 summarises structural and cosmetic damage assessment criteria for different types of buildings (presented in Table 9-3), which are widely used for the assessment of construction vibration effects on buildings in Australia. The criteria are specified as Peak Particle Velocity (PPV) levels measured in any direction at or adjacent to the building foundation.

Table 9-3: DIN 4150-3 vibration cosmetic and structural damage criteria

Structure type	Peak Particle Velocity (PPV), mm/s			
	Foundation of structure			Vibration at horizontal plane of highest floor at all frequencies
	< 10 Hz	10-50 Hz	50-100 Hz	
Buildings used for commercial, industrial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwelling and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in rows 1 and 2, and are of great intrinsic value (e.g. heritage-listed buildings)	3	3 to 8	8 to 10	8

A search of the NSW Office of Environment and Heritage Register indicates that there are no State Heritage sites identified in the vicinity of the remediation activities.

DIN 4150-3 states that exposing buildings to vibration levels higher than that recommended would not necessarily result in damage. These values are recommended as maximum levels of short-term construction vibration at which experience has shown damage reducing the serviceability of structures will not occur due to vibration effects.

DIN 4150-3 is considered to be suitable for the assessment of both structural and cosmetic damage as it considers a reduction in serviceability of the structure is deemed to have occurred if:

- cracks form in plastered surfaces of walls
- existing cracks in the building are enlarged; and

- partitions become detached from loadbearing walls or floors.

Human Comfort

The ICNG recommends that vibration from construction works be assessed under *Assessing Vibration – a technical guideline* (the Vibration Guideline), consistent with the SEARs issued by DPE.

The vibration assessment criteria defined in the Vibration Guideline are for human comfort and represent goals that, where predicted or measured to be exceeded, require the application of all feasible and reasonable mitigation measures. The Vibration Guideline also defines vibration assessment criteria for continuous, impulsive and intermittent vibration in accordance with the following definitions:

- *Continuous vibration*: continues uninterrupted for a defined period. Applies to continuous construction activity such as tunnel boring machinery.
- *Impulsive vibration*: rapid build-up to a vibration peak followed by a damped decay or the sudden application of several cycles of vibration at approximately the same magnitude providing that the duration is short. Applies to very occasional construction activities that create distinct events such as the occasional dropping of heavy equipment.
- *Intermittent vibration*: interrupted periods of continuous vibration (such as a drill) or repeated periods of impulsive vibration (such as a pile driver).

The majority of construction activities proposed as part of the remediation activities would be expected to be continuous or intermittent in nature.

Table 9-4 presents the management levels for continuous and impulsive vibration at different land uses. The management levels specified are as overall unweighted RMS vibration velocity levels. The Vibration Guideline specifies the management levels as suitable for vibration sources predominantly in the frequency range 8-80 Hz as would be expected for construction vibration.

Table 9-4: RMS velocity management levels for continuous and impulsive vibration

Land Use	Continuous vibration – RMS vibration velocity, mm/s		Impulsive vibration – RMS vibration velocity, mm/s	
	Preferred	Maximum	Preferred	Maximum
Critical areas ¹	0.1	0.2	0.1	0.2
Residences –daytime ²	0.2	0.4	6.0	12.0
Residences – night time ³	0.14	0.28	2.0	4.0
Offices, schools	0.4	0.8	13.0	26.0
Workshops	0.8	1.6	13.0	26.0
(1) Critical operating areas include hospital operating theatres and precision laboratories where sensitive operations are occurring. (2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm. (3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.				

For intermittent vibration, the Vibration Dose Value (VDV) is used as the metric for assessment as it accounts for the duration of the source, which will occur intermittently over the assessment period. The VDV management levels at different land uses for intermittent vibration sources are presented in Table 9-5.

Table 9-5: VDV management levels for intermittent vibration

Land Use	Continuous vibration – RMS vibration velocity, mm/s	
	Preferred	Maximum
Critical areas ¹	0.1	0.2
Residences –daytime ²	0.2	0.4
Residences – night time ³	0.14	0.28
Offices, schools	0.4	0.8
Workshops	0.8	1.6
(1) Critical operating areas include hospital operating theatres and precision laboratories where sensitive operations are occurring. (2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm. (3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.		

Project Specific Vibration Management Levels

To meet the requirements set out in Section 11.4.4 of the RAP, any vibration caused by construction at any residence or structure outside of the Remediation Areas and Staging Site must meet the guidelines set out in the NSW Department of Environment and Conservation (DEC) *Assessing vibration: a technical guideline*, which determines management levels of human exposure to vibration. The RAP also refers to the German Standard DIN 4150 Part 3 *Structural Vibration in Buildings, Effects on Structures*, which outlines vibration management levels regarding structural damage.

Although it is anticipated that the proposed works will not generate vibration to the extent that control measures will be required (as outlined in the RAP), these guidelines have been adopted to aid in the development of adaptive management measures should vibration impacts occur during remediation works.

9.4 EXISTING ENVIRONMENT

9.4.1 SURROUNDING LAND USES

The surrounding land uses of Kendall Bay in relation to the proposed Project activities are described in detail in Chapter 3 Project Location and Context.

9.4.2 MEASURED EXISTING NOISE LEVELS

A total of four environmental noise loggers were deployed during each background noise monitoring survey undertaken during September 2012 and November / December 2013. The location of the unattended noise measurements was determined through opportunistic consent from private landowners within targeted areas surrounding Kendall Bay and the Staging Site. The location of the unattended noise logging locations is shown in Figure 9-1.

Daily noise levels measured at each logging location may be found in Appendix 7. Unattended noise logging charts that visually present the measured existing noise levels and meteorological conditions (which varied during the logging period) in 15 minute samples, for the duration of the logging period are also provided in Appendix 7.

The September 2012 and November / December 2013 logging data is summarised in Table 9-6.

Table 9-6 Unattended environmental noise logging summary values

Location	Summary RBL ³ Values (Measured Existing Noise Levels)					
	ABL ¹ day (7am to 6pm)	ABL ¹ evening (6pm to 10pm)	ABL ¹ night (10pm to 7am)	Leq ² day (7am to 6pm)	Leq ² evening (6pm to 10pm)	Leq ² night (10pm to 7am)
L1	40	39	36	54	51	52
L2	35	32	26 ²	54	49	48
L3	37	36	32	55	53	50
L4	40	39	37	53	50	46
L5	37	34	30	59	54	48
L6	39	38	29 ²	62	64	51
L7	40	35	28 ²	57	52	49
L8	41	38	30	59	53	49

1. ABL Assessment Background Level.
2. Leq Level that represents the equivalent or average noise energy during a measurement period.
3. RBL Rating Background Level.

Based on observations made during the field survey by ERM, the measured noise levels are considered reasonable for the suburban (mostly residential) area under assessment and representative of the existing noise environment at the sensitive receptor locations where compliance is determined.

The summary values are consistent with a suburban area that, as defined in the INP, has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.

As represented in the data, suburban areas often have decreasing noise levels in the evening and night time periods and/or evening and night time ambient noise levels defined by the natural environment and infrequent human activity.

Additionally, it is noted that there has been a substantial amount of construction work within the broader Project Area over the years due to the construction of residential developments such as Breakfast Point and Majors Bay. The proposed remediation works are likely to be of a similar noise character to other construction activities already occurring in the area.

9.4.3 SENSITIVE RECEPTORS

Based on the review of aerial photos of the Project Area and surrounds, and site observations, potentially sensitive receptors were identified as the closest and / or potentially most affected receptors situated in proximity to site noise emission sources.

In each case, nominal assessment heights were selected to represent multi-storey buildings. Site emissions were assessed at each of these locations for each applicable assessment scenario considered.

All assessed sensitive receptors are presented in Figure 9-1 as building outlines. Baseline noise logging and measurement locations and their positions relative to the Project Area are also presented in Figure 9-1.

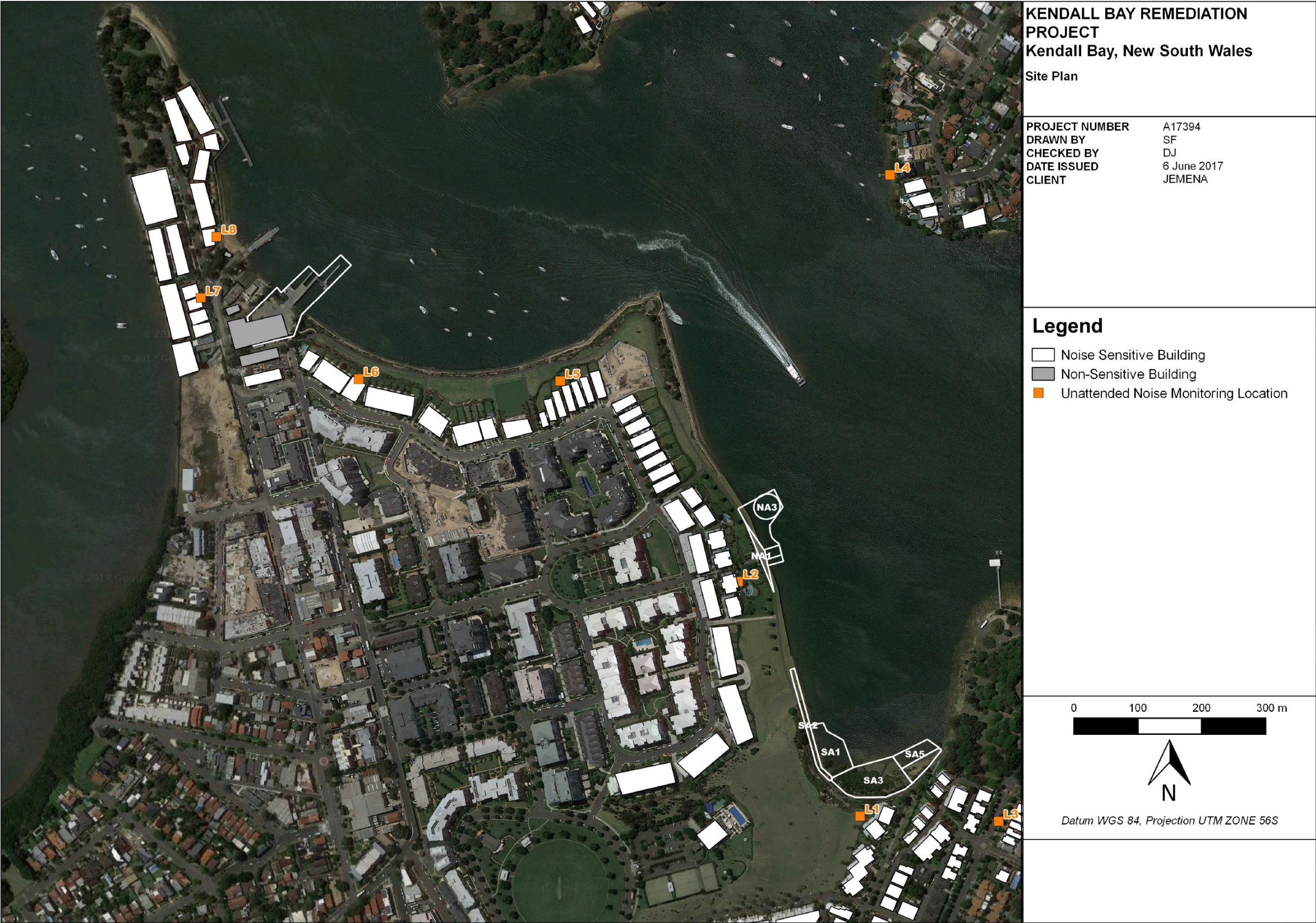


Figure 9-1: Sensitive receptor locations and unattended noise monitoring locations

9.5 STAKEHOLDER VIEWS

Potential noise impacts have been raised as a concern throughout the stakeholder engagement process undertaken for the Project. Community concerns regarding noise are mainly in relation to the hours of operation and whether noise would comply with the relevant guidelines.

While the community is concerned about potential noise impacts during the Project, there is an overriding desire in the community to ensure the bay is appropriately remediated.

9.6 POTENTIAL IMPACTS

9.6.1 SITE WORKS AND REMEDIATION NOISE

Predicted Noise Levels

Predicted $L_{Aeq, 15\text{minute}}$ noise levels are presented in Figure 9-2, Figure 9-3: Worst case cumulative noise level at NA2 + NA3 – sheet piling and Figure 9-4: Staging Site below. These figures are based on the noise modelling data and inputs described above and indicate the worst-case noise levels, including sheet piling installation. All modelled scenarios are contained in Appendix 7. In each case noise levels were predicted for separate works occurring at the Northern and Southern Remediation Areas as well as cumulative noise levels associated with works occurring in each remediation site (Northern and Southern Remediation Areas) concurrently.

Project $L_{Aeq, 15\text{ minute}}$ noise levels associated with the modelled scenarios are below 65 dB(A) at the majority of assessed sensitive receptor locations, with the highest up to 76 dB(A) predicted from sheet piling in Remediation Area NA2. The highest Project noise levels are predicted at receptors situated closest to site noise emissions sources.

All predicted $L_{Aeq, 15\text{ minute}}$ Project noise levels are generally below, and have been determined to comply with the fixed 'Highly Noise Affected Management Level' of $L_{Aeq, 15\text{ minute}} \leq 75\text{ dB(A)}$, with the exception of a potential marginal exceedance for sheet pile installation works at NA2 noted above. It is noted that installation of sheet piling in NA2 and NA3 is currently not proposed but may be included depending on the results of the limited field trial. If undertaken, the installation works would be of limited duration in the context of the overall Project schedule.

These findings indicate that the elevated noise levels generated by Project works will be discernible from other ambient and background noise levels for the most affected receptors. However, given that there has been a substantial amount of construction work within the broader Project Area over the years (i.e. the Breakfast Point and Majors Bay developments, some of which is still under construction), the proposed remediation works are likely to be of a similar noise character to these other construction activities that have already occurred in the area. Therefore, while discernible, the familiarity of the noise from the proposed works in context with other existing noise may lessen the perceived impact of the works. It is noted that by limiting the remediation works to daytime 'standard hours' the potential impact is also lessened.

Figure 9-2, Figure 9-3, and Figure 9-4 illustrate the modelled worst-case scenario cumulative noise contours across the stages of work, some of which may occur concurrently. This information is summarised in Table 9-7, and has been referenced against the various stages of the project duration. The estimated duration of the project phases (and related construction activities) are compared to the predicted noise levels at each receptor location (L1-L8).

Table 9-7: Predicted worst case cumulative noise levels across stages of work

Remediation Area	Stage of Work	Sensitive Receptor Location (Figure 9-1)	Highly Noise Affected Management Level	Noise Affected Management Level ³		Predicted Worst Case Noise Levels ⁴	Estimated Duration of Activity (Approximate Only ⁵)
				Standard Hours ¹	Non-Standard hours ²		
SA1	Stage 1: Sheet piling	L1	75	50	45	65-70	3 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
	Stage 2: Drill rig, mixing plant	L1	75	50	45	55-60	20 Weeks
		L2	75	45	40	Ambient	
		L3	75	47	42	Ambient	
		L4	75	50	45	Ambient	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
	Stage 3: Excavator, transport barge	L1	75	50	45	65-70	4 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
	Stage 4: Bobcat, transport barge	L1	75	50	45	65-70	4 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	Ambient	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
NA2+NA3	Stage 1: Sheet piling (Note: sheet piles may not be required in this area)	L1	75	50	45	60-65	4 weeks
		L2	75	45	40	70-75	
		L3	75	47	42	50-55	
		L4	75	50	45	60-65	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	

Remediation Area	Stage of Work	Sensitive Receptor Location (Figure 9-1)	Highly Noise Affected Management Level	Noise Affected Management Level ³		Predicted Worst Case Noise Levels ⁴	Estimated Duration of Activity (Approximate Only ⁵)
	Stage 2: Drill rig, mixing plant	L1	75	50	45	50-55	14 Weeks
		L2	75	45	40	60-65	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
SA2+NA1	Stage 1: Excavator, transport barge	L1	75	50	45	60-65	12 Weeks
		L2	75	45	40	60-65	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
	Stage 2: Bobcat, transport barge	L1	75	50	45	60-65	12 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
SA3	Stage 1: Excavator	L1	75	50	45	65-70	4 Weeks
		L2	75	45	40	50-55	
		L3	75	47	42	Ambient	
		L4	75	50	45	Ambient	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
	Stage 2: Bobcat, transport barge	L1	75	50	45	65-70	4 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	Ambient	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
SA4	Stage 1: Bobcat, transport barge	L1	75	50	45	55-60	3 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	

Remediation Area	Stage of Work	Sensitive Receptor Location (Figure 9-1)	Highly Noise Affected Management Level	Noise Affected Management Level ³		Predicted Worst Case Noise Levels ⁴	Estimated Duration of Activity (Approximate Only ⁵)
		L4	75	50	45	Ambient	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
		L8	75	51	46	Ambient	
SA5	Stage 1: Excavator transport barge	L1	75	50	45	60-65	2 Weeks
		L2	75	45	40	55-60	
		L3	75	47	42	Ambient	
		L4	75	50	45	50-55	
		L5	75	47	42	Ambient	
		L6	75	49	44	Ambient	
		L7	75	50	45	Ambient	
	Stage 1: Excavator	L8	75	51	46	Ambient	Intermittent activity throughout project for loading and unloading
		L1	75	50	45	Ambient	
		L2	75	45	40	Ambient	
		L3	75	47	42	Ambient	
		L4	75	50	45	Ambient	
		L5	75	47	42	50-55	
		L6	75	49	44	60-65	
		L7	75	50	45	60-65	
		L8	75	51	46	60-65	
1. Standard hours - Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, no work on Sundays or public holidays. 2. Non-Standard - Saturday 1 pm to 6 pm, and Public Holidays; Evening: 6 pm to 10 pm and Night time: 10 pm to 7 am (including works before 8 am Saturdays). 3. Noise Affected Management Levels dB L_{Aeq,15 min} (RBL + 10 dB for standard hours, RBL + 5 dB for non-standard hours) 4. Values obtained from worst case noise level modelling figures within <i>Resonate Noise Impact Assessment, Refer to Appendix 7</i> ([Figure B.1 for SA1, stage 1], [Figure B.2 for SA1, Stage 2], [Figure B.3 for SA1, Stage 3], [Figure B.4 for SA1, stage 4], [Figure B.5 for NA2+NA3, stage 1], [Figure B.6 for NA2+NA3, stage 2], [Figure B.7 for SA2+NA1, stage 1], [Figure B.8 for SA2+NA1, stage 2], [Figure B.9 for SA3, stage 1], [Figure B.10 for SA3, stage 2], [Figure B.11 for SA4, stage 1], [Figure B.12 for SA5, stage1], [Figure B.13 for staging area, stage 1]). 5. Estimated duration is approximate only and subject to change due to ground conditions encountered and weather conditions. The estimated duration is based on current estimated Contractor schedule. Note that some activities are expected to be completed in parallel. Section 4.4 provides an estimate of the overall anticipated timeframe for the Project.							

Table 9-7 illustrates that the majority of receptors will experience little change to ambient noise conditions during the project. Activities close to receptors are likely to result in slightly elevated noise levels above ambient conditions during working hours. The most significant noise impacts will be most obvious to nearby receptors only and will, in general, have durations of three to four weeks. Noise modelling for longer duration activities demonstrates that these are likely to have a lower impact than the short duration activities and are unlikely to be clearly discernible above ambient noise.

9.6.2 HEAVY VEHICLE NOISE

Predicted Noise Levels

The assessment predicted noise levels representative of the closest and / or potentially most affected noise sensitive receivers, at estimated distances of 7.5 metres, 10 metres, 12.5 metres and 15 metres. For the small traffic volumes expected, the predicted levels are below 48 dB LAeq, 15hour and 50 dB LAeq, 1hour.

For receivers at greater distances from road traffic the predicted noise level would be expected to be reduced when compared to the conservative results presented in the Noise Assessment Report (see Appendix 7)

The results presented above indicate that road traffic noise levels associated with the proposed heavy vehicle haulage are below the daytime $L_{Aeq, 15\text{hour}}$ 60 dB (external) criterion and below the $L_{Aeq, 1\text{hour}}$ 55 dB (external) criterion.

It is also important to consider that the intent of the RNP is to limit total traffic noise levels associated with overall road traffic, i.e. existing public road traffic and heavy vehicle haulage road traffic combined. Existing noise levels associated with the public road network will vary depending on the number of public vehicles that travel the road, the mix of vehicles (e.g. car, trucks etc.) and the posted speed limits. Existing noise levels of $L_{Aeq, 15\text{hour}}$ 58 dB(A) and $L_{Aeq, 1\text{hour}}$ 53 dB(A) have therefore been assumed to complete this assessment, both of which are 2 dB(A) below criterion.

Based on the predicted noise levels above, the change to the assumed road traffic noise level would be less than 1 dB, and would also comply with both the daytime $L_{Aeq, 15\text{hour}}$ 60 dB (external) criterion and the $L_{Aeq, 1\text{hour}}$ 55 dB (external) criterion. These findings indicate that the noise impact due to the increased traffic, while including an additional heavy vehicle every hour on average, would be barely discernible from the existing traffic for the most affected receptors. It should be noted that by limiting the remediation works to daytime 'standard hours' the potential impact is also lessened.

9.6.3 CONSTRUCTION VIBRATION

With the exception of sheet piling, the type of plant and equipment in use and remediation activities that are to be undertaken are not of a type associated with vibration-generating events.

Table 9-8 presents typical conservative vibration levels for sheet piling. Predicted vibrations are based on pre-construction vibratory sheet piling tests conducted by Resonate at another site. A conservative factor has been applied to account for the variation in ground conditions between the measurement site and Kendall Bay.

Table 9-8: Typical conservative vibration levels from key construction activities (on ground)

Source	Typical PPV at stated distance, mm/s				
	10 m	20 m	40 m	80 m	100 m
Vibratory sheet piling pre-construction testing	19.9	8.9	4.0	1.6	1.0

The predicted vibration levels presented in Table 9-8 are based on measured levels of ground vibration and therefore care should be taken in comparing them directly to the DIN 4150-3 targets which are relevant to vibration in building foundations. It is common to see reductions in vibration levels of 50% between the ground and the building foundations, due to inefficient transfer of vibration between the two, and therefore the vibration levels above can be considered conservative.

When comparing the predicted PPV values in Table 9-8 with the RMS velocity values associated with human comfort presented in Table 9-4, a factor of 0.5 may be applied (e.g. a predicted RMS velocity of 2.0 m/s at 40 m). This is a conservative approach as based on experience that the RMS velocity can be less than a third of the PPV, depending on the crest factor.

It is noted that the closest residential receiver to proposed sheet piling is approximately 50 m away. At this distance, vibration levels are expected to be less than building damage targets presented in DIN 4150-3, but may exceed management levels for human comfort presented in Table 9-4.

Vibration impacts are expected to be negligible, if any, for the majority of activities proposed and separation distance to the nearest sensitive receivers. Vibratory sheet piling may exceed management levels for human comfort when undertaken within approximately 120 m of the nearest residential receptor however vibration levels are not expected to exceed recommended limits for the prevention of building damage.

9.6.4 UNDERWATER NOISE

Underwater noise may be generated by the operation of excavation equipment, marine vessels and sheet piling, if used. However, it is considered that underwater noise levels will be negligible for the following reasons:

- high ambient underwater noise levels, from the large numbers of motorised craft, masking any underwater noise generated by the remedial works
- the shallow nature of Kendall Bay (generally less than 2.0m) which would prevent the transmission of underwater noise over large distances
- marine fauna that may be impacted are mobile and would avoid the bay area for the duration of the remedial works.

It is considered that impacts of underwater noise on marine fauna would be negligible and that no specific management measures are necessary on commencement of the works.

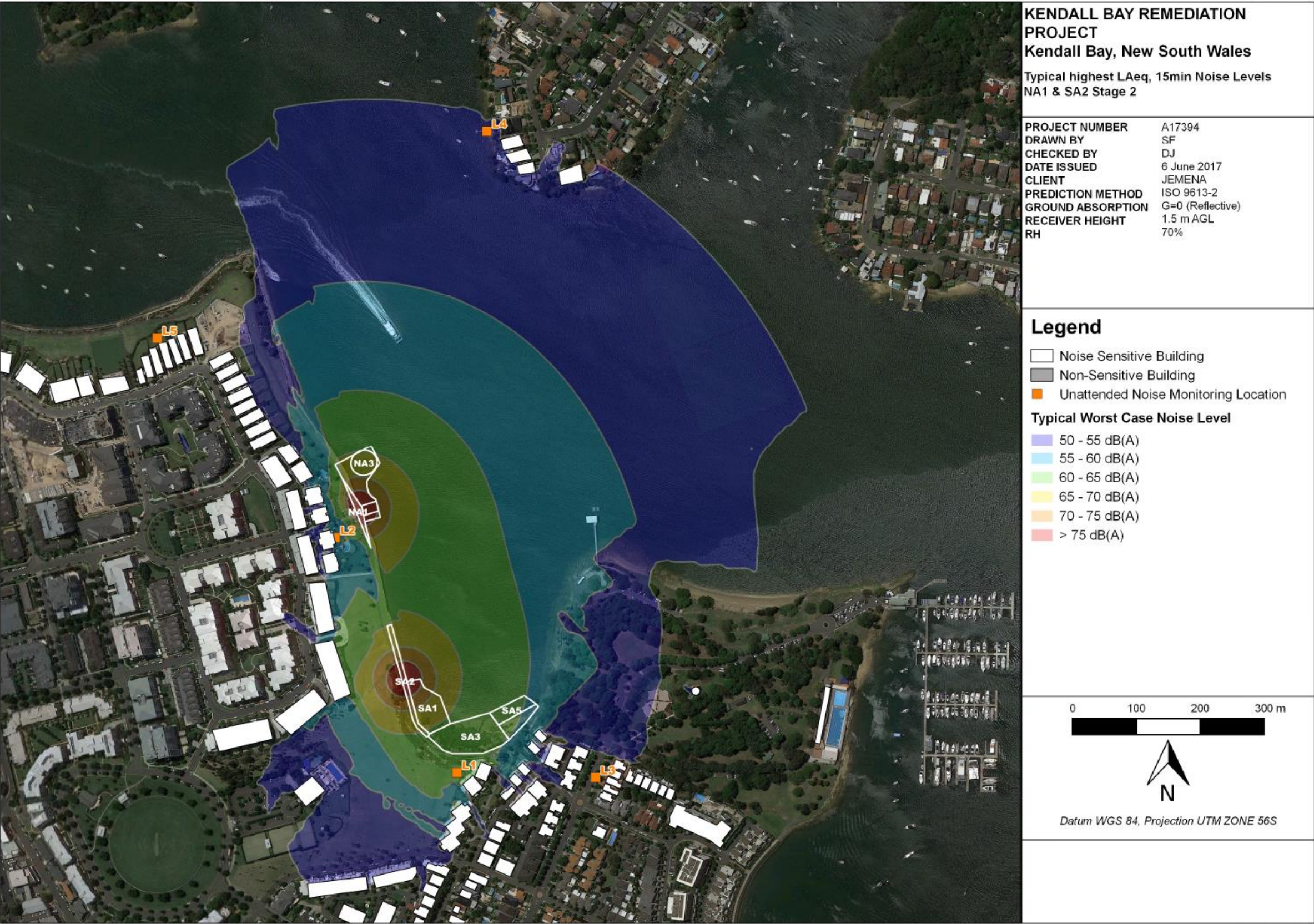


Figure 9-2: Worst case cumulative noise level at Southern and Northern Remediation Areas

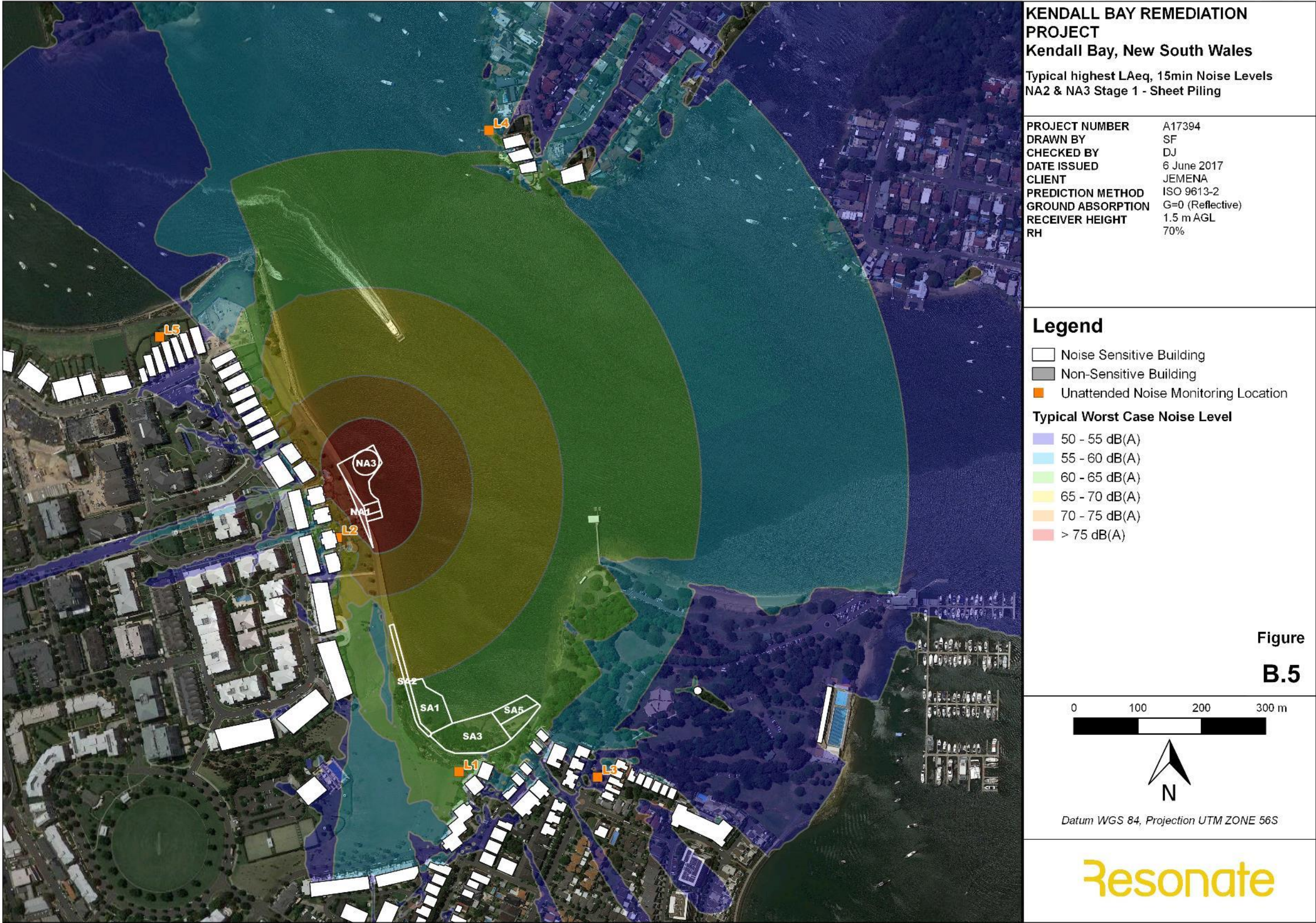


Figure 9-3: Worst case cumulative noise level at NA2 + NA3 – sheet piling

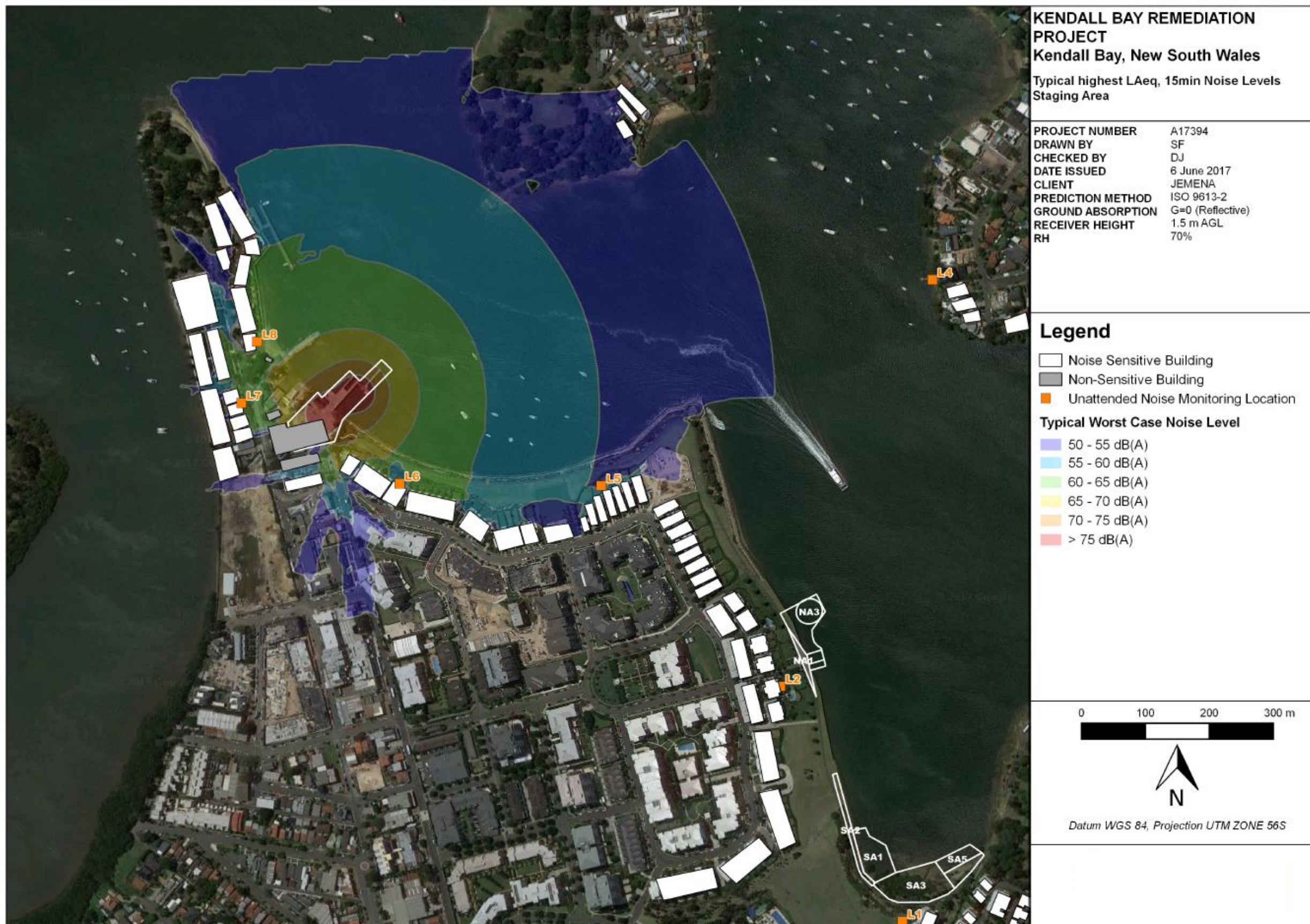


Figure 9-4: Worst case noise level at Staging Site

9.7 CUMULATIVE IMPACTS

The results of the noise assessment identified that the proposed works have the potential to generate impacts at the closest and / or potentially most affected residential receivers in proximity to the site. These impacts are however anticipated to be low and short term (occurring only in certain phases of the Project's duration). It is noted that there are other construction projects within the vicinity of the broader Project Area, such as Majors Bay, however, the cumulative noise impact is anticipated to also be low.

9.8 MITIGATION MEASURES

Noise modelling identified the need to consider noise level reductions associated with normal good practice construction and remediation measures, with a range of measures incorporated into the Project noise model. To ensure noise levels meet those presented in the assessment, Jemena (or the appointed Remediation Contractor) will prepare a Construction Noise Vibration Management Plan (CNVMP) that presents the approval conditions and applicable noise limits, noise control mitigation management measures to be followed and the noise monitoring program to be implemented. Despite limited vibration impacts being anticipated, vibration management measures and relevant criteria will also be outlined in the CNVMP.

Key mitigation measures which Jemena will undertake include:

- site inductions to ensure are personnel are aware of the CNVMP requirements
- negotiate periods of respite with relevant stakeholders in the case of unavoidable maximum noise level events (if identified as required through consultation)
- informing potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as site contact details
- strict adherence to the Project operating times
- use of alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable
- regular inspection and maintenance of equipment to ensure it is in good working order
- where relevant, appropriate and practical, mobile screens or temporary noise barriers may be implemented in proximity to plant and equipment or on the site boundary to reduce noise levels
- instructing truck drivers to limit periods of engine idling, engine revving and use of exhaust brakes
- keeping truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices
- all works, including sheet piling will occur during the daytime period only; and
- 'soft start-up' for each day of remediation works which could potentially create noise and / or vibration impacts i.e. sheet piling. A standardised soft noise period of approximately 5-10 minutes will ensure that marine mammals in the vicinity of the work area will disperse in time for remediation works to commence.

9.9 RECOMMENDED MONITORING

9.9.1 NOISE MONITORING

Noise levels should be monitored by operator attended noise measurements during periods where noise levels are expected to impact the community with the data reviewed by an accredited acoustician at regular intervals. Noise monitoring and measurement should be undertaken with due regard to and in accordance with AS1055 and with due regard to the Noise Management Levels determined in assessment report (Appendix 7).

It is recommended that a review and reporting of data is undertaken periodically for the duration of the Project and results are to be fed back to the Project management team, the construction contractor/s and relevant stakeholders, where necessary. The reports should detail:

- the date and times the monitoring occurred
- remediation activities that were occurring within the site
- the 'Sound Pressure Levels' (LP) recorded, including any exceedances of the Project-specific noise criteria
- Affected and Highly Noise Affected Noise Management Levels specified in this report
- if any exceedances occur, what measures were implemented
- the details of any noise related complaints made during the period; and
- any other information relevant to the consideration of the noise impact on residents or other sensitive receivers.

Noise measurements will be taken using a Type 1 Sound Level Meter set to 'fast' time response and 'A' weighting network as specified. The $L_{eq, 15\text{minute}}$ site contribution is to be determined by the consultant in the absence of any influential sound that is audibly distinguishable and extraneous to the sound from the site. For ground floor receivers, the sound level meter microphone should be placed at a height of between 1.2 metres and 1.5 metres. Where necessary, first and second floor noise levels should be measured at a height of approximately 4.5 metres and 7.5 metres above the ground.

9.9.2 VIBRATION MONITORING

Attended vibration monitoring during sheet piling will be undertaken in response to a complaint, where this is an appropriate response and will be conducted under the instruction of personnel suitably qualified and experienced in undertaking construction vibration measurements.

Where required, attended vibration monitoring at structures will be conducted at the nearest location to the works that is adjacent to the foundations of the relevant sensitive structure. If monitoring cannot be conducted at that location (e.g. access could not be obtained), then a representative location at an equivalent location will be selected.

If required, vibration monitoring may also be undertaken of significant plant to ascertain site-specific buffer distances from works to residential structures. Any vibration monitoring conducted to determine buffer distances will be undertaken on the site and as near to the area in which the equipment is to be used as practical such that the measurements are representative of actual site conditions.

Vibration monitoring will include tri-axial vibration sensors measuring over a frequency range from 1 to 315 Hz, and measurements will be conducted in general accordance with the requirements of DIN 4150-3.

9.10 POTENTIAL IMPACT AND MITIGATION MEASURES SUMMARY

Table 9-9: Summary of potential impacts and mitigation measures

Potential impact	Mitigation and management measures
Noise and vibration impacts on receptors	• Prepare and implement a Construction Noise and Vibration Management Plan (CNVMP) prior to commencement of Project with measures to mitigate noise and vibration impacts • strictly adhere to the following standard construction hours (and City of Canada Bay requirements), which are: – Monday to Friday 7 am to 5 pm – Saturdays 8 am to 1 pm; and – No works on Sundays or Public Holidays. • review of manufacturer's data and where practicable / practical select plant and equipment that achieve Sound Power Levels (L_w) below those used in the assessment • where necessary erect temporary mobile screens • ensure management of construction vehicles (e.g. idling, revving engines, use of exhaust brakes) • conduct noise and vibration monitoring where required • conduct ongoing stakeholder engagement • implement a complaints management plan; and • enforce respite periods if necessary.

9.11 CONCLUSION

Noise modelling based on conservative assumptions, has shown that construction and remediation noise impacts are likely to occur if left unmitigated and without appropriate management actions. However, these impacts are anticipated to be low and can be effectively managed with appropriate mitigation and management measures.

Vibration impacts are negligible, if any, for the majority of activities proposed and for most of the nearest sensitive receptors. Vibratory sheet piling may exceed management levels for human comfort for short periods while sheet piling is being undertaken for receptors within 120m of the noise source. Vibration levels during sheet piling are not expected to exceed recommended limits for the prevention of building damage.

The Construction Noise Vibration Management Plan (CNVMP) prepared by Jemena (or the appointed Remediation Contractor) will incorporate approval conditions and applicable noise limits, noise control mitigation management measures to be followed and the noise monitoring program to be implemented. Although vibration impacts are expected to be negligible, vibration management measures and relevant criteria will also be outlined in the CNVMP.

10. HYDROLOGY

This chapter discusses the potential impacts of the Project on the existing Kendall Bay and Fairmile Cove hydrological processes and outlines mitigation measures to manage these impacts.

The activities associated with the proposed remediation works have the potential to cause the mobilisation of sediment and alteration of the bathymetry as a result of excavation and placement of backfill (i.e. capping layers), as well as modification of the wave and wind climate during, and as a result, of the Project.

10.1 OBJECTIVES AND SCOPE

This chapter is based on the Hydrological Assessment undertaken by RHDHV (2018a) (refer Appendix 8) which describes the estuarine processes within Kendall Bay and the Parramatta River (where applicable) and provides an assessment of the potential impacts as a result of the Project.

The objective of the assessment was to identify management measures that will mitigate the potential impacts of Project activities on hydrological processes, as well as bed and bank stability within the Project Area.

This chapter addresses the following SEARs:

SEARs Requirement – Water Quality and Sediments
- Impacts on surface water and groundwater including potential impacts on bed and bank stability of Kendall Bay and the Parramatta River - Final landform following remediation and suitability of fill

Further information relating to the potential impacts of sedimentation and more general water and sediment quality, is provided in Chapter 11 Water Quality and Sediments.

10.2 ASSESSMENT METHODOLOGY

The hydrological assessment consisted of a detailed review of available information for the Project, a search of relevant published data on current and historical hydrological conditions, as well as a site visit to the respective areas of the Project to observe any key features and characteristics of the foreshore areas.

The assessment draws on previous studies conducted at Kendall Bay and Fairmile Cove, as well as the broader Paramatta River area. The historical studies included specific assessment of varying physical attributes and hydrological processes including:

- a detailed bathymetrical assessment
- a review of wind fetches and the procedures¹ for shallow water wind wave prediction in developing design wind wave conditions for 1 year Average Recurrence Interval (ARI) and 20 year ARI wind speeds

¹ Shore Protection Manual (SPM, 1984) and AS 1170.2 – 2011 Structural Design Actions – Part 2: Wind Action

- a review of the typical magnitude of waves generated by passing boat traffic
- a review of design ocean still water levels for the NSW coast at 2010, 2050 and 2100 (for various ARI events); and
- an investigation into tidal currents including an Acoustic Doppler Current Profiler (ADCP) survey of several transects across the Parramatta River, which included areas of Kendall Bay and Fairmile Cove.

10.3 EXISTING ENVIRONMENT

10.3.1 BATHYMETRY

Kendall Bay is a shallow embayment on the southern foreshore of the Parramatta River. The main channel within the Parramatta River runs across the entrance to Kendall Bay, with channel depths adjacent to the bay ranging between -6.0 metres and -8.4 metres Chart Datum² (CD). The Parramatta River channel has several deeper areas with depths between -16.1 metres CD and -15.6 metres CD between Breakfast Point and Raven Point, and down to -21.1 metres CD opposite Cabarita Point (Figure 10-1).

Within Kendall Bay, the bathymetric levels are typically less than -2 metres CD, with the exception of a -5 metres CD channel extending from the site of the former coal loading wharf on the western foreshore. According to a detailed bathymetry plan of the bay compiled by Hydrographic & Cadastral Survey Pty Ltd in 2014, seabed levels within the Southern Remediation Area range between -0.2 metres CD and +2 metres CD, and -1 metres CD and 0 metres CD within the Northern Remediation Area.

Seabed levels in the area adjacent to the Staging Site and the existing wharf structure proposed for the mooring of vessels, range between -3 metres CD to -3.5 metres CD (Figure 10-1).

² Chart Datum (CD) is approximately the level of Lowest Astronomical Tide (LAT) and is approximately 0.9 metres below Australian Height Datum (AHD).



Figure 10-1: Historical aerial photograph with coarse bathymetry (Source: URS 2006)

The foreshore areas of Kendall Bay are relatively shallow and intertidal with seabed levels above 0 metres CD. At the head of the bay, the foreshore slopes through the intertidal zone at a gradient of approximately 1V:20H (vertical to horizontal) and then flattens to slopes of up to 1V:100H throughout the middle of the embayment.

The rock platform along the eastern side of Kendall Bay transitions to a shallow beach area in the south-eastern corner (Plate 10-1). The sandy bed conditions continue into the eastern side of the stand of mangroves where sediments transition to fine muddy sediments, comprising silty sand with shell and gravel of coal and fill, which exist along the remainder of the western foreshore of the bay.

Existing foreshore protection structures in Kendall Bay and Fairmile Cove include:

- a low sandstone block wall in the south-eastern corner of Kendall Bay which acts as a retaining wall adjacent to the promenade along the foreshore. This structure is terminated by a concrete wall on the eastern side of the mangrove stand (Plate 10-2).
- a revetment behind the mangroves that has been formed by a facing of mortared sandstone blocks (Plate 10-3). This revetment structure has been incorporated into the landscaped terracing up to the level of the adjacent foreshore promenade. The toe of the sandstone revetment is protected by rip-rap generally less than 100mm in diameter, while bricks have been deposited along its base in the south-western corner of the bay.
- a vertical sandstone block seawall which continues along the western foreshore of Kendall Bay to the site of the former coal loading wharf within the Northern Remediation Area (Plate 10-4). Remnants of the demolished wharf structure also exist at this location with rubble and cut off concrete piles visible below the water surface. Angular basalt rip-rap between 50 mm and 200 mm has been placed along the toe of the seawall, with larger material up to 400 mm placed at the location of the former wharf.
- a recently finished sloped rock revetment begins approximately 250 metres south of Breakfast Point, constructed of large sandstone boulders, extending along the north-western foreshore of Kendall Bay (Plate 10-5); and
- a vertical blockwork seawall at the tip of Breakfast Point which has been constructed to retain a terraced pedestrian walkway (Plate 10-6). It continues around the tip of Breakfast Point before transitioning to a sloped rock revetment, which continues along the western foreshore of Fairmile Cove towards the Staging Site (Plate 10-7 and Plate 10-8).



Plate 10-1: View from eastern foreshore to head of Kendall Bay - looking west (Source: RHDHV, 2018a)



Plate 10-2: View from the eastern foreshore to the sandstone wall (Source: JBS&G, 2017)



Plate 10-3: View of sloped revetment behind the mangrove stand (Source: RHDHV, 2018a)

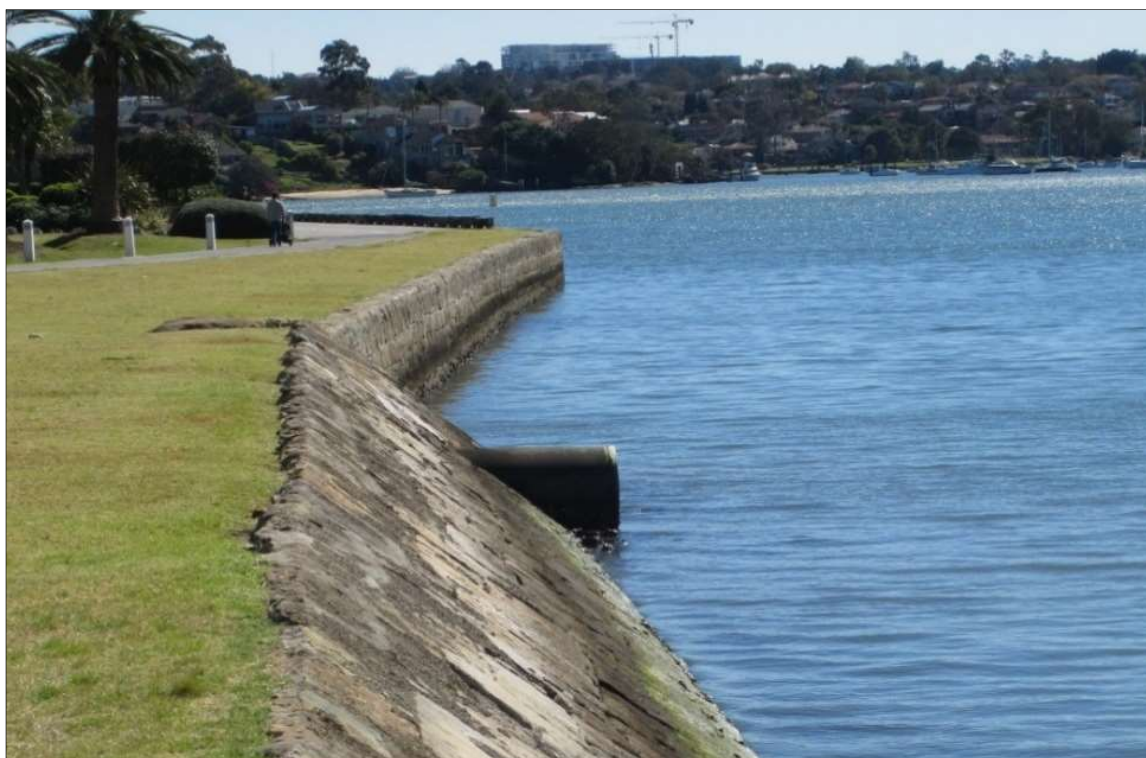


Plate 10-4: Transition between sloped revetment and vertical seawall structure continuing to former coal loading wharf site (Northern Remediation Area). (Source: RHDHV, 2018a)



Plate 10-5: Transition between sandstone block seawall and sloping rock revetment (looking towards Breakfast Point) (Source: RHDHV, 2018a)

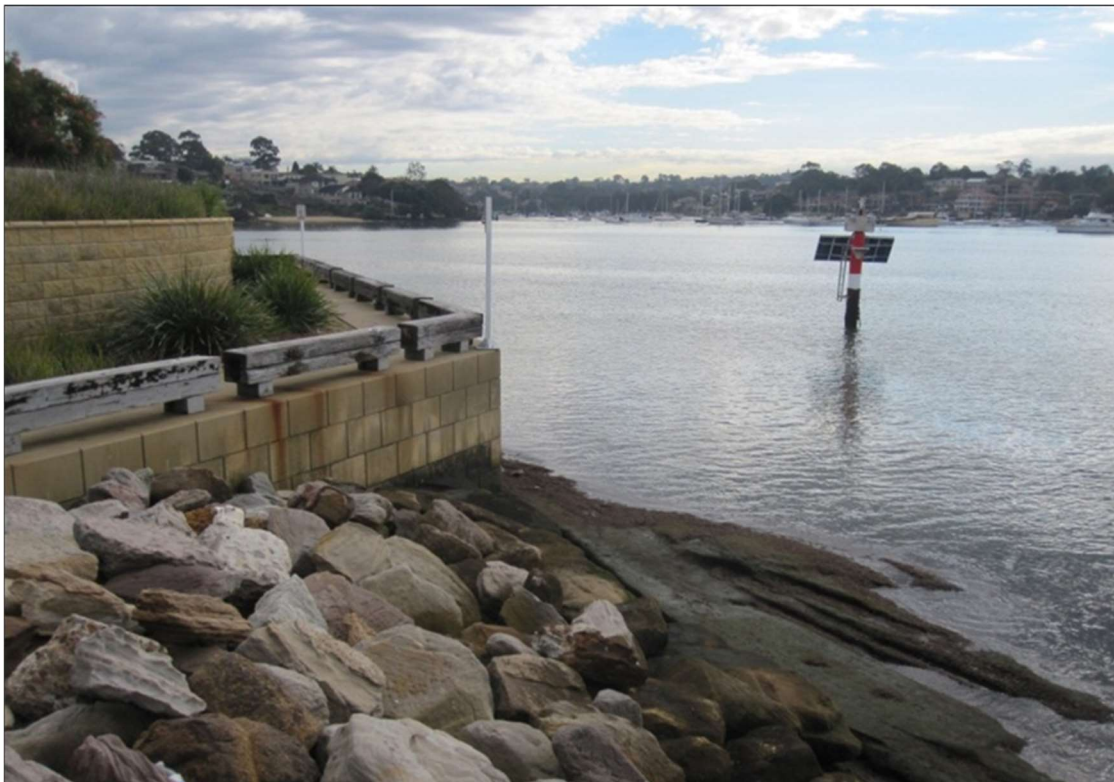


Plate 10-6: Vertical block sea wall at Breakfast Point. (Source: RHDHV, 2018a)



Plate 10-7: Sloped revetment within Fairmile Cove looking towards Breakfast Point. (Source: RHDHV, 2018a)



Plate 10-8: Sloped revetment within Fairmile Cove (looking towards proposed Staging Site). (Source: RHDHV, 2018a)

10.3.2 WAVE CLIMATE

The wave climate within Kendall Bay is influenced by wind waves and boat generated waves.

Kendall Bay is exposed to overwater wind directions (i.e. wind fetches) from the north-north-west and east. The wave climate from wind generated waves has been calculated for different wind directions from within the aforementioned sector, at various locations within the Project Area. The results indicate that a worst-case wind wave would be generated from a north-north-west wind, giving a significant wave height of around 0.56 metres and a peak wave period of approximately 2.15 seconds in the case of a 1 year ARI event³. The corresponding 20 year ARI⁴ wind wave would generate a wave height of around 0.72 metres and a peak wave period of approximately 2.34 seconds.

Waves generated by boat traffic provide a significant contribution to the daily wave climate in the bay due to the ferry services, which run through the main channel of the Parramatta River and pass Kendall Bay a number of times each day. Typical wave magnitude generated by passing boat traffic was reported in a previous environmental assessment for a marina proposal at Breakfast Point (GBAC 2009). Review of the 2016 ferry timetable determined Cabarita Ferry Wharf receives 25,608 ferries annually, which is broadly consistent with the numbers reported by GBAC in 2009. Despite an increase in recreational boat ownership in Sydney Harbour between 1999 and 2009, the main source of generated boat wave within Kendall Bay and Fairmile Cove is expected to be associated with ferry movements.

Although the height of waves generated by passing vessels is similar to that from more regular wind wave events, the wave period generated by the Rivercat and Harbourcat vessels is much longer and would be delivered unattenuated into the bay when these vessels access Cabarita Ferry Wharf, therefore imparting more wave energy into Kendall Bay

10.3.3 WATER LEVELS

Water levels within Kendall Bay vary primarily in response to astronomical tides, although storm surge and freshwater flooding may also influence water levels from time to time. Sea level rise may also have a long-term effect on water levels.

Kendall Bay is subject to semi-diurnal tides (i.e. two high tides and two low tides per day) that propagate along the Parramatta River from the estuary mouth at Sydney Harbour. Predicted astronomical tide levels at Fort Denison, located at the entrance of Sydney Harbour, range from 2.1 to -0.003 metres CD, with mean water levels ranging from 1.51 to 0.39 metres CD reported for Cabarita. High and low tides recorded at Cabarita lag the corresponding high and low tides at Fort Denison by approximately 9 and 7 minutes respectively (MSB 1995).

The combined effect of barometric pressure setup and wind stress setup is referred to as storm surge. Barometric pressure setup refers to the increase in mean sea level caused by a drop in atmospheric pressure, such as when a low-pressure system is centred over an area. Wind stress setup is the increase in mean sea level caused by the 'piling up' of water on a shoreline by wind action acting on the water surface. Design ocean still water levels for the NSW coast, specifically Fort Denison, at 2010, 2050 and 2100 for various ARI events, were derived by DECCW (2010a), as outlined in Table 10-1. These water levels include allowances for astronomical tide, design barometric setup and wind setup, and future sea level rise⁵, but do not include wave setup, which has been considered separately. Given

³ The 1 year ARI wave provides an indication of conditions that may occur at least once during the Project duration.

⁴ The 20 year ARI wave represents the design condition for 'temporary works' in accordance with Australian Standard AS 4997 – 2005 Guidelines for the Design of Maritime Structures.

⁵ The values adopted for sea level rise between 2010 and 2050, and 2010 and 2100, were 0.34m and 0.84m respectively and remain suitable for adoption for current planning purposes.

the similarity of the tidal levels between Cabarita and Fort Denison, these values are considered applicable for the Remediation Areas and Staging Site.

Table 10-1: Design still water levels at Fort Denison

Average recurrence interval	2010		2050		2100	
Years	m AHD	m CD	m AHD	m CD	m AHD	m CD
0.02	0.97	1.90	1.31	2.24	1.81	2.74
0.05	1.05	1.98	1.39	2.32	1.89	2.82
0.1	1.00	1.93	1.44	2.37	1.94	2.87
1	1.24	2.17	1.58	2.51	2.08	3.01
10	1.35	2.28	1.69	2.62	2.19	3.12
50	1.41	2.34	1.75	2.68	2.25	3.18
100	1.44	2.37	1.78	2.71	2.28	3.21

Wave setup at the shoreline is approximately 10-15% of the breaking significant wave height. For the worst case 20 year ARI wind wave conditions the wave setup is estimated to be between 0.09 metres and 0.13 metres. For the worst case 1 year ARI wind wave conditions the wave setup is estimated to be between 0.07 metres and 0.10 metres.

The Lower Parramatta River Flood Study (PWD 1986) and subsequent study update (SKM, 2005), reported that flood levels between the Silverwater Bridge and Ryde Bridge (downstream limit of the study area) were determined by the adopted storm tide level, and concluded that flood levels were not influenced by river discharge.

10.3.4 CURRENTS

Currents within Kendall Bay and surrounding areas are generated by several processes that include tides, freshwater flows, wind, boat wash and stormwater inflows.

Water velocities in areas including Kendall Bay and Fairmile Cove are generally low and complex during high (slack) tide with velocities less than 0.2 metres per second (m/s) (URS 2008). During the peak ebb tide, currents of up to 0.7 m/s were measured in an east-south-east direction off the end of Breakfast Point and were expected to be of a similar magnitude during flood tides.

Tidal currents were observed to be largely confined to the main channel through the Parramatta River and the higher velocity ebb tide currents recorded off Breakfast Point did not extend into the shallow waters of Kendall Bay. Tidal currents within Kendall Bay were generally recorded between 0.2-0.3 m/s on the ebb tide. Ebb tide currents within Fairmile Cove were around 0.15 m/s.

Currents resulting from freshwater flows are expected to be confined to the main channel of the Parramatta River and would not exceed peak tidal flows.

Wind induced and boat wash currents vary with depth, with currents at the bed calculated to range from 0.57 m/s (wind induced) and 0.63 m/s (boat wash) at a water depth of 1 metre, to 0.11 m/s to 0.27 m/s respectively at a depth of 3 metres. The previous assessment (URS 2006), concluded that near bed currents induced by wind waves and Rivercat wake are capable of disturbing the bed of Kendall Bay.

The stormwater outlets flowing into Kendall Bay have the potential to generate localised currents from the entry of strong freshwater flows into the shallow water environment of Kendall Bay. The large stormwater 1,650 mm diameter pipeline (Plate 10-9) behind the mangroves at the head of Kendall Bay incorporates erosion control structures, and under low flow conditions a shallow incised channel was

observed leading from the outlet (Plate 10-10). During a site inspection after a major storm event, significant erosion of the channel sediments was observed along the channel between the outfall and the shoreline, including excavation of pools more than 0.6 m deep and 2-4 m long. No evidence of localised erosion or scour protection measures were observed at other outlets during the site investigation, most notably two medium sized drains within Remediation Area SA4, these include:

- A 450 mm diameter outlet located towards the eastern edge of the beach, owned by the Council, which receives runoff captured from road drainage at the northern end of Cabarita Road and other surface inlet pits located in adjacent parkland areas (Plate 10-11); and
- A 670 mm diameter outlet located in the middle of the beach, that is privately owned, which receives runoff from the adjacent residential development known as Kendall Inlet (Plate 10-12).



Plate 10-9: 1650 mm stormwater outlet at the head of Kendall Bay (Source: JBS&G 2017)



Plate 10-10: Shallow channel leading from 1650mm stormwater outlet. (Source: RHDHV 2018a)



Plate 10-11: 450mm diameter stormwater outlet within Remediation Area SA4. (Source: RHDHV 2018a)



Plate 10-12: 670mm diameter stormwater outlet within Remediation Area SA4. (Source: RHDHV 2018a)

10.3.5 SEDIMENT TRANSPORT

Currents generated by wave action from existing vessel traffic, as well as wind from the north-west to the east, are considered to be capable of mobilising bed sediments. This is evidenced by the planform distribution of sediments where wave action at the shoreline margins has caused finer sediments to be removed and carried offshore and deposited in the deeper, lower energy environment, leaving behind a sandy beach. Wave action, particularly from Rivercats and Harbourcats, which is of longer wave period, is also capable of transporting sand sized material alongshore in the shallow littoral zone.

Currents from tides and freshwater flooding are very low in magnitude, and are not considered to have any significant influence on sediment transport within Kendall Bay.

A review of historical aerial photographs (Plate 10-13) and the Parramatta River Estuary Data Compilation and Review Study (Cardno Lawson Treloar 2008) suggest that the rates of sedimentation within subtidal areas of Kendall Bay, away from the immediate vicinity of stormwater outlets, are likely to be variable and lie in the range of 5 to 15 mm / year.

10.3.6 GROUNDWATER

The main rock type present at Kendall Bay is the Hawkesbury Sandstone, although a small patch of Ashfield Shale is present in the south-western corner of the Breakfast Point site (Dames and Moore 1996). The original Mortlake gasworks site was greatly enlarged by reclamation up to the 1940s, while Quaternary alluvium occurs in and near Kendall Bay as a result of sediment deposition.

Groundwater flow regimes were well understood prior to the Mortlake Rehabilitation Project being completed. The RAP states that a more uniform groundwater flow would now exist at the Breakfast Point redevelopment site, compared to the modified groundwater flow regime associated with local historical recharge sources from the former gasworks. However, the overall groundwater flow direction is expected to remain the same, with discharge occurring to Kendall Bay within the Remediation Areas.

Ongoing groundwater monitoring conducted at the Breakfast Point site, targeting the key areas of residual contamination located on the site, indicated that while some contaminants remain within the groundwater, monitoring has not identified any significant issues with residual gasworks-related contamination remaining on the site. Monitoring reports are made available to the EPA from time to time, and the status of the site/monitoring is covered in periodic discussions between Jemena and EPA staff.

Groundwater levels in the fill at Breakfast Point are maintained by recharge from onsite rainfall, and is considered to be locally 'perched' above the regional water level in the bedrock. Groundwater levels in the foreshore wells at the Breakfast Point site were historically less than mean sea level, and were observed to fluctuate according to local tidal levels.

Porewater exists within the depositional alluvial material, clays and sands (described in detail in Chapter 11), which has been deposited on top of the sandstone bedrock. While groundwater is inferred to exist beneath the proposed Remediation Areas, for the purpose of this assessment, it is anticipated that interaction with the regional groundwater aquifer will not occur (as excavation into the sandstone rock, and therefore the regional aquifer, is not proposed).



Plate 10-13: Aerial photographs of Kendall Bay in 1943 (left) and 2015 (right)

10.4 STAKEHOLDER VIEWS

The final bathymetry of the respective Remediation Areas has been a recurring concern from the Community Liaison Group, specifically the relationship between the importation of fill material relative to the excavated material. As described below, the final bathymetry is not anticipated to change considerably, with the excavated material typically replaced with clean imported material. The final bathymetry will be surveyed, with information made available to the public where requested.

An additional concern from the Community Liaison Group, and the broader community consultation, was associated with the geotechnical stability of the seawall within the Northern Remediation Area. As outlined below, the proposed remediation methodology includes the use of specific equipment within the vicinity of the sea wall, as well as a staged approach to excavation and backfilling. The seawall integrity will be constantly monitored during the course of the Project, with monitoring results compared to a dilapidation geotechnical survey completed at both the start and completion of the Project.

10.5 POTENTIAL IMPACTS

The Project has the potential to impact upon each element of the hydrological environment within Kendall Bay and Fairmile Cove as described above. The potential impacts and proposed mitigation measures are discussed below and summarised in Table 10-2.

10.5.1 BATHYMETRY AND SHORELINE MORPHOLOGY

Remediation activities will modify seabed levels in areas in the Southern and Northern Remediation Areas as part of the excavation of contaminated materials, however in the majority of remediation areas this will be temporary. The works in Remediation Area SA4 will involve raising beach levels in the south-eastern area of Kendall Bay by around 0.3 m. Remedial work within SA1, SA2 and NA1 will involve removal of the upper sediment layer and reinstatement to LAT.

Stained rock / rubble and sediments adjacent to existing seawall structures at Remediation Areas SA2 and NA1 are proposed to be removed, with careful excavation techniques adopted to avoid removal or damage to seawall foundations.

Piling associated with the installation of silt curtain enclosures and sheet pile walls will interact with the seabed and some localised scour may occur on the seabed outside of the Remediation Areas around the piles due to tidal currents and wave action.

The shallow draught requirements of the intertidal areas of Kendall Bay will largely determine the selection of floating plant and equipment and it is expected that dredging adjacent to the existing wharf facilities at the Staging Site will not be required to accommodate construction vessels.

10.5.2 WAVE CLIMATE

The wave climate within Kendall Bay is relatively benign in maritime construction terms, however Kendall Bay is regularly subjected to boat wake waves from passing Rivercats and periodically exposed to wind waves from the north-west to east sector. This has the potential to impact temporary structures, including piling used for installation of silt curtain enclosures, sheet pile walls for environmental management (Remediation Areas SA1 and potentially NA2+NA3), and anchoring / mooring of floating equipment. Waves interacting with the outer face of the sheet pile wall enclosures and reflected waves interacting with incoming waves have the potential to disturb bed sediments and cause localised scour along the toe of the sheet pile walls particularly during low tide conditions.

The temporary lowering of the bed levels within the Remediation Areas would be expected to cause waves to penetrate further into Kendall Bay before breaking. In Remediation Area SA1, SA2 and NA1 the bed levels will be permanently lowered to LAT which will likely result in greater wave penetration into the south-western corner of the bay. Shoreline impacts would be mitigated by the existing seawall along the western side of the bay, however the sand shoal forming substrate for mangroves growing at the head of the bay would be subject to increased wave action.

The boating traffic associated with the construction activities will temporarily increase the frequency of boat wake wave generation adjacent to the foreshore areas between Kendall Bay and the Staging Site. However, this entire length of shoreline is protected by existing seawall structures that would mitigate the impact of increased exposure to wave energy.

10.5.3 WATER LEVELS AND GROUNDWATER

Water level is an important consideration in the design of temporary structures required to undertake the remediation works. The performance of silt curtains around the perimeter of the works may be potentially affected by tidal variation. The shallow intertidal environment within Kendall Bay relative to tidal range means that there would be a tendency for the silt curtain to 'bunch up' at low tide. The

collapsed curtain at low tide may become partially buried by nearshore sediment movement as the tide rises and this can weigh the curtain down, preventing it from floating and performing its function as a continuous barrier.

Given the shallow and intertidal nature of the bathymetry in Kendall Bay, access to areas of the site with floating plant is likely to be restricted by tidal movement which will require particular activities to be scheduled at high tides (e.g. silt curtain pile installation).

The integrity of the seawall within the Southern Remediation Area SA2 may become compromised by hydrostatic uplift pressures from surrounding groundwater levels as a result of the in-situ stabilised raft slab within Southern Remediation Area SA1.

In general, although the works would need to accommodate water level variation, the construction activities associated with the Project would not have any measurable impact on local water level variations elsewhere within Kendall Bay and the Parramatta River due to the very small size of the Remediation Areas relative to the scale of the Parramatta River and Sydney Harbour as a whole.

10.5.4 CURRENTS

Currents within Kendall Bay and Fairmile Cove are not expected to adversely affect the efficiency of floating plant and equipment in execution of the proposed construction methods due to their low magnitude. The higher magnitude tidal currents off the end of Breakfast Point that may be experienced by floating plant in transit are relatively benign in maritime construction terms. Towed barges and other work boats regularly ply the Parramatta River without difficulty.

Near bed currents induced by wind waves and Rivercat wake are capable of disturbing the bed of Kendall Bay, as was concluded in a previous assessment undertaken by URS (2006). Although the primary and secondary silt curtains will provide attenuation of wave energy from wind waves, wake from Rivercats may still penetrate to the shoreline at each Remediation Area. Any potential disturbance of bed sediments within the Remediation Areas would be contained within the silt curtain enclosures, while disturbance of bed sediments outside of the Remediation Areas will not be contained.

The process of constructing sheet pile wall enclosures is likely to cause temporary changes to the flow of tidal waters around the barriers formed by sheet pile walls. In particular the speed of tidal currents passing through the enclosures will accelerate as water flows are concentrated through increasingly narrow entrances, potentially resulting in scouring and mobilisation of contaminated bed sediments.

Project-related floating vessels operating during the construction period will increase the level of boating traffic within the shallow waters of Kendall Bay, resulting in bed sediments being more frequently subjected to currents generated by boat wake waves and wash from propellers. As noted above, disturbance of bed sediments within the Remediation Areas will be contained within the silt curtain enclosures. Bed sediment disturbed by the movement of vessels outside the silt curtains could be transported by prevailing tidal or wind-induced currents.

There are several stormwater outlets within Kendall Bay that have the potential to generate localised currents from their discharge, which could cause scour of sandy bed materials in Remediation Area SA3 and SA4. In Remediation Area SA3, the large 1650mm diameter outlet at the head of the bay has the potential to create a scour channel extending into the proposed beach nourishment area created within SA4. The 670mm diameter stormwater outlet may discharge across the SA4 beach area during times of heavy rainfall, creating a scour channel and deposition of debris and rubbish from the catchment.

While the existing 450mm outlet within Remediation Area SA4 discharges over the foreshore area, it is located immediately behind a mangrove tree which has a root mass that would provide resistance against stormwater flows. Given the mangrove tree is proposed to be retained, and in light of the existing mangroves which have proven to be resilient to stormwater flows, particularly in Remediation Area SA3

where the large 1650mm diameter outlet discharges through a stand of mangroves, it is considered that the outlet would not significantly impact on beach amenity.

Since the seabed will generally be restored to at or slightly below its pre-remediation level, the proposed works would not have any adverse long-term impact on currents within the bay. Deepened remediation areas (e.g. SA1, SA2, NA1) may experience a minor reduction in current velocities, however natural infilling of these areas over time will act to smooth out bed contours and restore existing hydraulic conditions. However, the lowering of bed levels in Remediation Area SA1 may result in greater wave penetration into the south-western corner of the bay and increased exposure of sand shoals around the western perimeter of the mangrove area to currents from wave action.

10.5.5 SEDIMENT TRANSPORT

The proposed remediation works would have a temporary impact on sediment transport processes associated with potential cross-shore and a longshore movement of sediments by wind or boat wake wave action. This will be localised to the Remediation Areas where removal of bed material is proposed and would be limited to the period before the capping layer is placed. Some minor infilling within the deepened Remediation Areas by sediment mobilised from adjacent areas may occur prior to placement of the capping material, however this is not expected to adversely impact on the required excavation profile (i.e. it will not create a significant amount of additional excavation).

Installation of sheet pile walls in remediation areas SA1 (and NA2+NA3 if determined necessary following the field trial) is also likely to cause a temporary disruption in sediment transport processes.

The physical action of in situ cement solidification and excavation within Remediation Areas SA1 and NA2 / 3 by hydraulic and mechanical means will mobilise bed sediments into suspension within the water column. However, the transport of these sediments outside of these Remediation Areas will be prevented by the sheet pile wall and silt curtain enclosures. Some temporary reduction in sediment transport may occur in the lee of the floating (secondary) silt curtains due to the attenuation of wind waves and shorter period boat wake.

The imported capping material is expected to be more stable than the pre-existing muddy bed sediments, particularly in the deeper water offshore of the shallow intertidal beach areas. In deeper water, it is expected that the muddy sediments brought down the Parramatta River during freshes / floods, would accumulate and form a thin veneer of sediment above the capping material over the longer term, as side bays such as Kendall Bay are generally depositional environments.

Within Remediation Area SA4, wave action may lead to minor modifications to the existing beach profile and/or loss of sand offshore under wave action, while the existing 670 mm diameter stormwater outlet may potentially impact on beach amenity as a result of ongoing scour.

10.6 CUMULATIVE IMPACTS

While areas of the bay within both Remediation Areas will be modified by the remedial works, the variations in seabed morphology are likely to equilibrate as natural sediment deposition processes return to normal, infilling any voids left on top of the capping layers. The exception to this is within Remediation Areas NA2 and NA3 where seabed depth may be reduced (see Section 10.7.1), and within Remediation Area SA4, where beach levels will be raised by around 0.3 metres.

With respect to Remediation Areas NA2 and NA3, the potential reduction in seabed depth may impact vessel passage in this area. It is noted that the existing hazard to navigation posed by the mounded seabed in the former wharf area is already identified by a cardinal mark, which will remain in place to alert boaters of the shallow inshore depths following completion of the remediation works. With respect

to Remediation Area SA4, the residual impact will be positive, providing enhanced amenity to local beach users and residents.

The existing sandstone wall in Remediation Area SA4 will be extended to reduce scouring associated with stormwater runoff. As a result, eastward-migrating stormwater flows running alongside the extended wall may cause localised scour and undermining of the structure. Installation of spur walls within SA3 and an energy dissipation structure in SA4 are proposed to mitigate the potential for scouring of beach sands adjacent to stormwater outlets (discussed further in Section 10.7.4).

No cumulative impacts associated with hydrology are expected at the Staging Site.

10.7 MITIGATION MEASURES

10.7.1 BATHYMETRY AND SHORELINE MORPHOLOGY

Temporary depressions on the seabed caused by the removal of excavated material will generally be filled with capping material to a target finished level at or slightly below pre-remediation bed levels. In Remediation Area NA2+NA3 where penetration of hard surfaces over the footprint of the former coal wharf may not be possible, a capping layer of cobbles/sand will be placed over the top of the existing mounded area to provide substrate for re-establishment of viable benthic communities. This may lead to a slight raise of bed levels by 200-300mm in some areas.

Seabed material scoured due to tidal currents and wave action in the vicinity of sheet pile walls will likely be deposited in close proximity to the alignment of piling until the piles are removed and the natural sediment movement processes will infill localised depressions (see Section 10.7.2 below).

Key measures that will be implemented to ensure that the target bed levels in each Remediation Area are able to be achieved and the thickness of the cap is maintained include:

- provision of GPS and other depth survey equipment on work barges to measure bed levels throughout excavation and capping placement activities
- bathymetric survey (supplemented by land-based survey in shallow areas) to determine pre and post excavation levels, and finished capping levels and verification of capping layer thickness by comparison of pre and post capping surveys
- underwater photography using a drop camera and diver inspections at high tide and photographic records of foreshore and shallow areas taken at low tide
- sizing of the granular capping material that is stable under the action of currents from wind waves and regular boat wake waves from passing ferries
- specification, sampling and testing of rock capping material properties to provide required durability for use in the marine environment; and
- implementation of a Site Management Plan (SMP) for any ongoing monitoring and management of Remediation Areas required following completion of remediation works.

Key measures to manage the risk of seawall damage include:

- geotechnical stability assessment to identify any existing seawall instability and possible repair works (if required) to be completed prior to commencement of remediation activities
- preparation and implementation of an Excavation Management Plan
- toe apron slabs or rock fill which forms a layer to support the toe of seawalls will not be removed

- excavation along the toe of seawalls in limited lengths of maximum 10 metres followed by placement of capping material before the adjacent excavation is started
- visual monitoring (conducted daily) of seawall for signs of instability during the works; and
- completion of pre-remediation and post remediation dilapidation surveys.

10.7.2 WAVE CLIMATE

Temporary lowering of bed levels is expected to have minimal impact on the foreshore of Kendall Bay as it is protected with existing seawall structures. In some areas this situation would only occur temporarily before capping material is placed and pre-existing seabed levels are restored.

Plant and construction methods will be readily available to operate efficiently under the ambient wave conditions. Silt curtain enclosures installed around work areas are expected to attenuate wind waves and boat wake from smaller vessels having short wave periods (i.e. excluding ferries, Rivercats and Harbourscats) to some degree.

Temporary structures such as sheet pile walls around remediation areas SA1 (and potentially NA2 + NA3 if sheet piling for those areas is required), piling for silt curtain enclosures and anchoring / mooring of floating equipment will be designed to accommodate wave action. In accordance with AS 4997-2005, temporary structures presenting a low degree of hazard to life or property will be designed to withstand wave loads associated with a 20 year ARI wave condition. This wave height will be the average of the highest 1% of all waves in the design event and, in the case of wind waves, is determined by multiplying the significant wave height by a factor of 1.5 (for short narrow fetch).

Localised scouring caused by wave action interacting with the face of the sheet pile wall enclosures will be allowed for in the design of these temporary structures. It is expected that once the sheet piles have been cut-off at an elevation of lowest astronomical tide (LAT) at SA1 (and at seabed level if used in NA2+3) following remediation activities, natural sediment movement processes would infill any localised depressions, resulting in minimal longer term significant changes to seabed levels.

Monitoring of the western area of mangroves will be undertaken during the remediation works to identify loss of sand from the shoal and/or undermining of mangroves. Protection of the batter slope from the mangrove area (SA3) to the depressed area of SA1 may be required to mitigate against erosion although rip-rap already exists in the vicinity of this area at the toe of the seawall immediately adjacent to the mangroves.

The capping material for SA1, SA2, NA1, NA2 and NA3 has been selected as a cobble sized rip-rap blanket so as to be stable in the local wind wave and boat wake climate, thereby ensuring its longevity. The performance requirements and basis for the capping design to achieve the required durability and robustness over an extended period of time are documented within the Remediation Action Plan. The capping design is also subject to the future detailed design phase and refinement by the remediation contractor (to be provided in the Remediation Works Plan).

10.7.3 WATER LEVELS AND GROUNDWATER

Potential issues with the rise and fall of floating silt curtains within the intertidal zone will be mitigated by fixing (draping) the curtains to a series of poles or piles leading out from the foreshore until deeper water is reached and a floating barrier can be better accommodated. In addition, the silt curtain will incorporate a tidal compensating system that allows the boom at the top of the silt curtain to float up and down with the tide due the sliding action of floating rings fitted around each pile (see Figure 10-2). This concept is considered to be a suitable example of a method to accommodate tidal water level variation, although other options may be considered in the detailed design phase. A similar piled system will be employed for the portion of the secondary silt curtains running through intertidal areas. Sheet piles will also assist control in shallow areas of Remediation Area SA1.

In deeper areas, secondary silt curtains may comprise a geotextile skirt with a floating boom held in position by a typical system of anchor blocks and restraint lines.

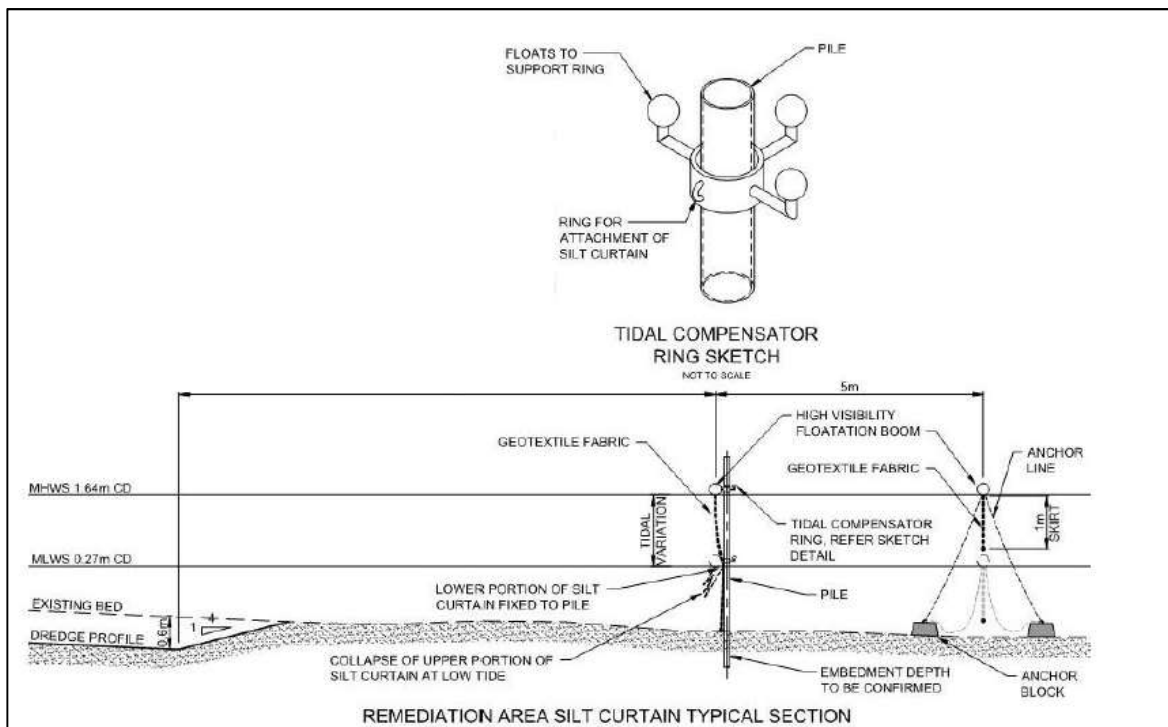


Figure 10-2: Tidal compensator ring system for silt curtains

Due to access restrictions associated with the shallow and intertidal nature of the bathymetry in Kendall Bay, consideration will be given to scheduling particular activities at high tides (e.g. silt curtain pile installation).

The construction of a five metre buffer adjacent to SA1 will allow hydrostatic uplift pressures from surrounding groundwater levels to be released rather than being applied to the base of the mass solidified layer within SA1 or the base of the seawall. As a precautionary measure, remediation of SA2 is proposed to be undertaken after SA1 so that any unintended mass solidified buffer material from SA1 will be excavated and replaced with capping material.

10.7.4 CURRENTS

Measures proposed to mitigate seabed scour resulting from concentration of tidal flows during installation of sheet pile enclosures include:

- completing final sections of sheet piling as quickly as practicable
- consider scheduling final stages of sheet pile wall construction during a neap tide (i.e. lower tidal range and currents)
- provision of ports or slots through sheet pile walls to limit concentration of tidal flows during installation

To minimise unnecessary disturbance of the bed by construction traffic both inside and outside silt curtain enclosures the following additional mitigation measures are proposed:

- enforcement of speed restrictions on construction vessels (note that an existing 4 knot zone is already enforced west of Breakfast Point and the RMS Boating Map for the Project Area states that a speed limit of 4 knots must be observed within 100 metres of any dredge, floating plant, ferry or punt working with chains and wires); and
- manoeuvring of non-propelled vessels will be undertaken using winches and cables wherever possible within the shallow waters of Kendall Bay in preference to the use of engine propulsion.

To mitigate potential scour of the replenished beach area in Remediation Area SA4 associated with the large 1,650 mm diameter outlet, remediation works include an extension of the existing sandstone wall. Eastward-migrating stormwater flows running alongside the extended wall may cause localised scour and undermining of the structure. To address this issue, stormwater flows are proposed to be redirected away from the wall by the installation of a series of spur walls along an alignment through the mangrove area as part of remediation works completed in SA3. These low-level rock mound structures would train stormwater discharge away from the wall extension whilst allowing the flow to spread over the sand shoals without scouring a deep channel.

To mitigate potential scour channels and the deposition of debris associated with the 670 mm stormwater outlet, one or a combination of the following management options will be implemented:

- diversion of the outlet to a location further to the east, where stormwater could discharge out on to the existing rock platform
- installation of a gross pollutant trap(s) (GPT) upstream in the system; and
- construction of an energy dissipation structure at the outlet (e.g. rock blanket).

Installation of an energy dissipation structure is currently considered the preferred option.

Based on the minor modifications to the sea bed depth, wave penetration into western perimeter of the mangrove area will be monitored during the remediation works to assess the exposure of the sand shoals associated with wave penetration. Impacts could be mitigated if required, by the provision of rock rip-rap protection over affected areas, which already exists in the south-western corner of the bay.

10.7.5 SEDIMENT TRANSPORT

The primary and secondary silt curtains will act to mitigate mobilised bed sediments within the water column. The effectiveness of the silt curtain enclosures to contain turbidity generated inside remediation areas will be maintained with the implementation of a water quality monitoring program and an inspection and maintenance program for the silt curtain structures.

Sheet pile wall enclosures in remediation areas SA1 (and potentially NA2 + NA3) will also provide environmental control during remediation activities and mitigate the infilling of excavated areas. Cutting off the sheet pile walls at LAT for SA1 (and seabed level if used in NA2+3) at the completion of works would restore natural sediment transport processes post-remediation.

Within Remediation Area SA4, readjustment of the beach profile and/or loss of sand offshore under wave action will be minimised by ensuring that the grading of the imported sand material is compatible with the existing beach sand and placed at the same slope and planform alignment. The beach sand will be retained by the proposed extension of the existing sandstone wall located on the western side of the beach.

Scour of beach sand by the existing 670mm diameter stormwater outlet and mitigation of associated impacts on beach amenity are discussed in Section 10.7.4.

10.8 POTENTIAL IMPACT AND MITIGATION MEASURES SUMMARY

A summary of the potential impacts on hydrology and morphology of Kendall Bay together with the mitigation and management measures to be implemented are outlined in Table 10-2.

Table 10-2: Summary of potential impacts and mitigation measures

Potential impact	Mitigation and management measures
Potential alteration to the morphology of Kendall Bay and modifications of sediment transport processes	• Prepare and implement Water and Sediment Management Plan • prepare and implement a Navigational Management Plan prior to project commencement outlining vessel speed restrictions and techniques to minimise boat wash • plant and equipment will be selected that are fit for purpose and can operate efficiently under the ambient wave conditions • marine vessels will be selected to have a maximum draught less than 2 metres • enforcement of speed restrictions on construction vessels • manoeuvring non-propelled vessels using winches and cables wherever possible • bathymetric survey (supplemented by land-based survey in shallow areas) to determine pre and post excavation levels, and finished capping levels • verification of capping layer thickness by comparison of pre and post capping surveys • specification of granular and rock capping material properties to provide required durability for use in the marine environment, and sampling and testing of rock supply to confirm that these specifications are satisfied; and • implementation of a Site Management Plan (SMP) for any ongoing monitoring and management of Remediation Areas required following completion of remediation works. Specific requirements for any ongoing monitoring are yet to be determined and will be determined in consultation with appropriate authorities.
Potential destabilisation of the existing seawall structure leading to their damage or possible collapse	• geotechnical stability assessment to identify any existing seawall instability and possible repair works to be completed prior to commencement of remediation activities • prepare and implement Excavation Management Plan to avoid direct impact to seawall structures • toe apron slabs or rock fill which forms a layer to support the toe of seawalls will not be removed • visual monitoring (conducted daily) of seawall for signs of instability during the works; and • completion of pre-remediation and post remediation dilapidation surveys.
Potential failure of the silt curtain structure due to wave action	• in accordance with AS 4997-2005, temporary structures will be designed to withstand wave loads associated with a 20 year ARI wave condition • as required incorporate a tidal compensating system that allows the boom at the top of the silt curtain to float up and down with the tide

Potential impact	Mitigation and management measures
	- in deeper areas, secondary silt curtain to comprise a geotextile skirt with a floating boom, held in position by a typical system of anchor blocks and restraint lines; and - schedule silt curtain pile installation and other particular activities during high tides (as far as practical).
Scouring of seabed due to presence of sheet pile walls	- design to allow for scouring in design of sheet pile wall enclosure - completing final sections of sheet piling as quickly as practicable - consider scheduling final stages of sheet pile wall construction during a neap tide (i.e. lower tidal range and currents) - provision of ports or slots through sheet pile walls to limit concentration of tidal flows during installation; and - installation of a silt curtain barrier across any narrowing entrance to the sheet piling enclosure during the final stages of construction to contain turbidity generated by any localised scour.
Potential loss of sand from the shoal and/or undermining of mangroves	- monitoring of sand within the western area of mangroves during remediation - protection of the batter slope from the mangrove area (SA3) to the depressed area of SA1 (as required) - grade imported sand material compatible with the existing beach sand - place sand at the same slope and planform alignment.
Potential scour channels and the deposition of debris associated with the 1,650 mm stormwater outlet	extension of the existing sandstone wall in Remediation Area SA4 and installation of spur walls through the mangrove area of Remediation Area SA3 to redirect stormwater flows away from the extended wall.
Potential scour channels and the deposition of debris associated with the 670mm stormwater outlet	Consideration of one or more of the following: - diversion of the outlet to a location further to the east, where stormwater could discharge out onto the existing rock platform; - installation of a gross pollutant trap(s) (GPT) upstream in the system; - construction of an energy dissipation structure at the outlet (e.g. rock blanket). Rock energy dissipating structure considered preferred option.

10.9 CONCLUSION

The Project will have a minor and temporary impact on hydrological processes within the Project Area as a result of:

- modification of the bed levels within the Remediation Areas
- additional boat wake and wind wave penetration into the Bay
- potential disturbance of bed sediments by construction traffic; and
- disturbance of bed sediments by cement-based solidification and excavation activities.

The final design will be developed to accommodate hydrological processes, with residual potential impacts managed through the implementation of the recommended management and mitigation measures. Raising of beach levels (SA4) will improve amenity through increased accessibility, and

increasing the beach width available for use by the public. The Project will be of overall environmental benefit.

11. WATER QUALITY AND SEDIMENTS

This chapter discusses the potential impacts of the Project on water quality and sediments and outlines mitigation measures to manage these impacts. It also includes an overview of the proposed monitoring program that will determine if additional mitigation measures are required to prevent potential impacts to water quality and sediment at both Remediation Areas, as well as the Staging Site.

The activities associated with the proposed remediation works have the potential to cause the suspension of sediment within the water column during marine transport, in-situ stabilisation, excavation works, sheet pile installation, placement of backfill and site demobilisation

11.1 OBJECTIVES AND SCOPE

This chapter is based on the Soil and Water Assessment undertaken by RHDVH (2018b) (see Appendix 9) regarding water quality and sediments within Kendall Bay and their interaction with the Project. The assessment addresses the key issues arising from the Project relating to water quality and sediments including:

- erosion and sediment controls during excavation and backfilling within the Remediation Areas
- stormwater management at the Staging Site; and
- waste water generated during the operation of the Staging Site.

The objective of the assessment was to identify risks to the Project activities and the potential impacts of Project activities on water quality and sediments in the Project area. The scope of the assessment extended to all Project phases, encompassing site establishment, remediation activities including the handling of excavated contaminated sediment, and decommissioning of the Staging Site and Remediation Area.

This chapter addresses the following SEARs:

SEARs Requirement – Water Quality and Sediments
Including:
• Erosion and sediment controls during excavation, dredging, transport and treatment of sediments, stockpiling and backfilling of the bay • Details of water quality monitoring program for Kendall Bay, with a focus on turbidity and key contaminants • Management of stormwater and treated wastewater discharges from the treatment facility • Management of wastewater generated during dewatering of extracted sediments • Impacts on surface water and groundwater, including potential impacts on bed and bank stability of Kendall Bay and the Paramatta River • Assessment and management procedures for acid sulfate soils

Further information on the potential impacts of hydrological processes on sediments and groundwater is provided within Chapter 10 Hydrology.

11.2 ASSESSMENT METHODOLOGY

The water quality and sediment assessment consisted of a review of existing conditions in Kendall Bay and at the Staging Site, including a bathymetrical survey of Kendall Bay. It included a review of available information and literature for the broader Sydney Harbour to understand the wider issues associated with water quality and sediments in establishing baseline water quality and sediment characteristics. These were determined based on multiple water and sediment sampling events.

A geotechnical model of sub-surface materials (JK Geotechnics 2017) was completed in conjunction with sediment sampling (Synnot and Wilkinson 2016a) and laboratory analysis, including hydrometer testing, to determine particle size distributions. In addition, URS (2007b) undertook preliminary sediment sampling and testing of samples using the Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) test suite.

A site visit to the Project Area was completed to review the existing stormwater infrastructure at the Staging Site and Remediation Areas which may convey regional or site-specific stormwater which could potentially impact the Project.

11.3 EXISTING ENVIRONMENT

11.3.1 TOPOGRAPHY

The terrain around Kendall Bay is relatively level with higher ground along Cabarita Road to the east and the Breakfast Point development on Village Drive to the south-west. Overland flow paths include shallow gullies along the northern and eastern edges of Waterfront Park, and overland flow down the western slope of Cabarita Park. Land adjacent to the western foreshore is relatively flat. Open space areas are generally well protected from erosion as a result of well-maintained lawns / grass in parklands or gardens stabilised with mulch.

The terrain at the Staging Site is relatively level and consists of an industrial building, a foreshore hardstand area, a concrete piled wharf structure, a number of mooring piles and several gangways providing access to floating pontoons.

The existing bathymetry within Kendall Bay, the marine-based corridor between the Staging Site and the Remediation Areas, and at the Staging Site itself is discussed in Chapter 10 Hydrology.

11.3.2 STORMWATER DRAINAGE

There are a number of existing stormwater outlets along the shoreline of Kendall Bay discharging into the bay. These include an 850 mm outlet located at the northern end of the revetment near Southern Remediation Area SA2, two outlets (375 and 1650 mm) in the sea wall behind the mangroves (which discharge onto a gabion blanket before flowing out onto the foreshore through the mangroves), and two outlets (450 and 670 mm) in the seawall on the eastern side of Kendall Bay which discharge onto the sandy beach area. Additional stormwater outlets enter the bay and Parramatta River from Cabarita Park.

At the Staging Site, several minor stormwater pipes protrude through the seawall structure located at the eastern side of the site, which are understood to drain rainwater collected from the roof of the warehouse building. Five surface inlet pits exist over the hardstand area which are likely to have been part of a first flush drainage system for the former marina (refer Figure 11-1). Drainage water collected from the pits is directed to a central collection pit where it is pumped to a desludging system (removal of sediments, oils and metals) located on the eastern side of the site. There are two existing water tanks on site for storage of water extracted from the desludging process. The system has an overflow provision

that is triggered when heavy rainfall exceeds the pumping capacity. This overflow water is discharged into the Parramatta River.

A 375 mm drain protruding through the seawall at the eastern boundary of the Staging Site is part of the public drainage network and receives stormwater runoff from inlet pits along Tennyson Road.

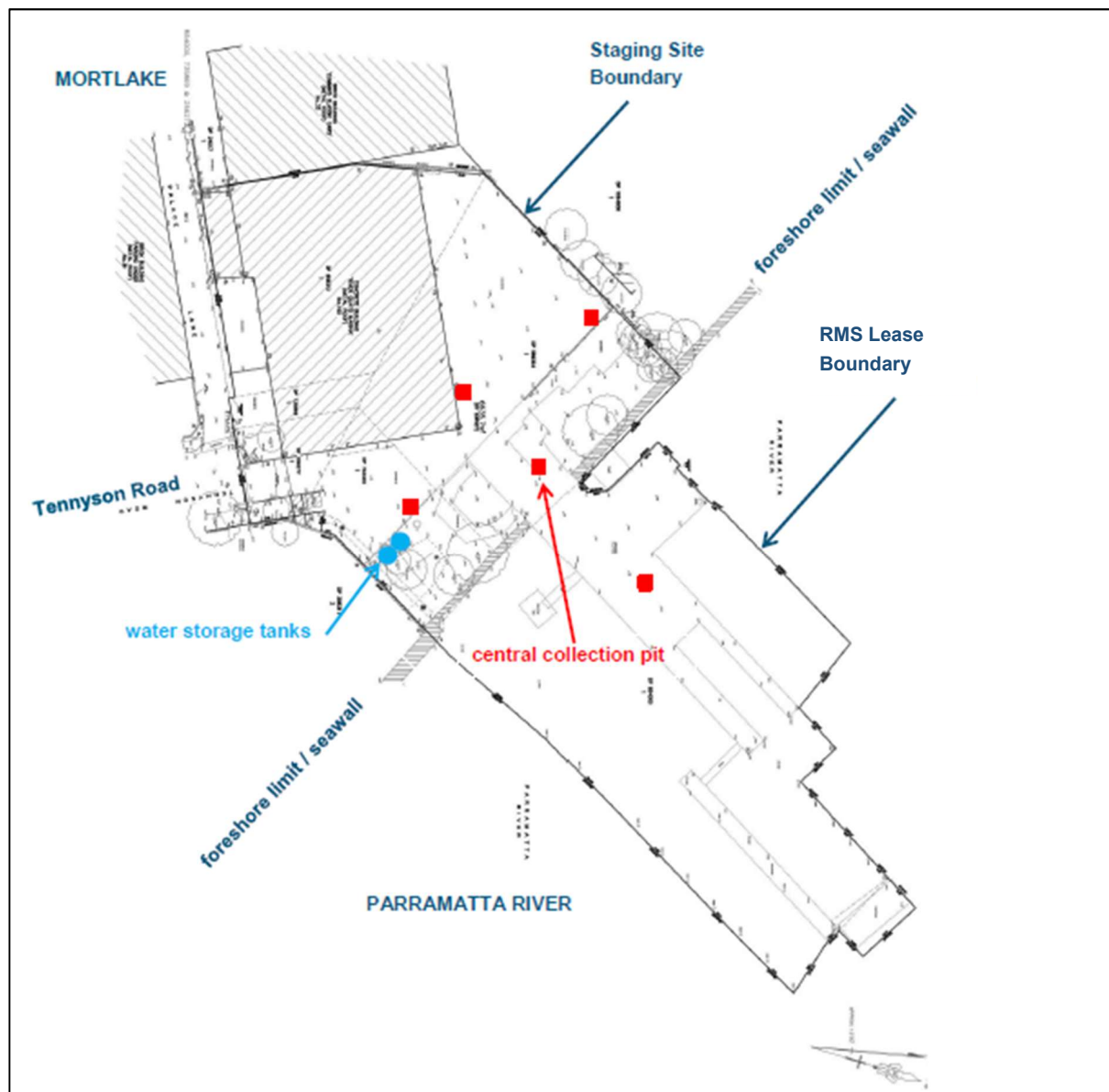


Figure 11-1: Staging Site layout

11.3.3 BATHYMETRY

The Kendall Bay bathymetry is discussed in detail in Chapter 10 Hydrology with detail relevant to this chapter summarised below.

Kendall Bay is a shallow embayment on the southern foreshore of the Parramatta River. The main channel within the Parramatta River runs across the entrance to Kendall Bay, with channel depths adjacent to the bay ranging between -6.0 metres and -8.4 metres Chart Datum¹ (CD).

Within Kendall Bay, the bathymetric levels are typically less than -2 metres CD, with the exception of a -5 metres CD channel extending from the site of the former coal loading wharf on the western foreshore. According to a detailed bathymetry plan of the bay compiled by Hydrographic & Cadastral Survey Pty Ltd in 2014, seabed levels within the Southern Remediation Area range between -0.2 metres CD and +2 metres CD and, and -1 metres CD and 0 metres CD within the Northern Remediation Area (refer Figure 10-1 Chapter 10 Hydrology).

Seabed levels in the area adjacent to the Staging Site and the existing wharf structure proposed for the mooring of vessels, ranged between -3 metres CD to -3.5 metres CD (refer Figure 10-2 Chapter 10 Hydrology).

11.3.4 SEDIMENT CHARACTERISTICS

The foreshore areas in front of the seawall within Kendall Bay are variously covered in rip rap, bricks, masonry and rubble. At Northern Remediation Area NA1, the foundations of the former jetty are also visible at the base of the seawall. A sandy beach is present from the southern head of the bay eastward to the exposed rock platform in front of Cabarita Park.

A geotechnical model of subsurface materials within Kendall Bay was developed by JK Geotechnics (2017), and comprises:

- Unit 1 – Marine Muds, very soft clay to sandy clay, usually dark grey/black to green, includes 'recent' surface sediment of 'jelly like' hydrous brown to green sediment to about 0.2m depth
- Unit 2A – Silty Sands to Silty Clays, variable, very loose to loose (sands) or very soft to soft (clays), grading to lighter grey with depth
- Unit 2B – Clay to Clayey Sand, stiff grading to very stiff or hard with a firm surface zone, light grey with orange and red brown mottles; and
- Unit 3 – Sandstone Bedrock, with shale/laminate beds, some low to medium rock strength with occasional clay seams.

The sediments generally comprise a very fine (clay to sandy clay) dark grey to black layer grading to coarser grained sediments (silty sands and gravelly sands) to depths of 0.5 to 5 m below bed level. The sediments are underlain by natural clays and weathered sandstone bedrock within the deeper parts of Kendall Bay. The thickness of all sediments above bedrock increases from east to west across the bay.

It is known (Irvine, 1980; Irvine and Birch, 1998; Birch and Taylor, 2004) that the sediments of the Sydney Harbour system are contaminated with metals and organics from a wide range of historical industrial and urban sources. The RAP (Synnot and Wilkinson 2018a refer Appendix 2) details sediment contamination and risk assessments have been completed within Kendall Bay since 1989: Dames and More (1989, 1996 and 1999); URS (2002, 2006, 2007a, 2007b, 2008 and 2009); AECOM (2009); EnviroPacific Services (2010, 2013); E3 Consulting (2011); SKM (2013).

These assessments have identified polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPHs) in excess of sediment quality guidelines and above levels in comparable background locations in the Parramatta River. These contaminants are present within Unit 1 and Unit 2A sediments as described above. Depth of contamination above the ANZECC / ARMCANZ (2000)

¹ Chart Datum is approximately the level of Lowest Astronomical Tide (LAT) and is approximately 0.9 m below Australian Height Datum (AHD).

Interim Sediment Quality ISQG – low guidelines was reported as deep as 7 m within the Southern Remediation Area, and to 4.6 m within the Northern Remediation Area, noting that contaminant concentrations typically decreased with depth.

A further comprehensive program of investigations was carried out in 2015 and 2016 (Synnot and Wilkinson 2016a) to update the existing human health and ecological risk assessments. The following concentrations were reported:

- PAHs up to 4,500 mg/kg (450 times the Australian sediment guideline value)
- TRH up to 100,000 mg/kg (360 times the Australian sediment guidance value); and
- elevated levels of heavy metals and metalloids, although the values found were comparable to the values present elsewhere in the Parramatta River likely to be due to historical activities along the Parramatta River and stormwater runoff from urban areas such as roads).

The Ecological Risk Assessment was updated by (Synnot and Wilkinson 2018c) who assessed the risk to aquatic organisms (e.g. fish, crabs, oysters, mussels, prawns, benthic infauna and epifauna, seagrasses) in the bay and the adjacent Parramatta River, and developed site-specific remediation criteria for the contaminated sediments (refer Appendix 4). Synnot and Wilkinson (2018b) reference work completed by the CSIRO which concluded that the majority of samples taken within the proposed remediation areas exhibited chronic or acute toxicity to the test organisms.

The sediments found to cause chronic toxicity or no toxicity were typically grey or grey brown, with either a 'marine' odour, no odour or, occasionally a slight hydrocarbon or tar odour. The sediment samples which CSIRO found to cause acute toxicity, were oily or had an oily sheen, and were generally black, with a strong tar odour. Acute toxicity was attributed to high levels of PAHs and TRHs. As set out in the ERA (Synnot and Wilkinson 2018c), CSIRO proposed the following ecological remediation criteria for the sediments based on the bioavailability and toxicity testing:

- Total PAH concentrations: average <25 mg/kg (1% TOC) (representing effects thresholds) and maximum <60 mg/kg (1% TOC) (representing effects occurring frequently); and
- TPH concentrations: average <4,000 mg/kg and maximum <5,500 mg/kg.

The human health risk assessment was updated by EnRisks (2018) (refer Appendix 3) to develop a set of exposure scenarios and toxicity reference values relevant to the calculation of site-specific risk-based sediment criteria. The driver of risk in the calculation of the remediation criteria is dermal contact with the contaminated materials, associated with the recreational use of the bay. In addition, the human health risk assessment also considered the potential risks to human health from odours during the remediation. Based on the exposure scenarios and the toxicity assessment outlined within the updated human health risk assessment, remediation criteria were developed that are protective of human health as outlined within Table 11-1. Sediment sampling and results are also discussed in Chapter 14 Human Health and in the RAP (Appendix 3).

Table 11-1: Proposed remediation criteria

Location	Site-specific remediation criteria – PAH concentration
Southern Remediation Area	
SA1	1 mg/kg
SA2	1 mg/kg
SA3 – western end adjacent to SA1	1 mg/kg
SA3 – rest of mangrove area	120 mg/kg

Location	Site-specific remediation criteria – PAH concentration
SA4	60 mg/kg
SA5	60 mg/kg
Northern Remediation Area	
NA1	1 mg/kg
NA2	Area submerged so ecological criteria applied
NA3	Area submerged so ecological criteria applied

11.3.5 ACID SULFATE SOILS

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments which contain iron sulphide. When iron sulphides are oxygenated (exposed to air) through disturbances such as excavation and dewatering, chemical changes result in the generation of sulphuric acid.

The NSW Office of Environment & Heritage (OEH) ASS risk map (OEH 1997) for Prospect / Parramatta River indicates a 'High Probability' of occurrence of ASS within the 'Bottom Sediments' of the broader Parramatta River area, and that there is a potential for severe environmental risk if bottom sediments are disturbed by activities such as excavation. It is noted however that the remediation areas themselves were not assessed.

Numerous investigations (URS 2007a and AECOM 2009) involving analytical testing of sediment from both Remediation Areas, outlined in the Soil and Water Assessment (refer Appendix 9), determined that potential acid sulfate soils above the action criteria trigger values in the Acid Sulfate Soils Management Advisory Committee (ASSMAC 1998) Acid Sulfate Soil Manual were present within the sediments at Kendall Bay.

11.3.6 GROUNDWATER AND PORE WATER

The Breakfast Point residential development occupies the site of the former Mortlake gasworks, which was remediated between 1999 to 2002 (Synnot and Wilkinson 2018a). Contaminated material was retained onsite as part of the remedial works, however post remedial monitoring, which is overseen by an EPA accredited Site Contamination Auditor, has not identified any significant issues with residual gasworks-related contamination remaining on the site. Monitoring reports are made available to the EPA from time to time, and the status of the site is covered in periodic discussions between Jemena and EPA staff.

Pore water within Kendall Bay was assessed by taking sediment samples and running them through a centrifuge to separate sediment and pore water (Synnot and Wilkinson 2018b). Pore water was reported to contain heavy metals (arsenic, cadmium, chromium, copper, nickel and zinc) above the 95% species protection concentrations from ANZECC/ARMCANZ (2000). Given the existing ANZECC/ARMCANZ (2000) water quality guidelines for PAHs are considered to be of low reliability, a toxic unit (TU) was calculated to determine if a chronic adverse effect would be likely, based on the individual PAH compounds. If the TU is greater than one, then benthic organisms may not be protected and adverse effects may result.

Porewater samples from bay sediments in the Southern Remediation Area reported TUs above 1, indicating the potential for adverse effects to exposed benthic organisms from PAHs. However TUs from samples collected in the mangroves were below 1 indicating that PAHs released from those sediments into surrounding waters would not be at levels predicted to cause adverse effects.

Groundwater is discussed further in Chapter 10 Hydrology.

11.3.7 BASELINE WATER QUALITY

Water quality monitoring within Kendall Bay has been completed in detail, across multiple sampling programs (URS 2006, URS 2007a, GBAC 2009, Royal Haskoning 2018b, and Synnot and Wilkinson 2018c and 2016c).

A baseline water quality program was undertaken at Kendall Bay and Fairmile Cove which included water sampling for analysis of chemical contaminants, and physical and chemical parameters. The monitoring program was originally developed to assess Remediation Areas A and B as defined in the 2014 RAP, which has since been superseded. However as the current Northern and Southern Remediation Areas are generally consistent with the areas defined in the 2014 RAP, the previous sampling is considered valid for the purpose of developing a suitable water quality baseline. Further water quality sampling is proposed prior to the full-scale remediation work, to provide an additional up to date round of baseline data to supplement baseline data previously collected for the Project.

The monitoring program was undertaken in two stages as follows:

- Stage 1 – August to October 2012 (refer to Figure 11-2 for sampling locations); and
- Stage 2 – November 2013 to February 2014 (refer to Figure 11-3) for sampling locations).

The objectives of the baseline monitoring were to:

- characterise site-specific 'nearfield' water quality conditions at Kendall Bay and Fairmile Cove; and
- establish a suitable background reference location that will be used during the remediation works period to define 'natural' water quality conditions.



Figure 11-2: Stage 1 sampling locations



Figure 11-3: Stage 2 sampling locations

The purpose of the nearfield locations was to collect data in the immediate vicinity of the Southern Remediation Area, formally Area A (Nearfield 1), the Northern Remediation Area, formally Area B (Nearfield 2), and near to the Staging Site where a potential return water discharge point may exist (Nearfield 3A).² The nearfield locations were positioned to be outside of the proposed silt curtains.

The purpose of the background monitoring locations was to provide reference data for the nearfield sites during the remediation period. Therefore, the background monitoring locations were positioned in areas subject to similar conditions as the nearfield locations (i.e. similar water depth, exposure to wind waves, boat wake) but sufficiently removed from the areas of potential disturbance that Project activities would not affect water quality at the background sites.

A summary of the existing water quality conditions established under the baseline water quality monitoring program is in Table 11-2.

Table 11-2: Summary of existing water quality conditions from baseline water quality monitoring

Water quality parameter	Description
Chemical contaminants/ toxicants (PAHs, TPH, arsenic, elevated levels of heavy metals)	The concentrations of chemical contaminants / toxicants were generally very low with the majority of samples collected reporting concentrations below the laboratory limit of reporting. There were isolated instances where elevated concentrations were detected for arsenic, copper, zinc, cyanide and PAHs, however, such

² Discharge of water from remediation activities from the Staging Site is not proposed however run-off from the site generated by rainfall etc will be monitored.

Water quality parameter	Description
	results were not consistently recorded. In addition, these elevated results were not confined to any particular monitoring location. Elevated levels of PAH were reported in three samples collected, however, the samples contained a high proportion of sediments indicating that mobilisation of bed sediments into the water column can result in elevated PAH concentrations within Kendall Bay.
Physical and chemical characteristics (dissolved oxygen, electrical conductivity, pH, turbidity and temperature)	The key physical and chemical characteristics of the water in Kendall Bay and Fairmile Cove are indicative of typical estuarine water quality conditions. Further, it was evident that water quality conditions were relatively similar at each sampling location within Kendall Bay and at Fairmile Cove. Dissolved oxygen concentrations levels were generally within the default ANZECC trigger limits of 80 to 110 %, which indicates that low oxygen levels, often associated with algal blooms, do not affect the site.
Temperature	Water temperatures were strongly influenced by prevailing air temperatures due to the relatively shallow water within the Project Area. Water temperature ranged between 14°C to 17°C during Stage 1, and 21°C to 26°C during Stage 2.

A preliminary site-specific turbidity limit was developed based on analysis of field TSS and turbidity data collected during the baseline monitoring period. As reported by Royal HaskoningDHV (2018b), the turbidity value is equivalent to 150 mg/L suspended solids (50 NTU (Nephelometric Turbidity Units)).

No data has been found on the quality of stormwater entering Kendall Bay and stormwater quality was not assessed as part of the Stage 1 or Stage 2 water sampling events. However assessment of stormwater quality is proposed prior to undertaking full scale remedial works. It was noted that, based on salinity measurements from the Stage 2 sampling event, while the results indicate a relatively high degree of ocean water mixing due to tidal flows, a reduction in salinity occurs within Kendall Bay associated with catchment runoff following rainfall events.

11.3.8 RECENT MONITORING RESULTS

The most recent work completed by Synnot and Wilkinson (2018b) was undertaken in January and April 2016 and October 2017 as part of a seasonal water quality monitoring program. Sample sites were located near locations for marine benthic sampling in the Northern and Southern Remediation Areas of Kendall Bay, elsewhere in Kendall Bay (refer Figure 11-4) and at appropriate locations outside the Bay that had not been exposed to gasworks-related contamination. The results concluded that:

- Levels of PAHs in water were very low, generally below or at detection limits, and there was no significant difference between the values found in the Northern and Southern Remediation Areas compared to the background locations.
- Levels of petroleum hydrocarbons, naphthalene and BTEX were generally at or below detection limits at all locations.
- Dissolved metal levels were typical of those found within urbanised estuaries and in the Parramatta River. As is commonly found, copper was typically several times higher than the ANZECC / ARMCANZ (2000) 95% Trigger Values (Marine) in all areas. There was no elevation of heavy metals in the Remediation Areas compared to the background locations; and
- Overall, the water quality data did not show any significant difference between the levels of contaminants in the Remediation Areas, other parts of Kendall Bay, or the background locations.



Figure 11-4: Water quality sampling locations – Kendall Bay and Parramatta River (2016 and 2017)

Water quality monitoring was also undertaken during the bulk sampling trial (within Remediation Areas NA2, NA3 and SA1) completed in September 2016. Monitoring comprised water sampling taken inside the silt curtain enclosure, immediately outside the silt curtain, as well as background samples taken before the work barges located to Kendall Bay and hours after the barges had left the bay. The results are outlined below:

- dissolved oxygen, temperature and conductivity levels did not vary significantly inside or outside of the silt curtain in comparison to background levels
- turbidity levels rose in the work area inside the silt curtain but rapidly dropped to background levels after the works finished
- levels of naphthalene and toluene were elevated inside the silt curtain (but not outside) during excavation
- levels of total and dissolved PAHs were slightly elevated inside the silt curtain, but not outside
- the elevated levels of naphthalene, toluene, total and dissolved PAHs rapidly returned to background levels after excavation ceased
- minor increases in levels of total chromium, lead and zinc were observed inside the silt curtain, but not outside, and returned to background levels after excavation ceased; and
- levels of suspended solids in the immediate areas of excavation inside the silt curtain increased during excavation, but rapidly returned to background levels after excavation ceased.

Surface water sampling and results are also discussed in Chapter 14 Human Health and in the RAP (Appendix 9).

11.4 STAKEHOLDER VIEWS

Initial public consultation considered the installation of a water treatment plant at the Staging Site, discharging treated effluent back into Fairmile Cove. A large number of questions were asked with respect to the proposed treatment and subsequent discharge, however as discussed previously this methodology is no longer under consideration for the Staging Site.

Contaminant transportation and potential recontamination of other areas and waters during, and following, the remedial works, was one of the main concerns of the Community Liaison Group, and was raised in surveys of stakeholders. A particular point of interest for NSW Health is water quality in Kendall Bay and potential Project impacts on the long term recreational water quality goal to have the Parramatta River meet recreational water guidelines by 2025.

Mitigation measures outlined below provide mechanisms to prevent against the mobilisation of contaminated sediment during construction. As outlined above in Section 11.3.7, water quality monitoring was undertaken during the bulk sampling trial within Remediation Areas NA2, NA3 and SA1, which indicated a successful implementation of the proposed silt curtain.

While the community is concerned about water quality impacts during the Project, there is also an overriding desire to ensure the impacted sediment is appropriately remediated to address contamination that presents potential risks to human health and the environment.

11.5 POTENTIAL IMPACTS

The site establishment, remediation works, offsite disposal and site demobilisation works have the potential to adversely affect Kendall Bay, the Parramatta River and the local community through the disturbance of sediments and associated turbidity and potential mobilisation of contaminants.

This chapter considers impacts on water and sediment quality while Chapter 10 relates to the impacts on ongoing hydrological process within Kendall Bay and Fairmile Cove.

11.5.1 TURBIDITY AND CONTAMINANTS OF CONCERN

Turbidity

Turbidity plumes may be generated during a range of Project activities, including:

- driving of piles into the bed for attachment of silt curtains
- installation of sheet pile walls
- placement and removal of anchors
- movement of floating equipment including barges and work boats to and from the Remediation Areas
- in-situ stabilisation and excavation process
- placement of capping material and creation of mudwaves
- removal of driven piles for the silt curtain

- decontamination of remediation equipment.

Spillage or windblown loss of VENM and other imported materials may occur at the Staging Site, or during the transport of capping material from the Staging Site. This may potentially create an isolated turbidity plume at the Staging Site, or outside of the primary and secondary silt curtain containment system in the scenario where losses occur in transit.

Localised scour of the shallow capping layer adjacent to existing drainage outlets may occur during high stormwater flows, particularly during low tide, which may lead to the generation of a turbidity plume.

Contaminants of Concern

Contaminants bound to the sediment or dissolved within pore water may potentially migrate into the marine water column during seabed disturbance from excavation, ISS and sheet pile installation having an indirect impact on amenity and aquatic ecology.

In addition, unbound contaminants (e.g. tars) released from the sediment may create a hydrocarbon sheen on top of the water column. During the solidification works the cement material may interact with the water column, impacting on the overall pH of the immediate area.

Unplanned Events

There is a potential for contaminant impacts to be mobilised beyond the Remediation Areas associated with the following:

- lowering and raising of floating silt curtains with water level variations in intertidal areas
- damage to the silt curtains from wash created by passing vessels or vessel impact
- leakage through silt curtain shore connections
- release from within the silt curtain enclosure during floating vessel entry/exit procedures; and
- movement of contaminated floating equipment.

Spillage of excavated material during excavation activities including loading, transit and unloading of barges may occur within the remediation areas and at the Staging Site, potentially generating turbidity plumes outside of the silt curtain sedimentation controls.

During decontamination of equipment, contaminants may spread outside the remediation areas associated with washing water, or as a result of poor cleaning methods and quality control measures.

Capping Layer Longevity

The long-term stability and performance of the capping material may degrade over time, causing the generation of a turbidity plume, or facilitating the remobilisation of encapsulated contaminated sediment.

11.5.2 ACID SULFATE SOIL

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments which contain iron sulfide. On oxidation of the iron sulphides through disturbances such as excavation, chemical changes occur which can result in the generation of sulphuric acid. Previous investigations undertaken in Kendall Bay indicate the likely presence of PASS within Kendall Bay sediments (Royal HaskoningDHV 2018b). Excavation within intertidal areas may lead to the oxidisation of Potential Acid Sulfate Soils (PASS).

11.5.3 BREAKFAST POINT GROUNDWATER

Groundwater monitoring has not identified significant concentrations of components of gasworks waste in groundwater. The risk of recontamination of remediated areas in the Project Area by migration of groundwater from the Breakfast Point site is considered to be insignificant. However, Synnot and Wilkinson (2018c) considered anecdotal evidence that low-level gas wastes were placed as backfill behind the seawall adjacent to the Remediation Areas. While these potentially impacted sediments will not be disturbed as part of the Project, there is a potential that infiltration and lateral movement of perched water from within the fill material at the Breakfast Point site may leach contaminants to groundwater and thus to the marine water column. The installation of a sheet pile wall in SA1 and potentially NA2 +NA3 will provide additional environmental control.

11.5.4 STORMWATER MANAGEMENT

The use of tracked and floating plant for in situ solidification, excavation and removal of waste materials, placement of the capping layer and construction of rock structures will not impact on the operation of stormwater drains within Kendall Bay.

The design of the remediation works accommodates existing stormwater outlets discharging into remediation areas by the construction of a permanent energy dissipation structure at the outlet discharging into remediation area SA4, as well as the combined spur wall in remediation area SA3 and sandstone wall extension in remediation area SA4. As such, the management of stormwater within the remediation areas is generally not required during construction other than ensuring that stormwater outlets are not blocked or impeded in any way by construction plant, equipment and materials.

Surface runoff from the hardstand areas at the Staging Site may contain minor sediments derived from handling activities. This will necessitate the separation and management of 'clean' and 'dirty' water pathways within the Staging Site during operations. 'Clean' surface water is considered to be water derived from areas not used for direct handling. 'Dirty' surface water is considered to be runoff captured from within the defined and segregated handling areas. Clean pathways are water channels that are not exposed to sedimentation material or waste water.

Without management, the central storage pit could become blocked based on the potential additional sediment loading at the Staging Site. Sediment received at the Staging Site will remain in sealed containers until collected from the site for further off-site treatment (if required) prior to off-site disposal. No treatment of sediment will occur at the Staging Site, therefore reducing potential sediment loading at the Staging Site.

As discussed above, vehicular traffic entering and leaving the site has the potential to track sediment into uncontrolled areas, potentially contaminating these areas.

11.5.5 POTENTIAL ALGAL BLOOM

Dissolved oxygen levels in the Project Area are generally within the default ANZECC trigger limits of 80 to 110%, which indicates that low oxygen levels do not affect the marine component of the Project Area. Low oxygen, high nutrient concentration and poor flushing have contributed to the outbreak of algal blooms in other parts of the Parramatta River, however well flushed sections of the Parramatta River such as Kendall Bay and surrounding areas, are not likely to be affected by algal blooms.

11.6 CUMULATIVE IMPACTS

Cumulative impacts are not expected to occur with respect to water quality and sediments, however it is noted that Remediation Area SA1 and NA2 + NA3 will retain contaminated material beneath the solidified raft slab (SA1) and monolith extending to Unit 2B (NA2+NA3). Contaminated sediment will be

further contained at SA1 within the cut-off sheet pile walls and the NA2+NA3 monolith is proposed will extend to the competent clay layer (Unit 2B). Should the raft slab in SA1 become compromised, there is potential for the remobilisation of contaminated sediment within Kendall Bay, in addition to potentially impacting the water column. The likelihood of this occurring is considered very low, however preventative management measures are outlined below.

Residual suspended sediment within the water column of Kendall Bay will exist immediately following the remediation works. The silt curtains will remain in place following completion of the capping material placement, allowing sufficient settling time to prevent the lateral movement of suspended sediment within the water column, outside the Remediation Areas. The silt curtains will remain in place until the water quality monitoring program indicates that the water quality parameters, specifically turbidity, are within the allowable range.

Although risks from contaminated groundwater migration associated with the former Breakfast Point site are considered low, the proposed remedial approach has been designed to avoid migration of any possible gasworks-related contamination into the remediated areas in Kendall Bay. This will be achieved by:

- incorporating a continuous sheet pile wall, to enclose Remediation Areas SA1
- a stabilised monolith extending down to Unit 2B at NA2+NA3 with the need for sheet piles to be assessed following the field trail.

The sheet pile wall will also prevent sediment contamination within the remediated area from migrating beyond the remediated area, essentially entombing the contaminated sediment materials within the designated remediation zones.

11.7 MITIGATION MEASURES

This section describes the mitigation measures that will be implemented to address the potential impacts outlined above. Mitigation measures have been segregated into three separate sections:

- operational marine works measures
- operational Staging Site measures; and
- the water quality monitoring program.

The mitigation measures described are commensurate with those prescribed in the following documents:

- Canada Bay Local Environmental Plan 2013
- City of Canada Bay (2012) Fact Sheet: Stormwater Pollution From Building Sites
- City of Canada Bay (2008) Contaminated Land Policy
- City of Canada Bay (2006) Rainwater Reuse Policy
- DUAP (1998) Acid Sulfate Soil Manual prepared by the Acid Sulfate Soil Management Advisory Committee (ASSMAC); and
- Landcom (2004) Management Urban Stormwater: Soils and Construction.

11.7.1 MARINE WORKS

Mitigation measures for marine works have been developed to minimise bed disturbance, turbidity and any spillage of dredged material, appropriately manage any PASS material and ensure geotechnical stability in the remediated area. Mitigation measures are listed in Table 11-3. Key measures include:

- Installation of semi-permanent (i.e. for the duration of the Project) silt curtain barriers and oil absorbent booms prior to commencement of any other remediation works, including:
 - silt curtains enclosing the Northern Remediation Area and Southern Remediation Area.
 - localised silt curtains installed around plant and equipment undertaking excavation works or piling activities and barges receiving excavated material as required.

The remediation contractor will be required to develop and implement formal procedures to ensure effective installation and maintenance of the primary and secondary silt curtains, including installation procedures for the anchoring system. The procedures will be documented within the Remediation Works Environmental Management Plan (RWEMP), described in further detail within Chapter 18. Other mitigation measures to be implemented include;

- Installation of sheet pile wall enclosures around the perimeter of remediation areas SA1 (and potentially NA2 +NA3).
- Procedures in the RWEMP to minimise the generation of sediment within the remediation area
- Minimising the timeframe between excavation and backfilling (SA3, SA4 and SA5) or cap construction (SA2 and NA1) within exposed sections of the remediation areas
- Design of capping materials to satisfy performance criteria relating to durability and robustness that ensure that the remediation treatments are effective for an extended period of time and are resistant to the action of natural process and anthropogenic influences
- Vessel movement procedures including detailed speed limits, anchoring instructions, non-propeller based movements where possible, special marker buoys, and methods for minimising equipment within the Remediation Area. In addition, a Notice to Mariners will be issued in coordination with NSW Roads and Maritime Services to advise the boating community of the extent, nature and duration of construction activities; and
- Developing and implementing an ASS Management Plan.

11.7.2 STAGING SITE

The Staging Site will be operated to mitigate the potential for spills and leaks and prevent discharges to the Parramatta River. The RWEMP will set out the installation, operation and maintenance of a materials handling system to address issues such as the handling and removal of skips from the barges to trucks. In addition, the RWEMP will include procedures for handling of VENM and other imported materials.

Onsite erosion and sediment control measures will include the segregation of excavated and imported materials, as well as the isolation of the drainage network to capture 'dirty' surface water runoff generated within any designated material storage and handling areas. A secondary bund will be installed beyond the materials storage and handling area to prevent against any potential spills which may impact the water quality leaving the Staging Site. Any 'dirty' surface water will be collected and stored within marked untreated water holding tanks for classification and off-site treatment and disposal.

11.8 PROPOSED WATER QUALITY MONITORING PROGRAM

A Water Quality Management Program will be prepared and implemented once the remediation contractor's work methods are finalised. The program will include:

- discussion of potential water quality impacts associated with the Project
- description of any water quality compliance requirements for the Project
- strategies to monitor and manage water quality
- details of a monitoring program to assess on-going compliance with water quality criteria; and
- response procedures and contingency measures to minimise adverse impacts associated with any failure of the strategies.

A general description of the proposed water quality monitoring program is provided in the following sections, which is broken in two main streams as detailed below.

11.8.1 WASTEWATER COLLECTION

No wastewater from dewatering sediment of is expected as the material is to go directly off-site for treatment and any further dewatering of excavated sediment required prior to acceptance at landfill will occur at an offsite facility. Some minimal waste water will be produced from the wheel wash, decontamination / wash down of equipment and any wastewater collected on barges. This water will be stored in tanks at the Staging Site and a liquid waste contractor will be contracted to dispose of wastewater off-site.

Stored wastewater would not leave the Staging Site until it has been assigned a liquid waste classification and an appropriately licensed waste facility has been identified to receive the wastewater. The wastewater is likely to meet the criteria for 'trackable liquid waste' under the *Protection of the Environment Operations (Waste) Regulation 2014* and would therefore be subject to the waste tracking requirements of the Regulation.

Water treatment options are also discussed in Chapter 4 Description of Project Activities.

11.8.2 PARRAMATTA RIVER MONITORING

Monitoring of waters in the immediate vicinity of the Northern and Southern Remediation Areas will be undertaken for the duration of the Project to detect any impact on ambient water quality due to Project activities. Monitoring may comprise in situ measurements using hand-held meters, laboratory testing of water samples, and visual inspections of water quality management systems.

The RAP specifies a requirement for the following water quality monitoring events:

- prior to the commencement of remediation;
- during remediation to monitor water impacts caused by the remediation (if any); and
- post remediation to validate there has been no impact caused by the remediation works.

The remediation contractor will undertake water quality monitoring and sampling field work and its environmental validation consultant will manage water quality sample analysis and reporting on water quality monitoring events. The scope of water quality monitoring proposed will be presented in the Validation Sampling and Quality Plan (VSQP) for endorsement by the Site Auditor. The extent of

monitoring will also depend on the requirements of the EPA's Environment Protection Licence (EPL) for the Project.

The following program for water quality monitoring is proposed but may require amendment once the VSQP and the EPL are finalised:

- one pre-remediation surface water quality sampling event to provide an additional up to date round of baseline data to supplement baseline data previously collected for the Project
- sampling during remediation activities with details of sampling timing and frequency to be confirmed (expected to be undertaken monthly during active remediation works)
- one round of surface water quality sampling will be conducted post remediation to validate that remedial works have not had a detrimental effect on water quality.

Pre and post-remediation water quality monitoring samples will be collected at several locations from a depth of approximately 0.5m from the water surface and samples will be analysed for total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons, heavy metals, total cyanide and total suspended solids (TSS). Other water quality parameters including turbidity, pH, dissolved oxygen (DO), and conductivity will also be measured.

In addition to water quality sampling and analysis, monitoring of the following parameters is also under consideration with methodology to be confirmed in discussion with consent authorities including the EPA:

- water level, wave and current measurements
- wind speed and direction measured from a shore based location
- stormwater quality and flow measured in event-based sampling exercises, subject to the occurrence of suitable rainfall events, over the remediation period. Measurement locations could be in the vicinity of the three stormwater outlets that discharge into the Remediation Areas (2 outlets into SA4, 1 outlet into SA3).

11.8.3 POST REMEDIATION MONITORING

A Site Management Plan will be developed for the Project, as outlined in Chapter 18 – Environmental Management Framework. The final program of ongoing monitoring to be undertaken following completion of the remedial works is yet to be determined but may include:

- Measurements of physical and chemical parameters (turbidity, temperature, pH, dissolved oxygen and electrical conductivity) until it can be confirmed that water quality conditions in Kendall Bay and Fairmile Cove are consistent with baseline levels for these parameters. Monitoring may be undertaken at two nearfield and two background locations.
- Collection of seasonal water samples at three monthly intervals for laboratory analysis of the key parameters outlined previously. Collection of these samples would be undertaken within the Northern and Southern Remediation Areas, and at the Background 2 reference site (refer Figure 11-2 and Figure 11-3).

The purpose of the post remediation monitoring would be to confirm that water quality conditions in the Project Area are consistent with baseline levels, and that there are no ongoing water quality issues associated with the Project. In particular, this monitoring would also assess the ongoing performance of the capping material and would be completed in conjunction with any other ongoing monitoring activities within the Site Management Plan. The nature and extent of any ongoing monitoring are yet to be confirmed and will be determined in consultation with the EPA, RMS and site auditor.

11.9 POTENTIAL IMPACT AND MITIGATION MEASURES SUMMARY

A summary of the potential impacts on water quality and sediment together with the mitigation and management measures to be implemented are outlined in Table 11-3. It is noted that the key mitigation measure will be the implementation of the water quality monitoring program, which will be used to assess the effectiveness of the mitigation measures, and as a trigger for implementing additional mitigation measures.

Table 11-3: Summary of potential impacts and mitigation measures

Potential impact	Mitigation and management measures
Turbidity plumes and or release of contaminants into the water column impacting amenity and aquatic ecology	- Develop and implement a RWEMP including Water and Sediment Management Plan - Undertake a Water Quality Monitoring Programme - Install semi-permanent (i.e. for the duration of the remediation project) silt curtain barriers, oil absorbent booms and spill response kits at relevant areas - Complete final sections of sheet piling as quickly as practicable and consider scheduling final stages of sheet pile construction periods of lower tidal range and currents - Conduct regular inspections for leaks / spills at silt curtain shore connections and immediate completion of any required repairs - Implement appropriate speed, manoeuvring and bed disturbance activities - Cut-off sheet piling at the finished seabed level at completion of the works to avoid sheet pile extraction and provide post-remediation contamination containment (SA1) - Implement appropriate mitigation measures to manage localised and temporary turbidity generation during dismantling of silt curtain enclosures - Disposal of waste materials (e.g. silt curtains, booms) at an appropriately licensed waste facility - Develop and implement a post remediation Site Management Plan
Release of unbound contaminants (e.g. tars) from within sediments creating hydrocarbon sheens	
Cross-contamination of areas in the bay outside of the designated remediation areas as a result of bed disturbance	
Localised bed scour due to concentration of tidal flows during construction of sheet pile walls	
Oxidisation of Potential Acid Sulfate Soils (PASS) within intertidal areas	
Unplanned events associated with the operation of the silt curtains	
Spillage or spreading of contaminated material during loading, transit and unloading of barges	Implement appropriate navigation measures, utilise suitable lifting techniques and appropriate equipment, and implement decontamination measures

Potential impact	Mitigation and management measures
Release of contaminated water or dust offsite or into the Parramatta River	• Utilise sealed bins in barges and covered trucks to transport materials on and offsite • Cleaning and decontamination of floating equipment undertaken within the Remediation Areas prior to demobilisation • Hardstand surfaces within the Staging Site thoroughly cleaned and decontaminated as part of site disestablishment activities and capture and storage of any wash water within marked untreated water holding tanks for sampling and analysis, waste classification and offsite disposal • Operation of truck shakedown and wheel wash and untreated water holding tanks until all earthmoving equipment has been demobilised from the site
Localised scour of the capping layer adjacent to existing drainage outlets by high stormwater flows that may occur at low tide	• Construct appropriate erosion controls
Poor long-term stability and performance of capping material	• Design the capping materials to satisfy performance criteria • Monitoring to assess ongoing performance of the capping material

11.10 CONCLUSION

The Project has the potential to impact on sediment and water quality through:

- Erosion and sedimentation occurring during activities undertaken at the Staging Site, marine based activities and unplanned events
- Disturbance to PASS during mechanical excavation activities within the Remediation Areas and during sediment handling and transport to the Staging Site; and
- Mobilisation and dispersion of contaminated sediments into the water column through direct disturbance to contaminated sediments during site establishment, remediation and decommissioning phases of the Project.

Mitigation measures have been developed to address these potential impacts. In particular, the use of primary and secondary silt curtains and sheet pile walls (within SA1) will minimise the risk of turbidity and mobilised contaminants moving outside the Remediation Areas.

These measures will be supported by a comprehensive water quality management program, allowing for adaptive management. Real-time monitoring of turbidity will ensure that, if a water quality limit is being approached during remediation activities, action can be taken to modify or temporarily cease activities so that the limit is not exceeded.

The management measures will be refined during the detailed design phase of the Project and incorporated into the RWEMP.

With the adoption of these measures, impacts from remediation activities on water and sediment quality are expected to be significantly reduced outside the remediation area. Impacts within the Remediation Areas will be temporary and short-term while activities are underway returning to baseline conditions

once activities are completed. The Project will, however, result in a significant improvement in sediment quality through the removal or containment of contaminated material.

12. BIODIVERSITY

This chapter discusses the potential impacts of the Project on critical habitats, threatened species, populations and ecological communities (including marine flora and fauna), and mitigation measures including management of mangroves and re-establishment of benthic flora and fauna. The chapter also discusses the assessment and management of the risks to ecological resources detailed in the Ecological Risk Assessment undertaken for the Project.

12.1 OBJECTIVES AND SCOPE

This chapter is based on information prepared for the RAP undertaken by Synnot and Wilkinson (S&W 2018a). The RAP included preparation of an Ecological Risk Assessment (ERA) (S&W 2018c) which incorporates an assessment of the risks to organisms exposed or potentially exposed to gasworks-contaminated sediments of Kendall Bay. The RAP is attached to this EIS at Appendix 2 and the ERA is attached at Appendix 4.

This chapter also draws on previous ecological studies in Kendall Bay, background literature reviews, database searches and field survey work undertaken by ERM on behalf of Jemena in 2012 and 2014.

The assessment in this chapter:

- describes the existing biological environment of the Project Area in relation to marine flora and fauna
- assesses the potential impacts of Project activities on threatened species, populations or ecological communities that occur or are expected to occur, and
- provides measures to manage and mitigate these impacts, where required.

This chapter addresses the following SEARs:

SEARs Requirement – Biodiversity
• An assessment of any impacts on critical habitats, threatened species, populations or ecological communities and their habitats
• Measures to minimise harm to mangrove habitat and details of proposed biodiversity offsets for impacts on aquatic habitat; and
• Details of backfill material that supports the re-establishment of aquatic flora and fauna

12.2 ASSESSMENT METHODOLOGY

The assessment draws on the extensive investigations that have been undertaken over a number of years for the Project as well as other projects in the vicinity of Kendall Bay and for the adjacent Breakfast Point development. The ecological studies reviewed are listed in Table 12-5 below; a further list of other environmental investigations undertaken in the Project Area is provided in Chapter 3 Project Justification and Alternatives.

The assessment comprised three elements as shown in Table 12-1 below.

Table 12-1: Assessment methodology

Methodology element	Description
Background literature and database searches	Background literature reviews and database searches were conducted by ERM prior to the commencement of field investigations to obtain current data on flora and fauna species, populations, communities and habitats known to occur within the site and broader locality. These searches were updated in 2018 as part of the review of previous studies undertaken for the Project. Relevant threatened species databases which were reviewed included the Office of Environment and Heritage BioNet Atlas (BioNet) (OEH 2018); the NSW Department of Primary Industries 'Listed threatened species, populations, ecological communities and key threatening processes online resource (species as listed in the schedules of the <i>Fisheries Management Act 1994</i>) (FMA list); and the Protected Matters Search Tool of the Department of the Environment and Energy (Cth) (EPBC database). Previous ecological investigations carried out in Kendall Bay and background studies for a proposed marina were also reviewed (see Section 12.5 below)
Field surveys of the Project Area	Surveys were undertaken in August 2012 and April 2014 by ERM, to complete a habitat assessment and investigation of the inherent biological attributes at the Project Area. Surveys focussed on identification of endangered ecological communities, threatened species / endangered populations and their habitat. Field survey comprised a random meander transect along the foreshore of the Project Area documenting potential marine and intertidal habitats. The 2012 survey was conducted at low tide to maximise the area accessible for assessment of intertidal species and habitats. The 2014 survey was conducted to assess the marine ecology at the Staging Site. The habitats identified in the field surveys is summarised in Section 12.4.3 below. Additional surveys were undertaken as part of preparation of the RAP in 2016 and 2017 to provide further information on marine benthic infauna assemblages at sites of known contamination within the Remediation Areas and at sites outside these areas to assess the potential level of impact on benthic fauna.
Impact assessment	Assessment of impacts of the Project on flora and fauna was undertaken in accordance with the requirements of the SEARs, relevant NSW and Commonwealth legislation and planning instruments. Relevant legislation includes the <i>Biodiversity Conservation Act 2016</i> (NSW) (BC Act), <i>Fisheries Management Act 1994</i> (NSW) (FM Act) and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act). Applicable planning instruments include the <i>Sydney Regional Environment Plan (Sydney Harbour Catchment) 2005</i> (Harbour SREP), SEPP (State and Regional Development) 2011 and SEPP 55. Other relevant legislation and planning instruments are detailed in Chapter 5 Statutory Framework.

Methodology element	Description
	The Impact assessment also included Biodiversity Offsets under the transition arrangements following repeal of the <i>Threatened Species Conservation Act 1995</i> (TSC Act) and the enactment of the BC Act in August 2017, the guidance of the NSW <i>Biodiversity Offsets Policy for Major Projects 2014</i> (OEH 2014a) remains current for a SSD project where the SEARs were issued prior to 25 August 2017 and the development application is made before 25 February 2019. The Biodiversity Offsets Policy applies to all biodiversity in NSW including aquatic biodiversity managed under the TSC Act and the FM Act (excluding impacts on migratory seabirds and marine mammals). Under the policy, the impacts of the Project on biodiversity are required to be assessed.

12.3 ENVIRONMENTAL PLANS AND HABITAT MAPPING

The Harbour SREP establishes a set of planning principles for the preparation of planning instruments for the hydrological catchment of Sydney Harbour, and categorises the waterways into nine different zones reflecting differing environmental characteristics and land uses of the harbour and its tributaries.

Kendall Bay is zoned in the Harbour SREP as 'W1 - Maritime Waters', which encompasses the main navigation channel between Sydney Heads and Parramatta. The area of mangroves within Kendall Bay (and an area on the north-west tip of Cabarita Park east of the ferry wharf) are designated as 'Wetlands Protection Area' under the Harbour SREP. Wetlands Protection Areas comprise habitats such as seagrasses, mangroves, saltmarsh or mudflats, within a 40 m buffer zone to address movement, growth and seasonal variation.

The Harbour SREP and the requirements in relation to Wetland Protection Areas are discussed further in Chapter 5 Statutory Framework and relevant Harbour SREP Zoning maps are shown in Chapter 3 Project Area Location and Context.

12.3.1 SEAGRASS HABITAT MAPPING

A preliminary assessment of the historical, current and future cover of seagrass in the estuary of the Parramatta River was undertaken by West and Williams (2008). The Project Area was not mapped in the historical distribution of seagrass as an area where seagrass occurs, however, based on West and Williams (2008) predictive modelling, the Project Area is considered as an area that is generally suitable for seagrass.

12.4 EXISTING ENVIRONMENT

This section describes the existing environment based on database searches and review of available assessment reports and specialist ecological studies undertaken in the Project Area. The review of the studies considered in this Chapter is summarised in Section 12.5.2. The general geographical context of the Project Area is described in Chapter 3 Site Location and Context. Additional environmental description relevant to marine ecology is set out in Chapter 10 Hydrology and Chapter 11 Water Quality and Sediments.

12.4.1 THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

A database search was undertaken to determine the threatened species or ecological communities and migratory species listed under the BCAct, FMAct and the EPBC Act, and their potential to occur in the Project Area.

A search for information regarding records and distribution of threatened and protected species within a 10 km radius of Kendall Bay was undertaken using the online NSW BioNet and EPBC Act search tools. BioNet was also used to search for records of flora and fauna sightings within the search area held in the Atlas of NSW Wildlife. The Atlas was also searched for information on known and predicted distributions of vegetation communities, endangered populations and key threatening processes listed under the BC Act occurring within the vicinity of Kendall Bay.

Assessment of Listed Threatened Species and Ecological Communities

An assessment of the likelihood of each of the identified threatened species occurring in the Project Area was made, taking into account that the habitat present in the Project Area is highly disturbed and modified, and represents a very small proportion of habitat in the area. Only those threatened species that are dependent on marine or tidal habitats are considered in this assessment. This likelihood of occurrence assessment is Appendix 4 and summarised in Table 12-2 and Table 12-3 below.

Flora

The BioNet search indicated that twenty-three species of threatened flora including three endangered populations (listed in the BCAct) could potentially occur in the search area (within 10 km of the Project Area). None of the threatened flora species reported for the locality are considered to potentially utilise the highly disturbed foreshore, marine and intertidal habitats in the Project Area and are therefore not considered further. The assessment of likelihood of occurrence of the endangered flora populations is summarised in Table 12-2.

Table 12-2: Endangered populations potentially occurring in the Project Area

Scientific name	Common name	Listing	Assessment of likely occurrence
<i>Wahlenbergia multicaulis</i>	Tadgell's bluebell	Endangered (BCAct)	Species is listed as an endangered population in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield. This species has not been previously recorded in the Kendall Bay area and is unlikely to occur in the Project area.
<i>Pomaderris prunifolia</i>		Endangered (BCAct)	Species is listed as an endangered population in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas. This species has not been previously observed or recorded in the Kendall Bay area and is unlikely to occur in the Project area
<i>Posidonia australis</i>		Endangered population (FMAct)	Seagrass endemic to the temperate waters of the south-eastern, southern and south-western coasts of Australia. Occurs in estuaries along the east coast of NSW, and within Sydney Harbour is only known to occur in the outer harbour areas near Manly and not within the Parramatta River (DPI 2018).

Fauna

The FMA Act lists a number of marine and estuarine shark and teleost fish species as Vulnerable under Schedule 5. *Syngnathiformes* (seahorses, sea-dragons, pipefish, pipe-horses and sea-moths) are protected under both the EPBC Act and the FM Act, with these species are associated with clear waters in coastal environments or seagrass beds. As neither of these environmental features occurs within Kendall Bay, it is considered unlikely that Syngnathiformes occur at or are present in the Project Area.

Two species of shark, the Grey Nurse Shark (*Carcharias taurus* Cth CE, NSW CE) and the Great White Shark (*Carcharodon carcharias* Cth V, NSW V), are listed as species that could potentially visit the locality due to connectivity between the Parramatta River and Sydney Harbour. Of the listed teleost fish species known from Sydney Harbour, the Black Rock Cod (*Epinephelus daemelli*) (Cth V, NSW V) has potential to occur in rocky reef areas.

There is potential for Bousfield's Marsh Hopper (*Microchestia bousfieldi*) (NSW V) to utilise the mangrove habitat within Kendall Bay, however the likelihood of occurrence within the stand is considered low, given the limited foraging and breeding habitat that the area provides and the presence of more suitable habitat in nearby areas. *Microchestia bousfieldi* is a small marine amphipod found in intertidal areas usually under mangrove debris, although has only been documented from South West Rocks Creek in the north. Given the very limited distribution of this species and the contaminated nature of the sediment within the remediation area, it is considered highly unlikely that this species would be found within the mangrove stand within Kendall Bay

A summary of the threatened bird and marine species that may potentially occur in the habitats of the Project Area is provided in Table 12-3. There are no currently listed threatened mammals, reptiles or frog species known to occur in the Project Area.

Table 12-3: Threatened fauna species with potential to occur in the PA

Scientific name	Common Name	Listing	Assessment of likely occurrence
<i>Ardea alba</i>	Great Egret, White Egret	Migratory (EPBC)	Intertidal areas, mangroves and the sandy beach provide limited habitat resource. Unlikely to occur.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Migratory (EPBC)	
<i>Calidris canutus</i>	Red Knot, Knot	Endangered (EPBC) Migratory (EPBC)	
<i>Calidris ferruginea</i>	Curlew Sandpiper	Critically Endangered (EPBC) Migratory (EPBC) Endangered (BCAct)	
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory (EPBC)	
<i>Calidris tenuirostris</i>	Great Knot	Critically Endangered (EPBC) Migratory (EPBC) Vulnerable (BCAct)	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	Vulnerable (EPBC) Migratory (EPBC) Vulnerable (BCAct)	
<i>Charadrius mongolus</i>	Lesser Sand Plover	Migratory (EPBC) Vulnerable (BCAct)	
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	Endangered (BCAct)	

Scientific name	Common Name	Listing	Assessment of likely occurrence
<i>Haematopus longirostris</i>	Pied Oystercatcher	Endangered (BCAct)	
<i>Heteroscelus brevipes</i>	Grey-tailed Tattler	Migratory (EPBC)	
<i>Hieraaetus morphnoides</i>	Little Eagle	Vulnerable (BCAct)	
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Vulnerable (BCAct)	
<i>Limosa lapponica</i>	Bar-tailed Godwit	Migratory (EPBC)	
<i>Limosa limosa</i>	Black-tailed Godwit	Migratory(EPBC) Vulnerable (BCAct)	
<i>Numenius madagascariensis</i>	Eastern Curlew	Critically Endangered (EPBC) Migratory (EPBC)	
<i>Numenius minutus</i>	Little Curlew	Migratory (EPBC)	
<i>Numenius phaeopus</i>	Whimbrel	Migratory (EPBC)	No saltmarsh habitats noted within the Project Area although mangroves may provide limited habitat. Unlikely to occur.
<i>Pluvialis fulva</i>	Pacific Golden Plover	Migratory (EPBC)	
Fish and Sharks			
<i>Carcharodon carcharias</i>	Great White Shark	Vulnerable (EPBC) Vulnerable(FMAct)	Very limited potential to occur despite connectivity between the Parramatta River and Sydney Harbour. No preferred habitats available in the Project Area.
<i>Carcharius taurus</i>	Grey Nurse	Critically Endangered EPBC) Critically Endangered (FMAct)	
<i>Epinephelus daemelli</i>	Black Rock Cod	Vulnerable (EPBC) Vulnerable (FMAct)	Potential to occur in rocky reef areas. While known from Sydney Harbour, is unlikely to occur in the Project Area.
Crustaceans			
<i>Microrchestia bousfeldi</i>	Bousfield's Marsh Hopper	Vulnerable (FMAct)	Potential to utilise mangrove habitat in Kendall Bay, but likelihood is low given limited habitat, and more suitable habitat nearby.

No Key Threatening Processes (KTPs) listed under the BC Act or the FM Act are relevant to Kendall Bay.

12.4.2 PROTECTED AREAS

There are no areas protected for natural values in the Project Area. Cabarita Park on the eastern foreshore of Kendall Bay is listed on the State Heritage Inventory (see Chapter 13 Cultural Heritage).

There are no marine protected areas (aquatic reserves, marine parks, national parks and nature reserves) in the locality of the Project Area.

Ramsar Wetlands

The nearest wetland of international importance identified in the EPBC Act online database search is the Towra Point Nature Reserve, which is located approximately 19 km south of the Project Area and within a different catchment. The nature reserve will not be affected by Project activities.

12.4.3 HABITATS IN THE PROJECT AREA

Field surveys were undertaken by ERM (on behalf of Jemena) in 2012 and 2014 and Cardno (on behalf of ERM) in 2015 as part of investigations for a previous proposal for the Remediation Project. The surveys were designed to determine species present in the Project Area and identified four marine habitats of interest:

- mangroves
- sandy beach
- rock platform; and
- artificial rock wall.

These habitats and other survey findings are described in further detail below and presented in Plate 12-1 to Plate 12-7. Brief habitat descriptions of the Staging Site and the 'Lady Edeline' are also below.

Mangrove Habitat

Mangroves are regarded as key fish habitat and are protected under the FMAAct. The Grey Mangrove is the most common and widespread mangrove in NSW.

A monospecific stand of Grey Mangroves (*Avicennia marina*) occurs on the southern shores at the head of Kendall Bay within the Southern Remediation Area (see Plate 12-1). The stand is primarily made up of mature mangrove trees, with the majority of vegetation ranging in height between 3-5 m. Very few seedlings or saplings are present, although a number of propagules were found on sediments within the stand. This Grey Mangrove community covers an area of approximately .25 ha and represents approximately 1% of the 19.5 ha of mangroves mapped within the Canada Bay LGA (Cardno 2015).

Mangroves in the intertidal zone have abundant vertical aerial 'peg roots' or pneumatophores, which are characteristic of this species. The majority of mangroves that occur higher on the shore, in the sandy beach sediments, have no visible peg roots.

The Grey Mangrove stand is likely to be contributing to the accretion of sandy sediments in this area. A seawall structure and landscaping associated with a pedestrian cycle path limits the landward extent of the mangrove community.

No gastropod snails were found in the mangrove foliage. No crustaceans (crabs) or polychaetes (worms) were seen within the mangrove habitat. The most abundant marine species in the mangrove habitat consisted of shells. The low diversity of invertebrate species utilising the mangrove habitat indicates that the habitat is unlikely to be providing significant value to the marine ecology of Kendall Bay.

Mangrove habitats typically provide food and shelter for various marine and bird species. The stand of mangroves in Kendall Bay appears to provide limited foraging habitat due to the small spatial extent of the habitat and the degraded nature of the environment, including the presence of coal fragments, gross litter and odorous sediment.



Plate 12-1: Kendall Bay mangroves at high tide. (Source: Cardno 2015)

Sandy Beach Habitat

A narrow sandy beach is located to the north-east of the mangroves extending approximately 60 m to the east. The beach sediments are generally clean or silty sands with visible coal particles. The area is devoid of signs of invertebrate activity such as worm burrows and mollusc trails, which are often seen along productive sandy coasts. (see Plate 12-2).



Plate 12-2: Sandy beach habitat along lower east shore of Kendall Bay (Source: Jemena 2018)

Rock Platform Habitat

Natural sandstone platforms are located on the eastern side of Kendall Bay extending approximately 200 m northwards from the sandy beach to Cabarita Point (Plate 12-3). The rock platforms in this location do not support a large diversity or concentration of biota. In the southern-most areas (closest to the proposed Southern Remediation Area) there were very few species on the rocks other than oysters, occasional blue mussels (*Mytilus edulis*) and small barnacles. The peg roots of an isolated mangrove tree were exposed due to the loss of sediment (sand) from the area, which may be a result of boat wash or strong winds causing erosion along the shore.

More species occurred with increasing distance north towards the boat ramp at Cabarita Point, including green algae (*Chaetomorpha* sp.) on the exposed upper surfaces of the rock platforms and small areas of the coralline red algae (*Corallina* sp.) on the vertical edges of fissures and boulders. Small rock pools near the boat ramp supported a range of species including both red and green algae, crabs, amphipod crustaceans, polychaetes, mussels, oysters, coniwinks and anemones.



Plate 12-3: Looking south at sandstone platforms towards beach and mangroves along southern shore of Kendall Bay. (Source: Jemena 2018).

Artificial Rock Wall Habitat

The shoreline from the Staging Site to the Southern Remediation Area is a man-made seawall constructed predominately from sandstone and reinforced in some areas with concrete. The adjacent shoreline is vegetated with low native shrubs and a walkway has been constructed for shared cycle / pedestrian use (see Plate 12-4).

Stormwater drains protrude into the bay at a number of locations along the seawall. Around the pipes, there is considerable oyster growth, which is probably the result of nutrient rich discharge coming from the surrounding parkland and streets.

The rockwalls and associated rubble noted along the base of the sea walls provide only limited habitat for marine species. The most common species found were green filamentous algae, oysters, mussels, barnacles and conniwinks.

An artificial sea wall also occurs at the Staging Site. The intertidal zone in this area consists of a heavy layer of silty mud. Growth of rock oysters (*Saccostrea glomerata*) in this location was very poor and noticeably uncommon. No algal growth was noted in this area. Fish that were observed using this area included small yellow fin bream (*Acanthopagrus australis*) and a common toadfish (*Tetractenos hamiltoni*).



Plate 12-4: Looking north to Breakfast Point along man-made sea walls. (Source: Jemena 2018)



Plate 12-5: Stormwater drains and plume of oyster growth. (Source ERM 2014)

The marine species observed in the above habitats are summarised in the following table.

Table 12-4: Marine species observed on field survey

Common Name	Scientific Name	Marine Habitat			
		Mangrove	Sandy beach	Rock Platform	Rock Walls
Grey Mangrove	<i>Avicennia marina</i>	Yes	No	Yes	No
Sydney Rock Oyster	<i>Saccostrea glomerata</i>	Yes	No	Yes	Yes
Noduled Conniwink	<i>Bembicium auratum</i>	Yes	Yes	Yes	Yes
Sydney Cockle	<i>Anadara trapezia</i>	No	No	Yes	No
Blue Mussel	<i>Mytilus edulis</i>	No	No	Yes	Yes
Red Coralline Algae	<i>Corallina sp.</i>	No	No	Yes	Yes
Green Filamentous Algae	<i>Chaetomorpha aerea</i>	Yes	No	Yes	Yes
Barnacles		Yes	No	Yes	Yes
Anemones		No	No	Yes	No

Seagrass Habitat

Cardno (2009a) reported that a small sparse patch of the seagrass *Halophila ovalis* was found on the rock platform near Cabarita Wharf, however no patches of seagrass were identified in the Project Area during field surveys.

Staging Site

The site is heavily disturbed and currently developed with small patches of planted vegetation on either side of the hardstand area that extends out onto the wharf. These patches of vegetation comprise mixed native and exotic species that appeared to be planted as a screen. There is no natural terrestrial landscape existing in or adjacent to the Project Area (see Plate 12-6).

The existing wharf and pontoons have some algal growth but in general, algal growth in these areas was minimal considering the time that these structures have been in situ (see Plate 12-7). The existing wharf, pylons and pontoons would provide shelter and some foraging habitat opportunities for fish and crustaceans. Fish that were observed using this area included small yellow fin bream (*Acanthopagrus australis*) and a common toadfish (*Tetractenos hamiltoni*).



Plate 12-6: Staging Site looking south from the wharf. (Source: JBS&G 2017)



Plate 12-7: Staging Site wharf looking north. (Source: JBS&G 2017)

[‘Lady Edeline’ Wreck](#)

The wreck of the Lady Edeline lies approximately 70 m to the east of the existing wharf at the Staging Site and 15 m from the shoreline. This wreck is listed in the Australian National Shipwreck Database and is protected under the *Heritage Act 1977* (NSW) (see Chapter 13 Cultural Heritage).

The wreck is likely to be an important marine habitat within this area. No marine plant and equipment is proposed to be transported in proximity to the wreck, and therefore no detailed habitat assessment of the wreck has been undertaken as part of this assessment.

12.5 ECOLOGICAL STUDIES IN THE PROJECT AREA

A series of environmental studies were completed previously for Kendall Bay and the adjacent parts of Sydney Harbour over a number of years. These are summarised in Table 12-5 below.

Table 12-5: Summary of previous ecological studies

Year	Author	Survey findings
1989, 1996 and 1999	The Ecology Lab	In 1988, the marine environment adjoining the AGL Mortlake gasworks site in Kendall Bay was described and a survey of aquatic flora and fauna undertaken to identify any potential constraints to shoreline development. A qualitative description of the aquatic flora and fauna associated with the intertidal portion of the vertical seawall and jetty piles was prepared and quantitative analyses were undertaken of the benthic invertebrates, fish and mobile invertebrates associated with soft sediments at sites within and adjacent to Kendall Bay. This study showed that although the original shoreline had been modified and sediments had been contaminated, the aquatic flora and fauna was well developed. In 1996, the infauna, epibenthic fauna, mobile fish and invertebrate assemblages associated with soft sediments at sites adjacent to the former AGL Mortlake gasworks were compared with those at nearby Reference Locations. The spatial variation in composition and abundance of the infauna was found to be consistent with observations and measurements of contamination. The patterns in fish and mobile invertebrates, however, did not show any effects consistent with contamination of the sediments. Sediments from Mortlake contained greater amounts of polycyclic aromatic hydrocarbons (PAHs) than that from the Reference Locations, suggesting that the gasworks had had an impact on benthic infauna. The levels of contaminants found in fish, however, were similar across all three locations.
2009	Cardno Ecology Lab	An ecological assessment, including quantitative surveys, was undertaken of infauna, epibenthic fauna, mobile fish and invertebrates. The investigation reported a diverse range of infauna was observed within the bed sediments despite the extent of the contamination. Key observations include: • Infauna taxa primarily consisted of polychaetes, crustaceans and molluscs. • Epibenthic fauna sampled consisted of an assemblage of benthic fish, polychaetes, crustaceans and molluscs with bivalve molluscs, amphipods and shrimp being the most abundant. Epibenthic fauna was described as being typical of the Parramatta River region. • Invertebrates assemblages identified were not typical of the region. No threatened marine invertebrate or algal species, critically endangered or endangered species were recorded in the Project area. Similarly none of the threatened populations, threatened ecological communities and habitats of conservation significance listed as

Year	Author	Survey findings
		occurring in the Sydney Metro Area have been identified in the Project area (Cardno Ecology Lab, 2009a). Although various fish species are likely to move through Kendall Bay and some species may reside within Kendall Bay for part or all of their lifecycle, Kendall Bay is not expected to provide critical habitat for any fish species, especially considering that the contaminated nature of the sediments is likely to restrict the availability of invertebrate prey items targeted by fish. For example Black Cod - listed as Vulnerable - whilst known to occur in Sydney Harbour has not been observed in Kendall Bay. This ecological survey of Kendall Bay, which included the current Project Area, was undertaken to support a development application for the proposed Kendall Bay Marina, which did not proceed.
2009	Creese <i>et al</i>	A comprehensive survey to expand and update the spatial information of key coastal habitats such as seagrasses, mangroves and saltmarsh habitat was undertaken by DPI in collaboration with the NSW Department of Environment Climate Change and Water (DECCW) and various Coastal Catchment Management Authorities (CMAs). Results of the survey conducted within Port Jackson, including Parramatta River, Lane Cove River and Middle Harbour Creek, suggest very little estuarine macrophytes exist within the vicinity of Kendall Bay. Areas of mangrove habitat are shown to exist to the west of the Project Area in Majors Bay, Haslams Creek and near Sydney Olympic Park, whilst beds of seagrasses occur to the east of the Project Area in Hen and Chicken Bay.
2006, 2007 2012	URS ERM (draft report prepared for Jemena)	An extensive sediment sampling programme undertaken throughout Kendall Bay in 2006 and later in 2012 by ERM identified the seabed in the bay as fine- grained sediment overlain by a thin layer of sand with no evidence of seagrass, macroalgae, reef or macroinvertebrates. It was concluded that the subtidal seabed in the bay was unlikely to support diverse benthic habitats. Colonisation of the seabed by marine plants and macroinvertebrates would be prevented or deterred by the contaminated nature of the sediments. A separate study included the analysis of tissue material taken from oysters in the Project area.
2015	Cardno Ecology Lab (draft report prepared for Jemena)	Study was undertaken to determine the impacts of removal of the mangroves as proposed by an earlier (and since rejected) proposal for the Project. Includes description of mangrove habitat at Kendall Bay. The mangrove vegetation was considered to be in reasonable health, although the lack of abundant faunal components such as shore crabs, marine snails and other crustaceans that are characteristic of temperate mangrove habitat suggests that the mangrove stand within Kendall Bay has limited ecological value compared with other mangrove stands within the Sydney region, most likely due to the contaminated nature of the underlying sediment within Kendall Bay.
2016, 2017	AH Ecology	The Marine Benthic Assemblages studies carried out for the Ecological Risk Assessment by AH Ecology (Hunt 2016; S&W 2018b) are detailed below in Section 12.5.1.

12.5.1 MARINE BENTHIC INFAUNA ASSEMBLAGES

Further studies of the marine benthic infauna assemblages were undertaken by AH Ecology (Hunt 2016 and S&W 2018b) to support the development of the RAP for the Project.

2016 Study (AH Ecology 2016)

The aim of the 2016 study was to determine whether ecological patterns within the benthic invertebrate community in the Northern and Southern Remediation Areas of Kendall Bay demonstrated evidence of ecological differences compared to background locations with Kendall Bay and the adjacent Exile Bay and Majors Bay. Key findings of the 2016 study were:

- The test sites and background sites all supported marine benthic communities. Differences between sampling locations were typically small scale and were related to the number of animals rather than taxa.
- The sediment samples contained a total of 25 taxa across all sample locations. The most abundant were *Mactridae* and *Veneridae* bivalves whilst polychaete worms, *Nereididae* and *Nephtyidae* commonly occurred.
- Southern Remediation Area samples contained the fewest taxa and number of animals. Three sediment samples from the Southern Remediation Area contained no infauna.
- One sample from Northern Remediation Area contained no identifiable fauna. It was noted that a significantly higher number of animals and taxa were observed in Northern Remediation Area than in the background sample locations within Kendall Bay.
- The lowest diversity was observed in the background sites for both Kendall Bay and Majors Bay. The remaining sampling locations had moderate and comparable levels of diversity. The greatest diversity and infauna abundance was observed in Exile Bay.
- The study supported the observations that small-scale variations in abundance and diversity of marine infauna are related to sediment grain size, organic and microbial content, food abundance and water depth (Morrissey 1995, Ellingsen 2002). Other influencing factors include natural cycles of benthic infauna recruitment, migration patterns and sea water temperatures.

2017 Study (Synnot and Wilkinson 2018b)

The 2017 study sought to widen the scope of the study to address particular questions raised by the NSW EPA following EPA staff review of the revised draft RAP. These centred around the level of residual chronic toxicity of the sediments that would remain in the Southern and Northern Remediation Areas in Kendall Bay after remediation and whether the residual toxicity of sediments is similar to the toxicity in the surrounding bays outside of the area of influence of the AGL former Mortlake gasworks.

The additional work was completed to better understand and quantify the levels of background chronic toxicity that exist in areas outside of the proposed Remediation Areas in Kendall Bay and in nearby embayments in the Parramatta River.

The benthic macro-invertebrate communities within these sediment samples were identified and analysed to characterise the benthic infauna communities in these areas. The data was then used to compare these communities to infauna communities outside of the Remediation Areas, but within the area of the EPA's declaration of Kendall Bay and immediate surrounds. Six previously sampled sites were also resampled for this study so results from two separate sampling events (2016 and 2017) could be compared.

The findings of this current study support the findings from the sampling program during 2016. Key findings of the 2017 study were:

- The study supported the observations made in 2016 with respect to the factors that may influence small scale variations in abundance and diversity.
- Chronic toxicity of sediments appears ubiquitous within this section of the Parramatta River.
- Even given this chronic toxicity, these sediments support a heterogeneous array of infaunal communities; and
- Infaunal communities appear to show no clear patterns in the abundance and diversity across all bays and sites sampled, indicating that areas within Kendall Bay which are outside of the identified Remediation Areas are likely to be representative of infaunal communities within the nearby embayments sampled in this study.

Details from the studies are set out in the RAP (Appendix 2). The 2017 report (S&W 2018b) is attached at Appendix 11.

12.5.2 SUMMARY OF ECOLOGICAL STUDIES

Four broad habitat types have been identified: mangroves, sandy beach, rock platform and rock wall. A number of threatened species were identified through desktop assessment as having the potential to occur in the Project Area, however following characterisation of the on-ground habitat characteristics and site surveys it is considered that the majority of these species are unlikely to occur or limited resources are available.

Field survey results suggest the mangrove habitats are unlikely to support a broad diversity of fauna and as such are not considered to have important / significant biodiversity value. The presence of large amounts of coal and gross litter (e.g. plastic) trapped amongst the mangroves is an indicator of the highly disturbed nature of the environment, being in a heavily urbanised catchment and with a legacy of past contaminating land uses. No wading or roosting birds were noted during the various field surveys further suggesting that the mangrove trees do not provide valuable habitat for bird fauna in the area.

Rocky habitats dominate the shores of Kendall Bay, with artificial wall habitat along the western shore and natural sandstone platforms along much of the eastern shore. The rock platforms within approximately 100 m of the mangrove area do not appear to support a diversity of fauna and are likely to have been affected by the heavily urbanised catchment and past land uses and as such are not considered to be important / significant for biodiversity. A small range of habitats was also present within the artificial sandstone of the sea wall. The most diverse rocky shore communities were apparent with increasing distance north along the eastern shore, with the highest number of intertidal species apparent in the rock pools near the boat ramp at Cabarita Point.

The sandy beach area north-east of the mangroves does not appear to provide valuable habitat for marine species. No tracks or traces of invertebrates were evident in the sand at low tide and no bird activity was observed during the survey period.

Although various fish species are likely to move through Kendall Bay and some species may reside within Kendall Bay for part or all of their lifecycle, Kendall Bay is not expected to provide critical habitat for any fish species, especially considering that the contaminated nature of the sediments is likely to restrict the availability of invertebrate prey items targeted by fish.

The majority of samples taken in the benthic community studies (both test sites and background sites), supported marine benthic communities. The differences among sampling locations were typically small-scale differences in the number of animals rather than substantial differences in the number of taxa. Some samples contained no fauna; these were generally in areas where gasworks contaminants were

exposed at the surface and were, or were likely to be on the basis of the CSIRO criteria, acutely toxic (S&W 2018a).

In the areas of the bay where a layer of black oily gasworks-contaminated sediments were identified this layer was generally overlain by 50-300 mm of recent silt containing benthic infauna comparable to that found at other sites, distant from gasworks contamination, in the Parramatta River and its bays. Infaunal communities appear to show no clear patterns in the abundance and diversity across all bays and sites sampled, indicating that areas within Kendall Bay which are outside of the identified Remediation Areas are likely to be representative of infaunal communities within the nearby Reference Area embayments sampled in this study (S&W 2018a).

12.6 STAKEHOLDER VIEWS

Concern was initially expressed by stakeholders, based on the original remediation approach, in relation to the impacts of the remedial works on marine ecology and biodiversity. In particular, members of the local community were concerned that the original proposed approach had the potential to remove all or most of the mangroves located at the southern end of Kendall Bay. The mangroves are noted by many community members as important habitat for marine species, but also as having a role in beach and seawall stabilisation, and providing visual and aesthetic qualities. It was noted during the consultation process that mangroves have not always been present in Kendall Bay.

There is also a concern held by others in the local community about the long-term effectiveness of remediation in improving the quality of water and sediments in the bay if the mangroves are retained. Some community members feel that the remediation of hot spots should be a priority irrespective of the presence of the mangroves.

Subsequent to community consultation, the remedial approach was revised with a significant reduction in the impact of the works on the mangroves in the bay. It is now anticipated that only one mature mangrove and some small offshoots may have to be removed as a result of the work in Southern Remediation Area SA2.

12.7 POTENTIAL IMPACTS

The overall aim of the Project is to reduce human health and environmental risk through the remediation of contaminated sediment in the Southern and Northern Remediation Areas. The ERA prepared for the RAP assessed the exposure risks of marine organisms and the RAP details the proposed remediation activities in light of the assessment of risks to the marine ecological and human health (see Section 12.7.1 below).

Assessment of the Project activities indicates that the remediation of sediments has the potential to impact upon biodiversity and the marine environment in the following ways:

- physical loss of habitat within the Remediation Areas
- generation of underwater noise during the in-situ solidification (ISS) process
- altered water quality as a result of a sediment plume associated with ISS; and
- risk of accidental hydrocarbon spills associated with plant used during the sediment remediation activities.

12.7.1 ECOLOGICAL RISK ASSESSMENT

An Ecological Risk Assessment (ERA) was undertaken for the Project (S&W 2018c) (see Appendix 4) using data from the detailed sediment contamination studies, water quality monitoring, biological tissue monitoring, marine benthic community studies, and bioavailability and ecotoxicology studies to assess the risks to organisms exposed or potentially exposed to the gasworks-contaminated sediments of Kendall Bay.

The ERA showed that two areas in Kendall Bay where oily gasworks sediments are present at or near the sediment surface (one area being on the south-western side and the other midway up the western side), are, or are likely to be, acutely toxic to benthic organisms due to levels of PAHs and TRHs greatly exceeding the chemical remediation criteria developed by CSIRO from toxicity testing of bay sediments (S&W 2018a).

The ERA concluded that remediation that targets these **acutely** toxic sediments should eliminate acute toxicity and result in few instances of chronic toxicity to benthic organisms in Kendall Bay (i.e. the intended result of remediation is that the remaining surface sediments have total PAHs and TRHs below the specified criteria).

The CSIRO results indicate that remediation targeting areas where **chronic** toxicity is observed may be ineffective at eliminating chronic toxicity of the sediments in the longer term. This is because remediated areas within the bay will be expected to become re-contaminated as sediment from the surrounding environment is redeposited, and also by future stormwater inputs, particularly from the large stormwater drain at the southern end of Kendall Bay.

The RAP details that the areas to be remediated will be those areas where contamination in near-surface sediments (0-300 mm) exceeds the above CSIRO chemical criteria and:

- the sediments were found to be acutely toxic; or
- the sediments were found to contain no benthic fauna; or
- oily gasworks contamination was present in surface sediments or within 50 mm of the sediment surface.

Where the gasworks contamination is overlain by at least 50 mm of recently deposited sediment containing benthic infauna comparable to the fauna found in areas of the bay uncontaminated by gasworks wastes, the sediments will not be remediated as this would remove a viable benthic community, cause environmental harm and be contrary to the principles of environmental sustainability, and USEPA policies for remediating contaminated sediments.

12.7.2 ASSESSMENT OF IMPACTS TO THREATENED SPECIES

No threatened species as listed under the FM Act, BC Act and / or the EPBC Act were reported to utilise the habitats recorded during the various field surveys and studies in the Project Area. Four primary marine environment habitats were identified, each having the potential to provide some habitat in the form of foraging or occasional visits by a number of threatened species however it is unlikely that any part of the Project Area provides suitable breeding habitat for any of the threatened species that have been recorded in the broader area.

Of the species that may occur in the locality of the Project Area, few would utilise the habitat resources in the area to any great extent and would generally be found in the locality as 'transients' or 'opportunistic feeders' since the Project Area does not provide any significant habitat features for these species.

It is concluded that no threatened species are likely to be dependent on the limited marine resources present within the Project Area and the locality does not constitute preferred habitat for any threatened aquatic species as listed under the FM, BC and EPBC Acts.

Key Threatening Processes

No key threatening processes listed under the FM Act, BC Act and EPBC Acts are relevant to the proposed Project activities.

EPBC Act Assessment

With reference to the Significant Impact Guidelines 1.1 Matters of National Environment Significance (DEWHA 2013), no EPBC Act listed threatened species or communities were considered to have the potential to be impacted by the activity based on the results of the habitat assessment (see Table 12-3) and field investigations. No further assessment is required.

Migratory bird species identified as potentially occurring within the Project Area are considered to be wide-ranging with generalist habitat requirements. It was determined that the remediation activities would be unlikely to have a significant impact on such species and was not considered to:

- substantially modify, destroy or isolate an area of important habitat for these species
- result in harmful invasive species becoming established within the site; or
- seriously disrupt the life cycle of an ecologically significant proportion of a population of the species.

Biodiversity Assessment

Desktop review, database searches and field surveys did not identify any threatened species, endangered or critically endangered ecological communities in the Project Area. No areas containing habitat for vulnerable, endangered or critically endangered species were identified in the Project Area.

No BC Act or FM Act listed threatened species were considered to have the potential to be impacted by Project activities based on the results of the habitat assessment (Appendix 4) and the field survey (refer Section 12.4.3).

Removal of one mature mangrove from the mangrove community located at the southern end of Kendall Bay, and disturbance to rock wall and seabed habitats in the Project Area will result in minor, temporary impacts to aquatic habitats from Project activities (refer Section 12.7.3). Remediation activities will result in ongoing positive impacts and will improve the quality of the marine environment and amenity of this area of Kendall Bay.

It is considered that there is no requirement for consideration of biodiversity offsets for impacts to threatened species, communities or the aquatic habitats

12.7.3 LOSS OF HABITAT

Mangroves

Mangroves are listed as Key Fish Habitat (KFH) under the FM Act. KFH is defined as marine and estuarine habitats up to highest astronomical tide level but it is also recognised that not all aquatic habitats are important for the conservation of fish populations and the sustainability of fishing activities.

Mangrove habitat is primarily located in the Southern Remediation Area SA3, with individual trees in SA1, SA2 and SA4. The overall objective for remediation in the Southern Remediation Area (which includes the beach and mangrove area), is to remediate to the extent practicable, the contaminated

sediments that pose an acute toxicity risk to the marine ecosystem and an unacceptable risk to the health of users of the mangrove and beach areas which are accessible at low tides.

Remediation Area	Potential impacts to mangroves
SA3	Rubbish, debris, coke and coal present in the mangroves in SA3 will be manually removed to minimise any impacts to the mangroves and a layer of certified virgin excavated natural material (VENM) - clean sand - will be placed over the existing mangrove sediments. The sand will be either pumped as slurry from a floating barge offshore or stockpiled on the beach by small earthmoving equipment deployed on the beach at low tide by a landing barge and distributed throughout the mangroves by hand using wheelbarrows, spades and rakes to protect the integrity of the mangroves. In the western end of SA3 the mangrove root mass can reach half a metre in depth. Human contact with contaminated sediments is likely to be prevented or greatly reduced by the mangrove root mass due to the physical difficulty in reaching the contaminated materials. Given the thickness of the overlaying dense root mat, the risk of human exposure in this western end of SA3 is considered negligible and it is proposed that mangrove root mass will be left in place. A large stormwater drain located behind the mangroves in SA3 discharges periodically during rainfall events and creates a scour channel through the mangroves, over the sand shoal further into the bay and occasionally extends across the beach area to the east. Stormwater discharge also carries a significant amount of debris and rubbish which is strewn throughout the mangroves and the scour channel. An extension of the existing seawall on the beach to the east of the mangroves is proposed to retain beach nourishment in SA4, but will also act to alleviate the impacts of east flowing stormwater (see discussion for remediation activities at SA4 below). To avoid undermining of the seawall from scour, construction of a series of 'spur walls' through the mangrove area is also proposed. These low-level rock mound structures walls will train stormwater discharge away from the wall extension whilst allowing the flow to spread over the sand shoals without scouring a deep channel.
SA2	In order to achieve human health risk objectives, one of the westernmost mature mangroves (and potentially some smaller mangroves shooting around it), in the southern end of SA2 will require removal to allow for accurate retrieval of contaminated sediment and replacement of clean material. The mangrove to be removed will be identified during development of the Remediation Works Plan (refer Chapter 18 Environmental Management Framework), with the intention that mangrove removal will be minimised to the extent practicable to achieve the remediation objectives.

The remediation is to be completed in a manner which minimises and, if possible, prevents impacts to the existing mangroves. As noted above the mangrove habitat has a low diversity of species and currently does not provide high value habitat. The mangrove sediments may provide suitable habitat for a limited number of marine species (oysters, coniwinks and barnacles), no viable marine community has been identified in the area. Disturbance to the sediments in the mangroves will be temporary and short term and it is therefore considered that impacts to non-threatened flora, fauna and habitats in this area are anticipated to be low.

Mangrove removal in SA2 will be minimised to the extent required to meet the remediation objectives and overall negative impacts to the mangrove habitat from mangrove removal are considered to be negligible.

The remediation of the adjoining SA1 will have a post-remediation positive environmental impact as the work will reduce the acute risk to the marine ecosystem that has been identified and will remediate the sediments where PAH levels exceed the adopted Human Health criteria of 1 mg/kg (refer Chapter 14 Human Health).

The positive long term impacts to the mangrove habitat and nearby beach environments from the removal of rubbish, capping of the contaminated sediments within the mangroves, and alleviation of stormwater scour through extension of the low spur walls are considered to be significant.

Sandy Beach

The sandy beach habitat is located in the Southern Remediation Areas SA4 and SA5 and will be temporarily disturbed during the remediation activities through surface material removal and sand replacement activities. The remediation objectives for SA4 and SA5 are to improve the public amenity of the beach and provide a cleaner firmer underfoot wading area to be accessed from the beach.

As noted previously ecological studies indicate that the sandy beach does not appear to support significant marine species and does not appear to provide valuable foraging habitat for wading birds.

The beach area in SA4 contains coal, coke and other rubbish, with low levels of PAHs detected in the subsurface. It is proposed to remove sand and debris to a depth of 0.2m and replace the surface of the beach with certified VENM clean sand of compatible quality at the same slope and alignment.

The quantity of sand on the existing beach fluctuates in response to prevailing wind wave action and the regular action of boat wake waves from Rivercats and Harbourcats, which may cause beach sand to move alongshore and be captured within the sand shoal that has been established in the mangrove area. To retain beach nourishment in SA4, seaward extension of the existing sandstone wall beyond the limit of sand placement is proposed. The extension will act as groyne to retain sand and will extend the length of the wall by about 30 m. Construction of the wall extension will be undertaken by small earthmoving equipment deployed from a landing barge at low tide.

Proposals to ameliorate the impacts from the stormwater outlet at the eastern end of the beach (scour and deposition of debris and rubbish) will be discussed with the Canada Bay Council and RMS prior to completion of the Remediation Works Plan by the remediation contractor.

Ongoing maintenance may require the occasional removal of mangrove saplings from the beach to prevent encroachment from the adjacent stand of mangroves.

Impacts to the local marine environment from the temporary disturbance of the sandy beach through the removal and replacement of surface materials and construction of the seawall extension are expected to be negligible. Ongoing positive impacts to the onshore and immediate offshore beach environment from sand replacement, sand retention measures and proposed stormwater discharge management are considered to be significant and will substantially improve the public amenity of the beach.

Rock Platforms and Artificial Rock Walls

The range of marine species currently found on the rock platforms on the eastern shore of Kendall Bay is small and restricted to very common and widespread species such as oysters, mussels, filamentous green algae and coralline red algae. The most diverse rock platform assemblages observed in the Project Area were recorded in the vicinity of the Cabarita Point boat ramp which is well outside the Remediation Areas. The boat ramp area is unlikely to be impacted by the Project unless significant changes in water quality occur within Kendall Bay as a result of the remediation activities.

None of the species observed on these rock platforms is listed as threatened. If remediation activities do impact on the rock platforms, they are likely to be recolonised by the same species within a short period of time after the remediation works are completed.

The artificial rock walls located along the entire western margin of Kendall Bay also currently support a small assemblage of marine species that includes the most common and widespread species found within Kendall Bay, such as oysters, mussels, filamentous green algae and coniwinks.

The artificial rock wall habitat is located within the Remediation Areas identified as SA2 and NA1. The remediation objective for SA2 is to remove contaminated sediments that present a human health risk and / or an acute ecological risk. The remediation objective of NA1 is to protect human health by preventing people using the area from being exposed to contaminated sediments. In both Remediation Areas this will include remediation of stained surfaces, sediments which give rise to odours when exposed at low tides and removal of rubbish. Seawall stability is also an important consideration in these remediation areas.

Remediation activities in the rock / rubble areas adjacent to the sea wall of SA2 will involve removal of stained rock and sediments to a depth of 0.3 m between the seawall and a nominal distance of 5 m seaward or to the surveyed LAT (Lowest Astronomical Tide) contour in the area. This will be done whilst preserving the existing toe support along the seawall structure.

The aim is for the final seabed level to be below LAT and incorporate a 0.3 m thick capping layer, noting potential geotechnical restrictions relating to the seawall. The capping layer will incorporate a rock layer and certified VENM clean sand to provide substrate within the interstitial spaces of the rocks. This approach will improve the marine ecosystem within the bay and prevent access to the contaminated rubble along the base of the seawall at low tide.

Remediation activities in NA1 will similarly involve removal of stained rock / rubble and any contaminated sediment within the designated areas adjacent to the vertical seawall, with the aim to lower the seabed to below LAT and replace with a rock layer, VENM clean sand substrate and clean sandstone to encourage benthic recolonisation and to restore aesthetics.

Impacts to the local marine environment from the disturbance to the rock wall habitat through the removal and replacement of surface materials will be temporary. None of the species present are threatened and the loss of the individuals within the Remediation Areas is not expected to significantly affect the viability of these species within the bay. The rock walls will also likely be recolonised by the same species within a short period of time after the project is completed.

Ongoing positive impacts to the rock wall environment as a result of remediation activities are considered to be significant and will substantially improve the quality of the marine environment, aesthetics and amenity of this area of Kendall Bay.

Sub-tidal Seabed Habitat

Disturbance to fish and benthic organisms has the potential to occur during the remediation activities involving the removal of surface sediments on the seabed.

The main areas of seabed disturbance will be in Northern Remediation Areas NA2, NA3 and Southern Remediation Area SA1 where the ISS methodology will be utilised. Nearshore sand removal is also proposed for SA3, SA4 and SA5.

To avoid migration during the remedial works of any contaminated sediments into Kendall Bay and the adjacent Parramatta River, a continuous sheet pile wall will be installed to enclose Remediation Area SA1, (and potentially NA2 and NA3 depending on the results of the field trial). It is anticipated that this sheet pile wall will also prevent the migration of other (gasworks) contaminants into Remediation Area SA1.

In NA2 and NA3 cement-based mass solidification techniques will be used to create a stabilised monolith extending down to the competent clay layer (Unit 2B), excavation and disposal offsite of upper sediment profile and overlying capping material placed to a finished level at or marginally below LAT. This technique is described in Chapter 4 Description of Project Activities and a detailed explanation is presented in Chapter 9 of the RAP (refer Appendix 2).

The stabilisation and / or removal of contaminated sea bed sediments and reinstatement of substrate using clean sand fill will positively impact the seabed and improve the opportunity for marine species to colonise the seabed within Kendall Bay.

In the Southern Remediation Area, Remediation Area SA5 extends from the beach in SA4, and extends out almost to LAT. Within SA5 sand will be removed to a depth of 0.3 m using an amphibious excavator and replaced to the same depth with certified VENM clean imported sand material compatible with the existing beach sand further inshore to provide a clean upper sediment profile offshore from the beach. The excavated material will be blended with sand for re-use in capping processes in the other Remediation Areas (i.e. SA1 and NA2+NA3).

No endangered or protected fish species are known to occur in the Project Area and previous ecological assessments in Kendall Bay did not detect seagrass, macroalgae or significant macrobenthic activity. Fish species inhabiting the water column within the area designated for remediation are likely to temporarily avoid the areas during periods of activity.

Impacts to the local marine environment from the temporary disturbance of the seabed through the implementation of the ISS methodology and removal and replacement of surface materials are expected to be temporary. The removal, stabilisation and capping of contaminated sediments and reinstatement of the bathymetry using clean sand fill will positively impact the seabed and improve the opportunity for marine species to colonise the seabed in the Remediation Areas. Ongoing positive impacts as a result of remediation activities are considered to be significant and will improve the quality of the marine environment and amenity of this area of Kendall Bay.

12.7.4 UNDERWATER NOISE

Generation of underwater noise will occur during the installation and operation of the equipment required for ISS. Noise is likely to be transmitted through the water within a range of several kilometres from the source. However, the absence of sensitive marine species such as marine mammals in the vicinity of the site (based on the EPBC and BioNet search) means that underwater noise is unlikely to significantly impact the marine environment. Fish that may inhabit Kendall Bay during the noisy activities are mobile and are considered likely to actively avoid stressful environments and return once the noise abates.

The noise disturbance will be temporary and in the context of the other existing (ambient) noise sources in the Parramatta River such as the regular ferry services, the impact of noise to aquatic biota is not considered to be significant. Vessel traffic and a range of construction activities within the river already contribute to underwater noise in the area. Piling activities will also have a soft start to ensure that mobile marine fauna will have an opportunity to temporarily move away from the Remediation Areas.

12.7.5 WATER QUALITY

Re-suspension of sediments and release of unbound contaminants

Impacts on water quality have the potential to occur as a result of the re-suspension of sediments during excavation causing increased turbidity and release of unbound contaminants from sediments creating a hydrocarbon sheen at the top of the water column. There is also potential that during the solidification works the cement material may interact with the water column, impacting on the overall pH of the immediate area.

Marine species most susceptible to increased turbidity, such as seagrasses and macroalgae, are not known to occur within Kendall Bay but sessile species that colonise rocky shores are sensitive to smothering by sediments. These species are found along the majority of shores of Kendall Bay albeit in low diversity in most areas close to the Remediation Areas.

It is anticipated that installation of a continuous sheet pile wall around Remediation Area SA1 and silt curtains for NA2 and NA3 will avoid or minimise the above potential impacts on water quality, sessile

species and habitats along the seawall or rocky shoreline. Anticipated impacts on sessile species are therefore not considered significant.

Discharge of water from within the remediation process to Kendall Bay

Discharge of contaminated water from the remediation process has the potential to impact on water quality in the bay. Contaminated water captured in the onboard storage tanks of the barges will be transferred to the Staging Site for offsite disposal at a licenced facility.

If required, water from the remediation works may be discharged to the harbour. This would only be able to occur following an assessment of the water quality, discharge volumes and issue of the appropriate licence by the EPA.

Accidental hydrocarbon spill

A reduction in water quality has the potential to occur through accidental hydrocarbon spills from plant and equipment used during the remediation activities. The occurrence of an accidental spill has the potential to impact on marine species.

Although unlikely, there is the potential for unplanned events to lead to a reduction in water quality. The extent, scale and duration of the impact will depend on the type and volume of the material and the point of discharge into the marine environment.

Effective implementation of standard operating procedures and mitigation measures will ensure that the probability of these unplanned events occurring is as low as possible.

12.8 CUMULATIVE IMPACTS

The removal of contaminated sediments and reinstatement of the bathymetry using certified VENM clean sand fill or sand which meets reuse criteria will positively impact the seabed and improve the opportunity for marine species to colonise the seabed within Kendall Bay.

It should be noted that Kendall Bay is largely a depositional area for sediment (S&W 2018a), and once remediation has been completed natural processes (tidal and wave currents) will transport suspended and bed sediment from surrounding areas of the bay and the adjacent Parramatta River, and begin to deposit this sediment in the Remediation Areas. As previously noted, the whole Parramatta River is contaminated with heavy metals and a range of other substances, and therefore over time the composition of surface sediments in the remediated areas will change to reflect background contamination in the Parramatta River.

12.9 MITIGATION MEASURES

The findings of this assessment indicate that there are no critical marine habitats in the Project Area and no threatened marine species known to utilise marine resources in Kendall Bay. Despite the absence of critical habitats and species within Kendall Bay, the Project will adopt measures to minimise or mitigate potential impacts to the marine environment in accordance with the mitigation hierarchy (avoid, minimise, mitigate).

Sediment removal is required in order to achieve the goals of the remediation which include addressing the existing unacceptable risk to human health and the environment. Substantial risk assessment has been undertaken from a contaminated site perspective to develop the proposed remediation approach that also considers avoidance and minimisation of the remediation footprint.

To minimise and manage impacts to biodiversity and the marine and intertidal ecosystems within and adjacent to the Project Area, mitigation measures relate to:

- minimising the disturbance footprint
- measures to manage water quality during the life of the Project
- stabilisation and rehabilitation measures following the disturbance; and
- monitoring water quality and habitats during and following the Project.

These measures are primarily related to managing the impacts to water quality and sediments of remediation activities and are discussed in detail in Chapter 11.

12.10 IMPACT AND MITIGATION MEASURES SUMMARY TABLE

A summary of the potential impacts on biodiversity and the marine environment together with the mitigation and management measures to be implemented are outlined in Table 12-6.

Table 12-6: Summary of impact and mitigation measures

Potential impact	Mitigation and management measures
Impacts on threatened or protected fauna species through loss of preferred habitat	There are no critical marine habitats in the Project Area and no threatened marine species known to utilise marine resources in Kendall Bay.
Physical loss of mangrove habitat	• Remediation methodology has been designed to minimise impacts to mangrove habitat. • Proposed remediation methodology is expected to only require removal of one mature mangrove in the southernmost end of SA2 only. • Rubbish, debris, coke and coal present in the mangroves in SA3 will be manually removed to minimise any impacts to the mangroves • Clean sand (VENM) distributed throughout mangroves by hand using wheelbarrows, spades and rakes to protect the integrity of the mangroves
Removal of contaminated sediments and re-establishment of the seabed in the Remediation Areas.	Stabilisation and / or removal of contaminated sea bed sediments and reinstatement of substrate using certified VENM clean sand fill or sand which meets reuse criteria will positively impact the seabed and improve the opportunity for marine species to colonise the seabed within Kendall Bay
Disturbance to fish and benthic organisms during the removal of sediment.	No mitigation or management measures were identified or are considered required to manage or reduce this impact.
Disturbance to marine fauna from underwater noise generated during the installation and subsequent removal of remediation equipment and infrastructure.	• 'Soft start' will be implemented during sheet pile installation to allow marine and terrestrial fauna to move away from the Remediation Areas. • Ambient noise in the area from existing activities (such as regular ferries etc) also assist in mitigating noise impacts.

Altered water quality as a result of disturbance of the bed of Kendall Bay by the excavation process and release of contaminants into the water column causing impacts to marine species	Management measures relating to soil and water described in Table 11-4 (Chapter 11 Water Quality and Sediments) are to be implemented to manage potential impacts to marine species, through a reduction in water quality. These relate to:
Accidental spills into the marine environment causing a reduction in water quality resulting in potential adverse impacts to marine species	• installation of silt curtain and continuous sheet pile wall (SA1) prior to commencement of remediation • maintenance of oil absorption equipment and oil spill response kits onboard all floating vessels • stormwater management at the Staging Site; and • water quality management plan and water quality monitoring program.

12.11 CONCLUSION

NSW EPA's policy requires that soil remediation and management is conducted in consideration of the principle that remediation should not proceed where it is likely to cause a greater adverse effect than leaving the site undisturbed. This principle is of special relevance to the remediation of sediments, the disturbance of which:

- has a high potential to mobilise contaminants into the water column; and
- have negative impacts on any existing ecosystem.

This principle has been incorporated into the design of the remediation activities to minimise the impacts of the activities whilst achieving the objectives of the Project. The aim of remediation of gasworks-contaminated sediments in parts of the Southern and Northern Investigation Area is to protect human health and protect the aquatic environment from acutely toxic sediments.

The biodiversity impact assessment indicates that there is potential for minor temporary impacts to marine flora and fauna from remediation activities within the Project Area. However, the absence of critical habitat and known threatened or endangered species within the locality combined with the application of the prescribed mitigation and management measures provides confidence that the remediation of contaminated sediments can be undertaken without significant risk to sensitive receptors.

Overall it is considered the outcome of the Project will be an improvement to the condition of the marine environment of Kendall Bay.

13. CULTURAL HERITAGE

This chapter describes the non-Aboriginal and Aboriginal cultural heritage in the broader Project area and provides an assessment of the potential impact of the Project on cultural heritage and the measures that will be used to mitigate those impacts. Four heritage listed items and two Aboriginal cultural heritage sites are located in the local area (but outside the Project Area).

13.1 OBJECTIVES AND SCOPE

The assessment provided in this chapter is based on the Statement of Heritage Impact (SOHI) undertaken on behalf of Jemena by Environmental Resources Management Pty Ltd (ERM) in 2015 and updated by JBS&G and Jemena, which is provided at Appendix 12.

This chapter addresses the following SEARs:

SEARs Requirement – Heritage

- Include an assessment of non-Aboriginal and Aboriginal heritage impacts.

13.2 ASSESSMENT METHODOLOGY

The assessment involved the following tasks:

- a search of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) Protected Matters Search Tool for heritage items or Places of National significance under the EPBC Act (Commonwealth heritage)
- a search of relevant databases including the Australian Heritage Database (AHD), NSW State Heritage Inventory (SHI), NSW State Heritage Register (SHR), Aboriginal Heritage Information Management System (AHIMS) and National Shipwreck database
- a review of the Canada Bay LEP for locally listed heritage items
- a site walkover to undertake a physical analysis of any heritage listed items within the Project Area; and
- an assessment of potential Aboriginal heritage impacts in accordance with the Office of Environment and Heritage (OEH) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010).

The assessment was undertaken having regard to the following legislation and policies:

- *Environmental Planning and Assessment Act 1979* (NSW)
- *Environmental Protection and Biodiversity Conservation Act 1999* (Cth)
- *Heritage Act 1977* (NSW)
- *National Parks and Wildlife Act 1974* (NSW)
- *Environmental Planning and Assessment Act 1979* (NSW)
- *Canada Bay Local Environment Plan 2013*

- *Burra Charter: Australian International Council on Monuments and Sites (ICOMOS) 1999*
- *Guide to investigation, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011a); and*
- *Aboriginal Cultural Heritage Consultation Requirements for Proponent 2010 (DECCW, 2010c).*

13.3 EXISTING ENVIRONMENT

Kendall Bay is located between the residential suburbs of Cabarita (to the east) and Breakfast Point (to the west).

The western shoreline area is generally developed consisting of a stone seawall, a shared pedestrian cycleway (promenade) and the residential dwellings of the Breakfast Point development.

Cabarita Park is on the eastern foreshore of Kendall Bay with internal access roads, walkways and picnic areas extending throughout the parkland. The eastern shoreline largely consists of rock outcrops and small pockets of mangroves.

The southern shoreline area of Kendall Bay consists of a small intertidal beach and mangrove area.

13.3.1 NON-ABORIGINAL CULTURAL HERITAGE

A review of the heritage databases outlined in Section 13.2 indicated that there are four statutory listed heritage items in the vicinity of the Project Area:

- **the Mortlake Ferry** - (or Putney Punt), which is listed in the SHI and identified as local Heritage Item 253 in Schedule 5 of the LEP
- **Cabarita Park** - which is listed in the SHI and identified as local Heritage Item 58 in Schedule 5 of the LEP
- **the Federation Pavilion** - located within Cabarita Park, which is listed in the SHR (listing number 1454); and
- **the 'Lady Edeline'** – which is listed in the Australian National Shipwreck Database (Shipwreck ID 1050) and is protected by the Heritage Act.

A description of these four listed heritage items is provided in Table 13-1 and their respective locations are shown in Figure 13-1. Photographs of each item are also provided in Plate 13-1 to Plate 13-5. A broader discussion on the heritage significance of each item is provided in the SOHI (refer Appendix 12).

Table 13-1: Historic cultural heritage items

Heritage item	Listing type	Location	Description / heritage significance
Mortlake Ferry/ Putney Punt	SHI Canada Bay LEP	Approximately 75 m north west of the Staging Site, outside the Project Area.	The Mortlake Ferry / Putney Punt comprises the ramp, slipway and setting. The Punt is a diesel powered vehicular cable ferry that runs across the Parramatta River from Hilly Street in Mortlake to Pellisier Road in Putney. There is evidence of earlier sandstone block construction at the slipway and along the embankment between the slipway and the ramp. The

Heritage item	Listing type	Location	Description / heritage significance
			Mortlake Ferry ramp has been modified and widened in recent years and is now constructed with concrete and bitumen. The Statement of Significance outlined in the SHI is as follows: <i>"Location of last vehicular punt in Sydney Metropolitan area. Displays rare waterfront character and activity. Sites giving good views of river and northern foreshore"</i> (OEH 2008).
Cabarita Park	SHI Canada Bay LEP	Situated to the immediate east of Kendall Bay and the Project Area, extending into the eastern shoreline.	Cabarita Park is a large reserve characterised by managed parkland with mowed grassland extending throughout. The north and western shoreline consists of a sandy beach, with patches of native grasses and indigenous Port Jackson fig trees. A 'Victory Coppice' extends along the southern boundary of the park and a large rotunda is located towards the southern boundary (see Federation Pavilion below). The parkland includes a playground and continues to be used as a recreational facility and appears well maintained. The Statement of Significance outlined in the SHI is as follows: <i>"Park of substantial historic importance reserved as a recreation area in 1856 and dedicated in the 1880s. Used as a venue to watch events on the river. Includes monument to world champion rower William Pearce and a Victory Coppice. The Federation Rotunda is of State Significance for its historical importance. The swimming pool is also important for its use since 1937. Parkland retaining some natural foreshore character, layout and planting from c.1920/30s set in a prominent position on the Parramatta River."</i> (OEH 2014b).
Federation Pavilion	SHR	Situated in the middle of Cabarita Park, approximately 190 m east of the Project Area.	The Statement of Significance according to the SHR is as follows: <i>"The Pavilion structure is significant as the timber frame of the pavilion that was used as the site for the swearing in of the first Governor General of Australia, Lord Hopetoun, the first Prime Minister, Edmund Barton, and the first Cabinet at the official inauguration of federation in Centennial Park, Sydney, on January 1901".</i> The Pavilion was moved to its current position in 1903.
'Lady Edeline'	Australian National Shipwreck Database	Located just off the southern shoreline of Fairmile Cove within	The 'Lady Edeline' is a partially submerged shipwreck, which operated as a passenger ferry prior to sinking at its mooring in 1987. The ferry was a double-ended wooden ferry that was launched in 1913 from the GA Washington

Heritage item	Listing type	Location	Description / heritage significance
		the marine corridor of the Project.	shipyard at Balmain, Sydney Harbour (Department of Environment and Energy, 2017). Timber and metal elements associated with the wreck are visible from the shoreline at Fairmile Cove. Without undertaking an underwater survey and condition assessment, it is difficult to determine the condition of the 'Lady Edeline', however, the exposed elements are in poor condition and will gradually deteriorate over time. As a maritime archaeological resource, the 'Lady Edeline' provides research potential to yield information that would contribute to an understanding of the area's cultural history.

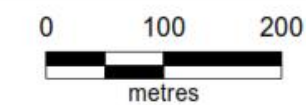
**Legend:**

- Staging Site (140 Tennyson Road, Mortlake)
- Declared Area
- Cultural Heritage Feature
- Cultural Heritage Boundary
- Northern Remediation Area
- NA1
- NA2
- NA3
- SA1
- SA2
- SA3
- SA4
- SA5
- Sea Wall
- Water Based Corridor**
- 10 Metres from Sea Wall
- 20 Metres from Sea Wall

Note: Declared and remediation area approximate only



Scale at A4 1:8,000



Coor. Sys. GDA 1994 MGA Zone 56

Kendall Bay Sediment Remediation Project,
Sydney, New South Wales

LOCATION OF CULTURAL HERITAGE ITEMS

Figure 13-1: Location of heritage sites in Project area



Plate 13-1: View of the Mortlake Ferry/ Putney Punt – looking north. (Source: ERM)



Plate 13-2: View of Cabarita Park - looking south-west. (Source: ERM)



Plate 13-3: View of the 'Lady Edeline' half Submerged in Kendall Bay (1987). (Source: Jemena 2017)



Plate 13-4: Visible remains of the 'Lady Edeline' (at low tide). (Source: Jemena 2017)



Plate 13-5: View of the Federation Pavilion – looking south–east. (Source: JBS&G 2017)

13.3.2 ABORIGINAL CULTURAL HERITAGE

The desktop search of AHIMS did not identify any Aboriginal cultural heritage items or places within the Project Area.

Two AHIMS sites (Nos. 45-6-2804 and 45-6-2532), both shell midden sites, have been previously recorded in Cabarita Park, north-east of the Project Area.

Site No. 45-6-2804 is located on the north-western tip of Cabarita Park, on the northern side of the concrete boat ramp. Site No. 45-6-2532 is a large shell midden located on the northern foreshore of Cabarita Park. The AHIMS sites are approximately 200 m from the closest Remediation Areas (SA4 and SA5).

13.4 STAKEHOLDER VIEWS

No issues were raised during the stakeholder engagement process in relation to cultural heritage. Jemena has undertaken further consultation with the OEH in relation to the Project and no additional issues or further requests have been received from the OEH.

13.5 POTENTIAL IMPACTS

13.5.1 NON-ABORIGINAL CULTURAL HERITAGE

This section provides an overview of the potential impact to the heritage listed Mortlake Ferry, Cabarita Park / Federation Pavilion and the 'Lady Edeline' wreck.

Mortlake Ferry

The existing cable alignment / route of the ferry between Mortlake and Putney will not be affected during Project related activities adjacent to the Staging Site. Project activities are proposed outside the curtilage of the Punt and associated ramp and slipway, and therefore are not expected to impact on the setting of that heritage place. There are no anticipated impacts to the Mortlake Ferry with regards to cultural heritage.

Cabarita Park and Federation Pavilion

Given that no onshore activities are proposed for Cabarita Park and based on the location of works relative to the broader park area, Project activities will not impact on the heritage significance of Cabarita Park and the Federation Pavilion, and users will still be able to access the park, and view and appreciate its significance.

Barge movements associated with the transportation of bulk material and placement of sedimentation barriers during construction are not expected to create excessive river surge to a degree that would impact on the shoreline of Cabarita Point. There is no predicted impact to the Cabarita Park and Federation Pavilion in relation to the Project.

'Lady Edeline'

As the wreck is located within the marine corridor of the Project, there is a risk of collisions between Project vessels and the wreck, which can be mitigated by the use of buoys to demarcate an exclusion zone.

Based on the trafficable speed limits within the vicinity of the marina, it is not expected that barge movements in the vicinity of the wreck would create wave surges to a degree that would cause accelerated deterioration of the wreck. The predicted impact to the 'Lady Edeline' is negligible.

13.5.2 ABORIGINAL CULTURAL HERITAGE

The historic establishment of Cabarita Park, the associated infrastructure and past industrial activities, have involved infilling of the coastal saltmarsh and wetlands, construction of a stone seawall and extensive disturbance of surface and sub-surface ground layers. These past activities have resulted in a low potential for the presence of Aboriginal cultural heritage sites along the shoreline and within areas adjacent to the Project.

The recorded AIHMS sites are located more than 200 m north of the ground disturbing activities associated with the Project, which are focussed on the marine and nearshore areas of the defined Remediation Areas within Kendall Bay. Onshore at the Staging Site, there has also been significant ground disturbance and building activity and it is considered unlikely that Aboriginal cultural heritage sites would be present.

It is considered that there will be no impacts to the previously recorded Aboriginal cultural heritage sites located in Cabarita Park and overall there are no anticipated impacts to Aboriginal cultural heritage in relation to the Project.

In the event that unexpected Aboriginal cultural heritage sites are discovered during site establishment and the remediation works, the mitigation measures in Section 13.7 will be strictly adhered to.

13.6 CUMULATIVE IMPACTS

No cultural heritage related cumulative impacts are expected to occur as a result of proposed Project activities.

13.7 MITIGATION MEASURES

While the assessment has not identified significant risks to heritage resources, the following proposed heritage management and mitigation measures will be implemented when undertaking the proposed works. to ensure that potential impacts are minimised.

13.7.1 CULTURAL HERITAGE INDUCTION

Prior to commencement of Project activities, workers and sub-contractors will be made aware of the location of Cabarita Park, the Mortlake Ferry, the remains of the 'Lady Edeline', their associated heritage values and the need for caution and reporting of any inadvertent damage to the items. Of particular importance is due care of the remains of the 'Lady Edeline'.

A brief presentation on the incident reporting procedure which would require work to be stopped in the unlikely event of damage to the heritage items, will also be made during the Occupational Health and Safety briefing / induction. This will include induction on procedures to be followed in the event of suspected discovery of Aboriginal heritage item. Guidance from OEH will be sought prior to the resumption of Project work in the immediate vicinity of the heritage item affected.

13.7.2 ABORIGINAL CULTURAL HERITAGE

To limit potential impact on any unidentified Aboriginal sites or objects in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010c) the following measures will be adopted:

- If during Project works, a suspected Aboriginal object is found, work in that location will stop and OEH notified immediately; and
- In the event that human skeletal remains are uncovered, work must cease immediately in that area and the area secured (fenced and / or marked). Jemena will notify the NSW Police and OEH immediately.

13.7.3 DEMARCATION OF THE REMAINS OF THE 'LADY EDELINE'

As the wreck is located within the marine corridor of the Project, prior to the commencement of Project activities, a 5 metre buffer area will be established with the use of buoys placed around the exposed remains of the 'Lady Edeline'. The buoys will clearly expose the 'Lady Edeline's' location and assist with the prevention of inadvertent collisions between project vessels and the wreck.

13.8 IMPACT AND MITIGATION MEASURES SUMMARY

A summary of the potential impacts on cultural heritage in the Project Area together with the mitigation and management measures to be implemented are outlined in Table 13-2.

Table 13-2: Summary of potential impacts and mitigation measures

Potential impact	Mitigation and management measures
Potential unplanned impacts to the: • Mortlake Punt; • Cabarita Park and Federation Pavilion; and • 'Lady Edeline' wreck.	• Cultural heritage induction for contractors prior to commencement of Project activities • Establishment of a 5 metre buffer zone around the exposed remains of the 'Lady Edeline'.
Potential damage to previously unrecorded sites during remediation activities.	• Cultural heritage induction for contractors prior to commencement of works outlining procedure for suspected discovery of an Aboriginal object. • Work will stop at that location if a suspected Aboriginal object is found during works and OEH will be notified. • If human skeletal remains are uncovered, work will cease immediately in that area and the area secured (fenced). Jemena will notify the NSW Police and OEH immediately.

13.9 CONCLUSION

A review of relevant heritage databases indicated that four listed historic heritage places and two previously recorded AHIMS sites were identified in close proximity to the Project Area. Only the 'Lady Edeline' wreck was determined to be located within the proposed Project Area, however its location will be situated outside the proposed vessel navigation route and well outside the Remediation Areas.

Ground disturbing works will be limited to the marine and nearshore areas within Kendall Bay and there is low potential for the presence of Aboriginal sites on the highly disturbed and developed shoreline areas adjacent to the Project area.

Given the separation distances between the proposed Project activities and the location of the listed heritage items, and subject to the implementation of the recommended mitigation and management activities, the Project is not expected to adversely impact on the heritage values identified in the vicinity of the Project Area.

14. HUMAN HEALTH

This chapter discusses the potential impacts of the Project on human health and summarises the findings of the Human Health Risk Assessment undertaken for the Project. It provides justification for the Project in terms of existing risks to human health, as well as discussion around the management of human health impacts during and following the remediation phase.

14.1 OBJECTIVES AND SCOPE

This chapter is based on the Human Health Risk Assessment (HHRA) undertaken by Environmental Risk Sciences Pty Ltd (EnRiskS 2018) (refer Appendix 3) as part of the preparation of the Remediation Action Plan for the Project.

This chapter addresses the following SEARs:

SEARs Requirement – Human Health and Ecological Risk Assessment

Include an assessment of the health implications of the development (including from the extraction of sediments, treatment and disposal of treated material), during and following remediation, including details of exposure scenarios and demonstration that the development will not have unacceptable acute or chronic health effects on humans or ecological resources.

The objective of the HHRA undertaken for the Project was:

- to review the existing monitoring data and previous human health risk assessments
- to identify toxicity reference values and a set of site-specific exposure scenarios
- to develop site-specific sediment risk-based criteria; and
- to evaluate the potential health risks and odour impacts during remediation.

The 2018 HHRA built on previous risk assessments undertaken for the Remediation Area by URS (2007a) and SKM (2014a) and includes consideration of potential risks to human health from sediment and from odours which may be generated during the Project.

An initial screening assessment was conducted as part of the HHRA to identify the chemicals of concern which required further assessment, including the development of human health remediation criteria. The risk-based criteria have been developed using exposure values derived from a combination of site specific data, exposure parameters presented in various guidance documents and best professional judgement regarding realistic exposure scenarios. The derived risk-based criteria have been adopted as the remediation criteria for the Project.

This assessment indicated that the potential human health risks are associated primarily with adults and children who use the beach, mangrove and rocky areas of the Southern Remediation Area for recreation activities as outlined in Section 14.4.

It is not within the scope of this EIS to assess occupational health and safety, which is covered by the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2011*. A Work Health and Safety Plan which will address the site specific requirements to manage risks to the health and safety of workers on the Project is discussed further in Chapter 12 of the RAP (refer Appendix 2).

14.2 ASSESSMENT METHODOLOGY

The approach for the HHRA was completed in accordance with guidelines endorsed by Australian regulators, including:

- *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards* (enHealth 2012a)
- *Australian Exposure Factor Guide* (enHealth 2012b); and
- *National Environment Protection (Assessment of Site Contamination) Measure 1999* amended 2013 (ASC NEPM 1999, amended 2013).

The above documents are supplemented by protocols and guidelines developed by international agencies such as the USEPA (USEPA 1989, 1991, 2002, 2004, 2009).

The methodology for undertaking the HHRA (as detailed in the ASC NEPM 1999, amended 2013) is shown in Figure 14-1 below and involves the following tasks:

- identification of issues
- hazard assessment
- exposure assessment; and
- risk characterisation.

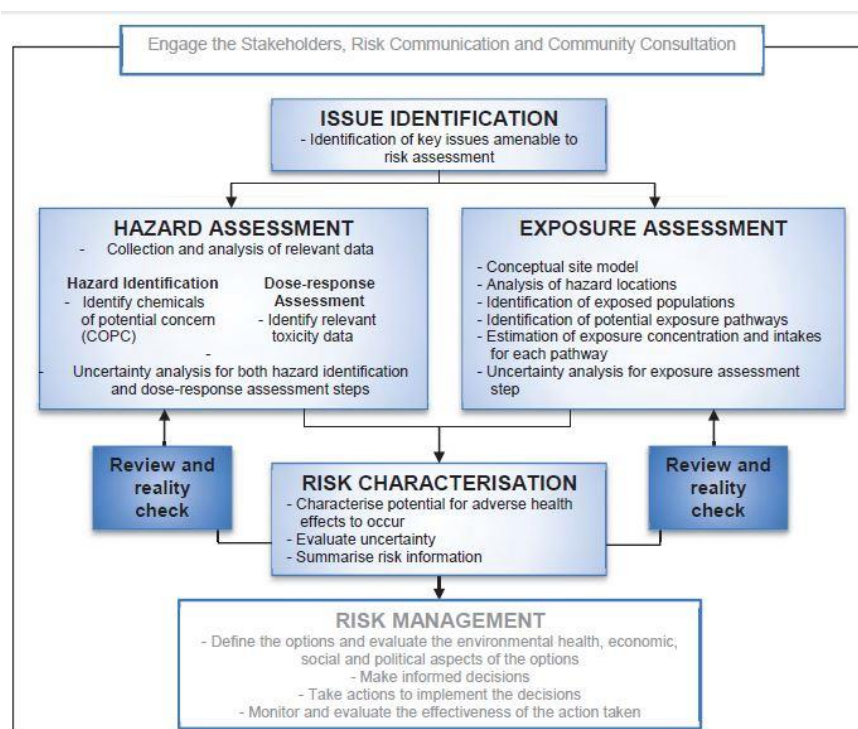


Figure 14-1: Environmental health risk assessment model. (Source: enHealth 2012a)

14.2.1 DATA REVIEWED FOR ASSESSMENT OF HUMAN HEALTH RISKS

A large amount of data relating to the sediments in Kendall Bay has been collected over almost a decade, with more than 100 locations sampled throughout the various site investigations for the beach and mangrove areas. Several previous HHRA (refer Chapter 2 Project Justification and Alternatives) have also been undertaken for Kendall Bay to determine if remediation was required and if so, what areas needed to be remediated to address potential risks to human health.

This existing data and the previous human health risk assessments were reviewed as part of the development of the HHRA for the Project, which included the following key steps:

- review of background site information
- review of previous site investigations
- review of the existing human health risk assessments
- review of new monitoring data for sediments, surface water and biota
- establishment of exposure scenarios relevant to determining remediation criteria
- identification of relevant toxicological information and data for the key chemicals
- assessment of the potential risks to human health and derivation of remediation criteria and sensitivity analysis; and
- consideration of odours during remediation

Additional studies were undertaken in 2015, 2016 and 2017 to refine the remediation design. The additional data obtained, together with recent updates to national risk assessment guidance and consideration of the need (where possible) to retain the mangroves at the southern end of Kendall Bay, were used to develop remediation criteria for the Northern Remediation Area and Southern Remediation Area. The Northern and Southern Remediation Areas are discussed in more detail in Chapter 3 Site Location and Context and Chapter 4 Description of Project Activities.

Site-specific remediation criteria which are protective of human health have been determined on the basis of the exposure scenarios and the toxicity assessments set out in the HHRA. Separate site-specific human health remediation criteria have been derived for benzo[a]pyrene toxic-equivalents (BaP TEQ), representing carcinogenic PAHs, based on exposure to sediments at the southern end of Kendall Bay, i.e. beach area, central mangrove area and the western corner of Kendall Bay, while undertaking recreational activities. These remediation criteria have been indicated for application in this EIS for Southern Remediation Areas SA1, SA2, SA3 (at the western end adjacent to SA1), SA3 (remainder of the mangrove area), SA4, SA5 and Northern Remediation Area NA1 (refer Figure 1-1 Chapter 1 Introduction).

The human health protective remediation criteria are not considered applicable to the Northern Remediation sub-areas NA2 and NA3, as these areas remain submerged by water. The ecological criteria as adopted in the Ecological Risk Assessment (refer Appendix 4) are regarded as more relevant (refer Chapter 12 Biodiversity) to NA2 and NA3 and therefore NA2 and NA3 are not discussed further in this Chapter.

The proposed site-specific human health remediation criteria are summarised in Section 14.6.1 and Table 14-2 below and discussed in detail in the HHRA (refer Appendix 3).

14.3 EXISTING ENVIRONMENT

14.3.1 SOURCE CHARACTERISATION

Chemicals of Potential Concern (COPCs)

As described in further detail in Chapter 11 Water Quality and Sediment, the following chemicals have been identified in the Project Area from a number of previous sediment investigations and risk assessments:

- total recoverable hydrocarbons (TRH)
- benzene, toluene, ethylbenzene and xylene (BTEX)
- polycyclic aromatic hydrocarbons (PAHs)
- cyanide (free and total); and
- heavy metals.

Sediments

Sediment sample results were reviewed to identify whether the recorded maximum concentration of COPCs exceeded the adopted screening criteria, i.e. human health risk-based investigation levels or relevant national and international screening guidelines. Chemicals which exceed the screening criteria are subjected to further evaluation or selected as the COPCs which required the development of remediation criteria.

Sediment sampling and results are detailed in Chapter 11 Water Quality and Sediments and in the RAP (Appendix 2).

In summary, the sediments in the most contaminated parts of Kendall Bay contained the following chemicals in excess of the adopted screening criteria, namely:

- carcinogenic PAHs [assessed as benzo[a]pyrene toxic equivalents (BaP TEQs)]
- Total PAHs
- TRH C15-C28 (TRH F3); and
- heavy metals (i.e. chromium and lead) (Note: the values found were comparable to the values present elsewhere in the Parramatta River, likely to be due to historical activities along the Parramatta River and stormwater runoff from urban areas such as roads).

The TRH F3 and heavy metals were excluded as COPCs in the HHRA based on a screening assessment using modified screening criteria derived from site-specific exposure assumptions. The COPCs in the sediments were identified as carcinogenic PAHs (as BaP TEQs) and total PAHs. Hence, the HHRA has developed site-specific remediation criteria for BaP TEQs (representing the carcinogenic PAHs), to mitigate the potential risks to human health for recreational activities at the accessible foreshore areas and western end of the mangrove area, the remainder of the mangrove area and wading areas.

Surface Water

Surface water sampling was undertaken at various locations in Kendall Bay, Exile Bay and Majors Bay. The concentrations of chemical contaminants were all found below the adopted water quality guidelines

for protection of human health within each bay except for carcinogenic PAHs (as BaP TEQs, were exceedances were reported in each bay). The BaP TEQs in surface water has been determined to be associated with suspended particulates. The BaP TEQs concentrations in the surface water were below the limit of reporting during the investigation conducted in October 2017.

The concentrations of chemical contaminants in surface water were also found to be below the adopted ecological water quality guidelines except for copper and zinc. It is unlikely that gasworks-related contamination in the sediments is a significant source of copper or zinc in the environment, including surface waters. Both of these metals are common contaminants found in urban areas. Higher or similar surface water concentrations were reported in the nearby Exile Bay and Major Bay. The copper and zinc concentrations in the surface water were either below the limit of reporting or below the adopted screening criteria during the investigation conducted in October 2017.

Surface water sampling and results are detailed further in Chapter 11 Water Quality and Sediments and in the RAP (Appendix 2).

Biota

Levels of copper and zinc in oysters collected from Kendall, Majors and Exile Bays were elevated above levels considered to be safe for consumption on a regular basis. As noted above, the presence of copper and zinc in the sediments and surface water, and in turn the biota, is most likely influenced by the broader urban catchment which affects most of Sydney Harbour.

The health risks associated with copper and zinc from consumption of biota are considered to be mitigated given there are currently closures on the taking of any shellfish in Sydney Harbour and its tributaries, and general advisories in place recommending limits for the consumption of fish and other seafood caught in Sydney Harbour, Parramatta River and other connected tidal waterways including Kendall Bay.

Odour and Vapour

Odour modelling, and modelling of evaporation of volatile chemicals undertaken for the Project has shown that none of the chemicals relevant to the gasworks waste are predicted above detection or at concentrations that are above conservative ambient air guidelines (protective of lifetime exposures) in shoreline locations, even under worst case dispersion conditions.

The results of air dispersion modelling and the air quality data from the bulk sediment sampling trial suggest low or non-detect concentrations of chemicals in the air, and generation of odours during remediation works are possible, and likely to be most significant during excavation of contaminated sediments.

The results from the modelling and bulk sediment sampling trial also indicate that health risks due to inhalation of chemicals and chemical vapours emitted during the remediation are unlikely and are therefore not assessed further in this chapter. Odour and vapour issues are discussed further in Chapter 8 Air Quality and Odour, and Appendix 6.

14.4 EXPOSURE ASSESSMENT

Exposure scenarios were developed by looking at the activities which could be undertaken in the beach, mangrove and rocky areas of the Southern Remediation Area and Northern Remediation Area NA1 and considering the pathways by which human receptors may be exposed to the contamination.

The HHRA identified the COPCs as those chemicals that require remediation and therefore the development of remediation criteria. As noted above the TRH F3 and heavy metals were excluded as COPCs in the HHRA based on a screening assessment using modified screening criteria derived from site-specific exposure assumptions. Based on the lithology and concentration of COPCs within impacted sediments observed during site investigations, and assessment of exposure scenarios, the HHRA focussed on the presence of PAH contamination in sediments at the Northern and Southern Remediation Areas of Kendall Bay as a source for potential human exposure. This area incorporates:

- the beach area (defined as SA4 and SA5)
- the central area located in the stand of mangroves (defined as SA3 excluding the western edge adjacent to SA1); and
- the western end of the mangroves and the rocky shore area adjacent to the sea wall (defined as SA1, SA2, the western end of SA3 adjacent to SA1 and NA1).

Based on the source areas identified above, the HHRA determined that the primary human receptors of concern for the Project are adults and children undertaking recreational activities in these areas.

The primary exposure pathway for adults and children determined by the HHRA was incidental ingestion and dermal (skin) contact of sediments through recreational activities (e.g. walking, wading, swimming, bird watching, supervising children) on the identified beach, mangrove and rocky shore areas. A summary of the sensitive human receptors of concern and associated exposure scenarios developed by the HHRA is shown in Table 14-1 Summary of receptors and exposure pathways below, and discussed in further detail in the HHRA (Appendix 3).

Table 14-1 Summary of receptors and exposure pathways

Receptor	Exposure Pathway/Mechanism	Activity
Adults	Incidental ingestion and dermal contact with sediments • beach area • mangrove area • rocky area	Exposure may occur while undertaking a variety of recreational activities • walking • wading • swimming
Children	Incidental ingestion and dermal contact with sediments • beach area • mangrove area • rocky area	Exposure may occur while undertaking a variety of recreational activities • beach play • wading • swimming

The HHRA addressed potential worst-case exposure to the COPCs in sediments, based on the exposure assumptions for a Reasonable Maximum Exposure (RME) scenario.¹ It should be noted that the RME is generally based on conservative assumptions and may result in overestimation of total exposure.

¹ RME was estimated using intake variables and chemical concentrations that define the highest exposure that is reasonably likely to occur in the area assessed.

14.4.1 KEY EXPOSURE ASSUMPTIONS

As noted above, ingestion of sediments is considered a key pathway of exposure, particularly for young children. Hand to mouth behaviour is most prevalent in young children, and considered less likely in older children and adults.

Young children are the focus of the calculations for quantification of potential intakes as the risks posed are higher for this life stage, making their use in back-calculating a relevant screening criteria the most conservative and therefore the most relevant for determining criteria for remediation. The HHRA (EnRisks 2018) notes that while not quantified in the HHRA, potential exposure and chemical intake by older children and adults will be lower than considered for young children.

Dermal absorption of chemicals from sediments is another key pathway of exposure, the extent of which is influenced by the area of skin in contact with the sediment, the concentration of the chemical in the sediment, the duration of contact with the sediment, how tightly the chemical is bound into the sediment and the ability of the chemical to be absorbed through the skin.

Both site-specific and generic exposure assumption have been adopted in the HHRA (Section 7) for derivation of the human health remediation criteria. One of the key site-specific assumptions adopted is the exposure frequency. The HHRA has considered an exposure frequency of 40 days per year for the Beach Area and 20 days per year at both the Central Mangrove Area and the Western Mangrove Area. It was assumed that 50% of the visit to the Beach Area includes time spent at the Central or Western Mangrove Area.

Bioavailability, which is a factor determining the amount of chemical that may be dissociated from the environmental matrix and then absorbed into the body, has been determined from samples collected from the site and adopted in the HHRA.

14.5 STAKEHOLDER VIEWS

Stakeholders raised a range of issues during community engagement for the Project. Concerns raised ranged from queries in relation to monitoring for potential health impacts to residents during works, legal implications of harm to the health of residents that may be caused by remediation works and the ongoing quality of the beach area for recreation (particularly by children) once remediation has been completed.

In 2015, during planning for the remediation and consultation with the community, issues were raised which triggered further investigation. In regard to the HHRA, this additional work undertaken in response to community concerns included:

- development of site-specific human health remediation criteria
- consideration of potential risks from exposure to surface waters and biota (based on recent data); and
- consideration of potential risks during excavation works that might form part of the remediation to inform development of risk mitigation measures.

14.6 POTENTIAL IMPLICATIONS FOR HUMAN HEALTH

The potential implications for human health relevant to the Project, as identified in the HHRA, relate to the exposure of the sensitive receptors identified in Table 14-1 to contaminated sediments in parts of Kendall Bay, primarily exposure to carcinogenic PAHs.

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are a large group of organic compounds formed from incomplete combustion of organic materials such as through the processing of coal, crude oil, combustion of natural gas, refuse, vehicle emissions, heating, cooking and tobacco smoking as well as natural processes.

Food is a major source of human exposure to PAH due to the formation of PAH during cooking or from atmospheric deposition of PAHs on grains, fruits and vegetables (WHO 1998).

There are several hundred PAHs, with benzo[a]pyrene (BaP) being the most extensively studied. There are typically 16 individual PAHs which are analysed in site contamination investigations.

In PAH contaminated soil there is likely to be a diverse compositional range of non-carcinogenic, and carcinogenic PAHs of varying potency (WHO 1998). This is due to various major sources of PAHs at any given location that invariably contribute to the presence of a mixture of PAHs in soils, which is also considered the case regarding the sediments of Kendall Bay.

The primary potential human health impact of the Project is the exposure of sensitive receptors to PAHs in contaminated sediments during the remediation works and following completion of remediation activities. As discussed above, human exposure in the Project Area occurs primarily through the dermal and ingestion pathways.

14.6.1 REMEDIATION CRITERIA

Site-specific remediation criteria have been developed to assist in the development of the remediation strategy and to achieve the required human health outcomes of the Project.

The chemicals which would require development of site-specific remediation criteria for the protection of human health were determined by screening the maximum chemical concentrations in the identified beach, mangrove and rocky areas against relevant national and international guidelines.

The dermal exposure pathway (contact with skin) has been identified as the primary driver of human health risk in the derivation of the remediation criteria. The assumption set out in the HHRA, which forms the basis of the human health remediation criteria, is that humans may come into direct contact with the sediments 40 days per year in the Beach Area and 20 days per year in both the Central Mangrove Area and the Western Mangrove Area. It is assumed that on each occasion the lower arms, hands, lower legs and feet will be covered by the sediments.

The calculated remediation criteria for each of the Remediation Areas are summarised in Table 14-2, along with the relevant exposure pathways. The human health remediation criteria have been derived to meet the acceptable non-threshold risk of 1×10^{-5} , in accordance with the ASC NEPM.

Table 14-2: Human health remediation criteria for the Remediation Areas for carcinogenic PAHs

Location	Site specific remediation criteria: BaP TEQs ² (mg/kg)	Receptor / exposure pathway
Southern Remediation Area		

² The major approach advocated by regulatory agencies for assessing the human health risks of PAH-containing mixtures involves the use of "toxicity equivalence factors" (TEFs). This approach relates the toxicity of other (potentially carcinogenic) individual PAHs to that of BaP, the most widely studied carcinogenic PAH. The TEFs adopted have been applied for all routes of exposure for the carcinogenic PAHs assessed.

Location	Site specific remediation criteria: BaP TEQs ² (mg/kg)	Receptor / exposure pathway
SA1	1	Ingestion of PAHs in sediments Dermal contact with PAHs in sediments
SA2		
SA3 – western end adjacent to SA1		
SA3 – remainder of mangrove area	120	Ingestion of PAHs in sediments Dermal contact with PAHs in sediments
SA4	60	Ingestion of PAHs in sediments Dermal contact with PAHs in sediments
SA5		
Northern Remediation Area		
NA1	1	Ingestion of PAHs in sediments Dermal contact with PAHs in sediments
NA2	Area submerged – ecological risk assessment process and criteria considered relevant at this location	
NA3	Area submerged – ecological risk assessment process and criteria considered relevant at this location	

14.6.2 DERMAL CONTACT WITH COPCs

Sediments

At the western end of the mangroves (SA1 and western portion of SA3) and the rocky area of SA2, current levels of carcinogenic PAHs exceed the derived human health remediation criteria of 1 mg / kg (see Table 14-2). This indicates a potential human health risk from exposure, including dermal contact with contaminated sediments under the current conditions. There are also potential risks of dermal exposure to contaminated materials which may arise from disturbance and removal of sediments from these areas during the proposed remediation works.

Some locations in the western end of SA3, which exceed the adopted human health remediation criteria, are covered by the mangrove root mass, which in this area can be up to 0.5 metres in depth. The driver of risk in the calculation of the remediation criteria is dermal contact with the contaminated materials. If dermal contact is prevented by the mangrove root mass or is, at least, greatly reduced due to the physical difficulty in reaching the contaminated materials, then the risk is much reduced. Hence the risk of human exposure to contaminated sediments at the western end of SA3 is considered low.

During remediation works, there will be some excavation of contaminated sediments which will be transported initially to a barge, for subsequent transfer to the Staging Site and off-site disposal. During this process, in areas such as SA2 and NA1 located adjacent to the foreshore, there is potential for minor excavated sediment to inadvertently travel onto foreshore areas (including the footpath), potentially creating a risk of dermal exposure with contaminated sediment. Similarly, during transport of excavated sediment to the Staging Site, during the unloading / loading process at the Staging Site and during transport off-site, there is potential for an unplanned spill which may lead to direct contact with the contaminated sediment. While the likelihood of these exposure scenarios is considered very low, measures will be taken to further reduce their occurrence and plans in place to respond appropriately if needed.

Measures to mitigate the exposure, including dermal contact, with the existing contaminated sediments and during the remediation works are set out in Section 14.8.

Water

Surface water sampling undertaken for the Project demonstrated that concentrations for relevant chemicals in Kendall Bay generally do not exceed the relevant screening criteria, with the exception of copper, zinc, cyanide and PAHs.

Further assessment showed that PAHs were detected in unfiltered samples but not in filtered samples, indicating these chemicals are attached to the particles in the water. The measured PAH concentrations in the unfiltered samples were reported only marginally above the screening guidelines. These results indicate that in most cases the PAHs are bound to the particles in the water, and therefore reduce their bioavailability to sensitive receptors. The HHRA notes that no further detailed assessment was required for PAHs in surface water.

The potential impacts to human health from exposure to PAHs in the waters of the Remediation Area are considered to be low.

Copper and zinc metals are common contaminants in urban areas as they wash off roads and other surfaces in stormwater. The levels detected are not likely to be due to the gasworks contamination. The sediment concentrations of these metals in Kendall Bay are similar to those in Exile and Majors Bay. The HHRA concluded that no further detailed assessment was needed for copper and zinc.

14.6.3 INGESTION OF COPCS

The existing risks for ingestion of sediments which exceed the adopted human health remediation criteria, and the potential risks associated with the remediation works, relate to accessibility to the sediments and are similar to those outlined above regarding dermal exposure.

As noted above, there are sites in the mangrove area where PAH levels exceed the human health remediation criteria, but where access to the sediments is limited by the mangrove root mass. This will similarly reduce the risks of ingestion of contaminated sediments in these areas by humans.

Measures to mitigate the potential risks to human health from ingestion of the existing contaminated sediments and during the remediation works are set out in Section 14.8.

Water sampling shows that levels of copper, zinc, cyanide and PAHs exceed the screening criteria, indicating potential human health risks resulting from exposure by ingestion. The relevant recreational water guidelines are based on the ingestion of 200 mL of recreational water every day for a lifetime. This is considered to be an overestimate of likely exposure to the marine waters at Kendall Bay and therefore is considered conservative screening criteria as the HHRA has assumed the recreational activity at the beach area would be up to 40 days per year.

Biota sampling found that oysters and mussels collected in Kendall Bay did not contain any PAHs indicative of gasworks waste. Oyster samples contained copper, cadmium and zinc with concentrations the same in samples from Kendall, Majors and Exile Bays indicating that the contamination was not related to the gasworks contamination but rather likely related to widespread urban sources. The levels of copper and zinc detected in the oysters and mussels were above those that would be acceptable for consumption on a regular long-term basis.

There is currently a fishing advisory in place for all of Sydney Harbour (NSW DPI 2012), which advises against consumption of any fish for areas west of the Sydney Harbour Bridge. The taking of any shellfish including oysters is also prohibited throughout Sydney Harbour (NSW DPI 2012). Consumption of

seafood was therefore not required to be included for further assessment in the HHRA. No further restrictions need to be implemented.

Given the low level of risks from potential exposure to PAHs in the surface waters in the Kendall Bay (in terms of ingestion) and the existing advisory and prohibitions on the taking and consumption of shellfish, the risks to human health from exposure to PAHs from surface water and aquatic biota are considered low.

14.6.4 EXPOSURE TO ODOUR AND VAPOUR

As noted above, modelling of odour and evaporation of volatile chemicals showed that none of the gasworks related chemicals are predicted to exceed the ambient air guidelines for shoreline locations, even under worst case dispersion conditions.

It is therefore expected that no COPCs are likely to be present in areas where people could be exposed at levels posing a risk to human health during excavation of the sediments. It is possible that noticeable but transient odour impacts may occur during remediation, especially during bulk excavation.

14.7 CUMULATIVE IMPACTS

Cumulative negative impacts are not expected to occur with respect to human health, however it is noted that should the capping material, in-situ stabilised raft slab or in-situ stabilised monolith become compromised in the future, there is potential for remobilisation of contaminated sediment within Kendall Bay, leading to a potential risk to human health. The likelihood of this occurring is considered low and preventative management measures to ensure that the risk is minimised are outlined below.

It is expected that there will be ongoing positive impacts on human health through the removal / solidification of contaminated sediments and improvement in the quality and amenity of the publicly accessible beach, mangrove and rocky areas on the southern foreshore of Kendall Bay.

14.8 MITIGATION MEASURES

14.8.1 REMEDIATION DESIGN

A priority of the remediation works is to target sediments which poses a potential human health risk, ensure they are appropriately managed during the remediation works and that such sediments are not accessible to people following remediation (i.e. sediments are not exposed at the surface where people may come into direct contact with them, or near the surface where disturbance from normal activities such as wading or playing in sand may allow contact).

The Remediation Areas of SA3, SA4, and SA5 require remediation works to address potential risks to human health and address aesthetic issues.

The proposed remediation for the rocky areas of SA2 and NA1 adjacent to the seawall reduces the ongoing potential for impacts to human health by removing the surface sediments to below the Lowest Astronomical Tide (LAT) mark, then adding clean rock and sand to a surface level also below the LAT mark. This will significantly reduce the risk of people coming in contact with contaminated sediments and also reduces the volatilisation and emission odours from the contaminated sediments at low tide.

The overlaying dense root mat in the western end of SA3 reduces the risk of human exposure in this location. The proposed remediation treatment in this area is to leave the mangrove root mass in place. Coke and coal will be removed from the sand surface amongst the mangroves and replaced with clean sand to restore the original surface.

Within SA4, the beach contains coal, coke and other rubbish, and low levels of PAHs in the subsurface. It is proposed to remove the surface sediments and debris to a depth of 0.2 m and replace with addition of a 0.5 m layer of clean sand to add to the current beach present in this area.

Within SA5, remediation activities will facilitate a firmer underfoot offshore wading area which can be accessed from the beach. It is proposed to remove the surface sediments and debris to a depth of 0.3m and replace the surface of the beach with a clean layer of sand.

14.8.2 MANAGEMENT OF REMEDIATION WORKS

Management of the remediation works will be in accordance the Remediation Works Environmental Management Plan (RWEMP) which will set out the environmental management measures that are required to be implemented during remediation works in order to manage risks to the environment and to site personnel during remediation activities. All works that require disturbance of the sediments will be undertaken in a manner that protects the health of users of the areas adjacent to the Remediation Areas and the workers on the site.

Specific measures to reduce the risks to human health will be implemented including isolation of the work site by fencing during each phase of works, preventing access by the general public. Only authorised personnel will be permitted to enter the active Remediation Area or Staging Site.

Potential risks of dermal exposure to contaminated materials which may arise from disturbance and removal of sediments during the proposed remediation works will be managed through management and monitoring procedures set out in the Remediation Works Environmental Management Plan (RWEMP). Works that require disturbance of sediments will be undertaken in a manner that protects the health of the workers and users of the areas adjacent to the Remediation Areas and appropriate monitoring will be undertaken to identify compliance with the RWEMP and corrective actions, if required.

Appropriate quality control measures will be followed as outlined within the Validation Sampling, Analysis and Quality Plan (VSAQP) which is discussed in Chapter 18 Environmental Management Framework. The VSAQP will ensure that all remediation work has been undertaken in accordance with the RAP achieving the objectives therein.

Excavated material handling procedures will be followed as outlined within the RWEMP (refer Chapter 18 Environmental Management Framework) in order to prevent the spillage of excavated material during:

- loading of barges within the active remediation areas
- transport of the excavated sediment to the Staging Site
- unloading / loading of the excavated sediment off the barges and onto the transport trucks; and
- in transit from the Staging Site to off-site treatment (if needed) and disposal facilities.

Excavated materials will be transported via barge to the Staging Site. To mitigate potential odour emissions, hoppers / containers will be sealed with lids. Transporting excavated material in sealed containers will minimise generation of odours.

Excavated materials will be sent by truck to EPA licensed treatment (if required) and landfill facilities. The containers will remain sealed during transport and all trucks carrying sediments to the off-site

facilities will be covered to prevent the generation of dust and mitigate the potential for spills and odour generation to occur in transit. Offsite treatment and landfilling will be carried out in accordance with the Environmental Protection Licence for the respective facilities.

14.8.3 QUALITY CONTROL AND POST REMEDIATION MANAGEMENT

Appropriate quality control measures will be followed as outlined within the VSAQP (refer Chapter 18 Environmental Management Framework), and integrated with the Site Management Plan (refer Chapter 18 Environmental Management Framework), which will define any post-remediation monitoring. The specific requirements of the post remediation SMP are yet to be confirmed and will be determined in consultation with RMS, EPA and the Site Auditor.

14.9 POTENTIAL IMPACTS AND MITIGATION MEASURES SUMMARY

A summary of the potential impacts on public and health and safety together with the mitigation and management measures to be implemented are outlined in Table 14-3.

Table 14-3: Summary of impacts and mitigation measures

Potential impact	Mitigation and management measures
Potential dermal contact or accidental ingestion of contaminated sediment through unrestricted access to the Remediation Areas	- Installation of security or safety fencing / screening (if required) which ensures pedestrian and cycling access is maintained to the shared pathway. - Development of a Remediation Works Plan.
Potential dermal contact or accidental ingestion of contaminated sediment from spills of excavated sediment	- Site fencing installed in areas where public are most likely to enter to prevent public access to Remediation Areas - Lashing of barges to the barge-mounted excavator so that they are immediately adjacent during loading operations - Loading of hoppers or skip bins such as to maintain a suitable freeboard to minimise the likelihood of material spilling over the sides under prevailing environmental conditions (wind waves, passing ferry wake etc), noting hoppers / skip bins are to be closed following filling and prior to transport to Staging Site. - Covering of hoppers or skip bins with close-fitting covers or lids during overwater transit to the Staging Site - Preparation and implementation of Spill Response Plan - Implementation of navigation safety measures to mitigate the risk of vessel collisions - Lifting of hoppers or skip bins off the transport barges and on to the wharf at the Staging Site to avoid overwater handling of excavated material outside the Remediation Areas
Potential dermal contact (or accidental ingestion of contaminated sediment) associated with offsite tracking of sediment on wheels of equipment exiting the Staging Site	Installation of a truck shaker and wash down area at the exit to the Staging Site and storage of collected wheel wash water within marked untreated water holding tanks for sampling and analysis, waste classification and offsite disposal
Potential dermal contact (or accidental ingestion of contaminated sediment) associated with vehicle accidents	- Inspection of equipment and risk assessment / site approval prior to use - Completion of routine maintenance on equipment

Potential impact	Mitigation and management measures
during road transportation leading to spillage of waste materials	• Prestart operator checks • Completion of any equipment maintenance arising from prestart checks • Instruction to drivers to leave suitable gap to traffic ahead and avoid sudden braking • Adhering to vehicle load limits • Trucks used for the transport and offsite disposal of materials should be fitted with splash boards, a rubber-sealed tailgate and cover to prevent the loss of materials during road transport • Development and implementation of a Traffic and Pedestrian Management Plan • Operation of equipment by appropriately licensed drivers
Potential for dermal contact or accidental ingestion of contaminated sediment associated with poor performance of capping material	• Design of capping materials to satisfy performance criteria relating to durability and robustness that ensure that the remediation treatments are effective for an extended period of time and are resistant to the action of natural process and anthropogenic influences • Development and implementation of a post remediation Site Management Plan to define any ongoing monitoring and management of Remediation Areas to be undertaken (if required) to confirm that the objectives of the RAP have been achieved after remediation is completed. • The activities completed as part of the Site Management Plan are to be confirmed in consultation with the site auditor, EPA and RMS. The Site Management Plan may include activities such as: – visual inspections of capping material integrity, presence/absence of marine biota, presence absence of sheens or seeps – identification of triggers for rehabilitation and/or repair – survey of capping perimeter and elevation – water sample collection and analysis within Remediation Areas and background sites – sediment sample collection and analysis within Remediation Areas and background sites – benthic sampling and analysis of benthic communities within Remediation Areas and background sites • Results of any activities defined in the Site Management Plan are to be reported to RMS, the Site Auditor and NSW EPA
Potential occupational exposure of Project workers to contaminated material	• Prepare and implement a Work Health and Safety Plan which will address the site specific requirements to manage risks to the health and safety of workers on the Project

Potential impact	Mitigation and management measures
Odour nuisance to workers and surrounding residents. While it has been confirmed through conservative modelling that there will be no human health risk impacts associated with the odour, but it is likely that workers and residents may experience some unpleasant odours during certain stages of the remediation works.	- Excavated material will be loaded into the smallest practical sized bins (to prevent the duration that excavated material is exposed) - Bins to be equipped with close fitting, essentially airtight lids, so as to mitigate odour travel during the barge journey to the staging site, and road transport to an approved waste facility. - Minimising drop height from excavator bucket to bin during excavation and loading - Regular cleaning of sediment from equipment and other working areas - Evaluation of wind direction to limit works (if required) to periods when wind is blowing from the west

14.10 CONCLUSION

Remediation is being undertaken with the priority of addressing / targeting areas that present a potential human health risk due to the presence of gasworks-related contaminated sediment in Kendall Bay. There will also be some potential human health risks which will need to be managed during the remedial works. The health risks identified are generally low and mitigation measures have been identified and set out in this chapter.

The HHRA identifies the existing risks to human health posed by the contaminated sediments in the Remediation Areas. In relation to ongoing risks to human health, the HHRA determined that the focus for positive human health outcomes will be on the potential risks to the recreational users of the beach, mangrove and rocky foreshore areas in the Southern and Northern Remediation Areas. Site specific remediation criteria for human health were developed to meet the desired health outcomes.

By designing a remediation strategy for each of the specified locations in the Southern and Northern Remediation Areas based on ensuring that the sediments of Kendall Bay are below the human health remediation criteria, the risks of exposure through dermal contact and ingestion of contaminated sediments will be minimised and the potential impacts to human health from the presence of the contaminated sediments will be mitigated.

The process of remediation also has the potential to cause impacts to human health through the disturbance of sediments and during the transport of excavated material to the Staging Site and for further offsite processing / disposal. These impacts will be managed through the environmental management framework for the Project as set out in Chapter 18 Environmental Management Framework),

Achievement of the human health remediation criteria in accordance with the commitments to environmental management made in this EIS will ensure that Kendall Bay offers a safer and more appealing recreational area for the local community.

15. LANDSCAPE AND VISUAL

This chapter describes the existing landscape and visual amenity of the Project Area, and provides an assessment of the potential impact of the proposed remediation works on these existing values, particularly from the perspective of members of the community who live nearby or who visit or pass through the Project Area.

15.1 OBJECTIVES AND SCOPE

This chapter is based on the Kendall Bay Sediment Remediation Project Visual Impact Assessment undertaken on behalf of Jemena by ERM in June 2014 and updated by JBS&G and Jemena, which is provided at Appendix 13.

This chapter addresses the following SEARs:

SEARs Requirement - Visual

Include an assessment of the visual impact of all aspects of the development, particularly on any adjoining landowners and significant vantage points in the public domain.

15.2 ASSESSMENT METHODOLOGY

The methodology used for assessment of potential visual impact from the proposed remediation works in Kendall Bay, the Staging Site and water-based corridor included the following steps:

- characterisation of the visual components of the proposed remediation works within Kendall Bay and the associated Staging Site at 140 Tennyson Road, Mortlake.
- capturing representative viewpoints within the public domain based on photographs which show the view of the existing area.
- assessment of the potential visual impacts using three criteria, each of which are assigned a value of low, medium and high rating. The three key criteria and value rankings are:

1. Distance = the distance of the viewer(s) from the proposed development.

Low	Where the proposed development would be difficult to discern as it is in the far distance
Medium	Where the development would be a moderately dominant element in the view
High	Where the development would be a highly dominant element in a view

2. Nature and sensitivity of the surrounding landscape = the existing level of scenic quality of the surrounding landscape in relation to its ability to absorb the visual impacts of the proposed development. Generally, a highly modified landscape with many artificial elements will have a low sensitivity and therefore greater visual absorption capacity when compared to a natural landscape.

Low	Highly modified or disturbed landscapes with low visual amenity
Medium	Moderately disturbed landscape, displaying remnant natural features and limited introduction of artificial elements with a medium scenic quality
High	Relatively undisturbed, naturalistic landscape with a high scenic quality

3. Exposure = the number of viewers able to see the development and experience the change in visual amenity.

Low	Infrequently visited locations which are separated from populated areas and major thoroughfares, including local roads and farm dwellings
Medium	Roads and less frequented tourist attractions such as coastal areas or tourist routes
High	Public areas which experience a high degree of visitation, including populated areas. Public areas with high exposure such as recreational parks recreation and scenic lookouts. High sensitivity is generally assigned to locations with express purpose of observing and appreciating the landscape

The scale of the visual impacts was considered as follows:

Nil	The development would not be visible and therefore would not have a visual impact
Negligible	The level of visual change would be virtually unnoticed
Minor	A minor detrimental change that is noticeable, however would not result in a substantial change to the visual characteristics of the landscape
Moderate	A moderate detrimental change to the landscape characteristics of the landscape and visual amenity
High	A significant and detrimental change to the landscape characteristics and visual amenity

As discussed in Chapter 3 Project Location and Context, Kendall Bay is located on the southern side of the Parramatta River, adjacent to land which falls within the Canada Bay Local Government Area. The land use within this area is primarily associated with public and private recreation and medium density residential areas that border the Parramatta River. The primary locations surrounding the Project Area, where some or the entire Project Area will be visible, include:

- Cabarita Park and ferry terminal to the east
- Kendall Bay and Waterfront Park to the south
- Breakfast Point Residential Precinct to the west
- Mortlake Residential Area to the north-west
- the Parramatta River to the north; and
- northern banks of the Parramatta River to the further to the north which include Kissing Point Bay, Putney Park and Morrisons Bay.

Based on these locations, a total of 17 specific viewpoints were selected to inform the assessment. Numerous site walkovers, satellite imagery, site photographs and photomontages were used to determine the potential visual impacts of the remediation works. These viewpoints (VPs) are identified in Figure 15-1. The existing view from these locations is discussed further below.



Figure 15-1: Viewpoint locations

15.2.1 PROMENADE VIEWING LOCATIONS (VP1-VP10)

The promenade is a dedicated pedestrian / cycleway which runs adjacent to Kendall Bay and Fairmile Cove from the Cabarita Ferry Terminal to a point immediately to the east of the Staging Site. It does not extend past the Staging Site. Plate 15-1 to Plate 15-11 below show the sequential views for a pedestrian travelling from east to west and the location of the Project Area (Southern Remediation Area, Northern Remediation and Staging Site).



Plate 15-1: Viewpoint 1 - looking south

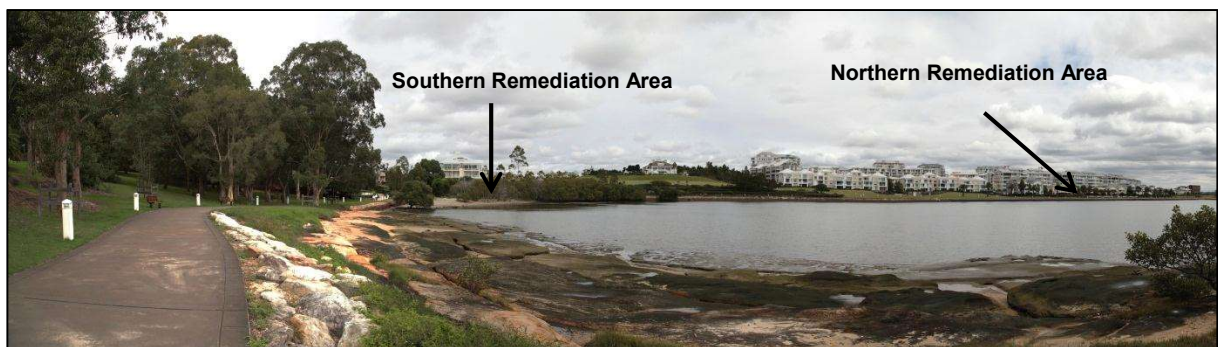


Plate 15-2 Viewpoint 2 - looking south-east



Plate 15-3 Viewpoint 3 – looking north



Plate 15-4 Viewpoint 4 – looking north-east



Plate 15-5 Viewpoint 5 - looking south-east



Plate 15-6 Viewpoint 6 – looking south-east



Plate 15-7 Viewpoint 7 – looking south-east



Plate 15-8 Viewpoint 8 – looking south-east



Plate 15-9 Viewpoint 8 – looking west



Plate 15-10 Viewpoint 9 – looking west



Plate 15-11 Viewpoint 10 - looking west

15.2.2 HINTERLAND VIEWS (VP11)

The promenade continues further south into the Hinterland. Viewpoint 11 is located on the path at the entrance to Waterfront Park and is indicative of views from locations further removed from the promenade (Plate 15-12). Waterfront Park is a large, open grassed park between the residential development at Cabarita and the Breakfast Point residential development. Waterfront Park has one path running from the south at Admiralty Drive and joins the promenade to the north-west.



Plate 15-12: Viewpoint 11 – looking north

15.2.3 OTHER SOUTHERN SHORE VIEWS (VP12)

The viewing locations from the southern side of the Parramatta River are not limited to those from the promenade. A residential development is located on Hilly Street in Mortlake, which has views across Fairmile Cove to the Parramatta River (Plate 15-13).



Plate 15-13: Viewpoint 12 – looking south-east

15.2.4 NORTHERN SHORE VIEWS (VP13-VP17)

Several viewpoints have been selected from the northern side of the Parramatta River (Plate 15-14 and Plate 15-15). Views from locations on the north shore of the Parramatta River towards the south are limited in extent in many locations due to vegetation and or residential buildings.



Plate 15-14: Viewpoint 15 – looking south



Plate 15-15: Viewpoint 17 – looking east

15.2.5 PARRAMATTA RIVER VIEWS

Water-based views will be available for occupants of boats and ferries operating on the Parramatta River. These views may be:

- fleeting (from a ferry) or longer (from a stationary fishing boat)
- from differing distances as the boats may be close to shore or on the other side of the Parramatta River or any point in between
- orientated towards the Remediation Areas or looking the other way; and
- taking in landscapes with vastly different characteristics. Some areas may appear 'natural', however most views will be towards a developed shoreline.

15.2.6 RESIDENTIAL VIEWS

There are numerous low to high density residential developments that have been developed on the banks of the Parramatta River, particularly at Breakfast Point. The majority of these developments are multi-storey buildings that have been designed to take advantage of the river views, particularly Kendall Bay.

15.3 STAKEHOLDER VIEWS

Feedback received during stakeholder consultation and social surveys undertaken in 2013, 2014 and 2015 (as discussed in Chapter 6 Stakeholder Engagement) identified some community issues relating to visual impacts. Although potential visual impacts are of concern, they are to a lesser extent than issues such as traffic, air quality and noise impacts. Most of the comments highlighted stakeholders' desire for visual impacts of the remediation works to be adequately assessed and further information provided on the appearance and functionality of the Project Area at completion.

Also of note is that a trial dredging exercise was held on the bay in September 2016 using a barge-mounted excavator in close proximity to the Breakfast Point community (Plate 15-16). The trial activities attracted some curiosity from a few residents but no complaints were received. The general feedback from ongoing consultation was that residents were pleased that progress was being made with the remediation Project.



Plate 15-16: Barge mounted excavator and silt curtains used for trial

15.4 POTENTIAL IMPACTS

15.4.1 PROMENADE VIEWING LOCATIONS (VP1-VP10)

As the viewer(s) travel along the promenade, a perceptible visual change from the current baseline would be experienced from:

- barge-mounted equipment operating on the bay carrying out the sediment remediation
- temporary fencing at VP3 to prevent the public entering, while shoreline remediation works are being conducted
- potentially some temporary posts installed between VP4 and VP7 to provide a safe anchoring point for workers cleaning the sea wall (which would require the approval of Breakfast Point Community Association, the owners of the sea wall)
- removal of the westernmost mangrove in the southern area of Remediation Area SA2
- installation of ISS raft slab beneath the lowest astronomical tide level; and
- sheet pile installation which may present a different aesthetic during installation.

Access to the works will be via the water, not the land, and the works will not cause obstruction or inconvenience to pedestrian or to vehicular traffic.

The remediation works will be visible and pedestrians will be aware of the remediation works, particularly at the southern section of Kendall Bay.

Whilst the promenade exists to provide views over Kendall Bay and Parramatta River, the current viewshed will be interrupted for short distances along its extent around Kendall Bay, though for the most

part, pedestrians would retain views of the river. The scale of impact is therefore assessed as minor as it is noted that visual changes resulting from the Project within Kendall Bay will be temporary.

At Remediation Area SA2 removal of the westernmost mangrove tree is necessary to conduct remediation works. This marginal visual impact is expected to last for only the duration of works (14 months) as any removed mangroves will be re-established as part of the post construction management works. Once the mangrove has re-established, the visual impact will be Nil.

As the ISS raft slab and monolith will be retained beneath the lowest astronomical tide level it is not expected to be visible from above the water line and furthermore will be covered by a cap, which once again is below lowest astronomical tide level.

The installation of steel sheet piles will nominally extend 0.5 m above the mean tide and require additional waler beams or supports as required to provide stability during the works. Once works are completed sheet piles will be cut at the lowest astronomical level, to remove the visual impact.

It is considered that overall the visual impact of the Project on the promenade during remediation activities is Moderate but at the completion of the Project activities would be assessed as Nil.

15.4.2 HINTERLAND VIEWS (VP11)

Views to Kendall Bay from VP11 are limited due to topography and the existing vegetation within Waterfront Park. Only the tips of the mangroves at the southern end of Kendall Bay and a small section of the Parramatta River are visible. However due to topography, the security fencing and remediation equipment associated with work in the Remediation Areas would only be a small element in this view. For these reasons, the overall visual impact would be Negligible to Minor and at the completion of the Project activities this would be assessed as Nil.

15.4.3 OTHER SOUTHERN SHORE VIEWS (VP12)

The Remediation Areas are located to the south-east of VP 12 and would not be visible due to Breakfast Point.

The main visual components would be associated with operations at the Staging Site and barging activities. These elements would however be screened somewhat by the existing Mortlake Ferry and would not directly obstruct views of the Parramatta River.

The visual impact has been assessed as Minor, however the duration of these impacts would be limited to the length of the Project (approximately 14 months). Once remediation works are completed and the Project infrastructure has been decommissioned, the Staging Site will be returned to its existing state. At this point, the visual impact would be reduced to Nil.

15.4.4 NORTHERN SHORE VIEWS (VP13-VP17)

Even where views are available, the distance to the proposed remediation works means that the larger machinery that may be used in the work areas will be a minor element in the view. If the equipment or works areas are lit when work is undertaken in the evening, the additional lighting would be an insignificant element in the existing backdrop which has a dense pattern of existing lighting.

For these reasons, the overall visual impact from locations along the north shore of the Parramatta River is assessed as Negligible. Furthermore, the duration of these impacts would be limited to the length of the Project (approximately 14 months). At the completion of the Project and once the Project infrastructure has been decommissioned, the residual visual impact would be assessed as Nil.

15.4.5 PARRAMATTA RIVER VIEWS

Due to the character of the visual environment, the visual impact from water-based views, which may be at similar distances to alternative land-based locations, would generally be less significant. However, in adopting a conservative approach, the evaluation considered that the visual impact from water-based vantage points would lie between the assessment of land-based viewpoints on the northern and southern banks of the Parramatta River, as discussed previously. For example, the north shore viewpoints (VP13-VP17) would also represent views from a boat close to the north shore and as previously assessed the visual impact from locations adjacent to the north shore would be Negligible.

Similarly, views from locations proximate to the Remediation Areas or the Staging Site have been discussed in the preceding analysis of VP1 to VP10 and also VP12. The visual impact at these closest locations has been assessed as Moderate in the short term, during remediation works. The residual visual impact, after the Project is completed, would be Negligible to Nil. A similar level of visual impact would occur for water-based locations close to the Remediation Areas and the Staging Site.

15.4.6 RESIDENTIAL VIEWS

Views from adjoining residential areas will be impacted by the Project.

Limited temporary light pollution will be generated associated with directional and navigation lighting from barges within the Remediation Areas and water-based navigational corridor. It is noted that no works are proposed to be undertaken at night, and as such, the only semi-permanent - lighting within the Remediation Areas would be on top of the sedimentation barriers for navigational purposes. Additional lighting may be installed on a temporary basis, as required, during times of limited lighting, noting that work will not be completed outside of the designated working hours:

- Monday to Friday: 7 am to 5 pm
- Saturdays: 8 am to 1 pm
- Sundays and public holidays: not anticipated that work will be undertaken

Existing security lighting will be maintained at the Staging Site, while limited additional directional lighting will be installed should out of hours emergency works be required.

These impacts will be limited to a short duration (14 months) and will be lesser in time in comparison to multi-storey residential developments on adjoining land. For these reasons, it is not anticipated that the overall visual impact from any adjoining residential property, which has views over the proposed Remediation Areas, would be any greater than the Moderate level of visual impact assessed for viewpoints in the public domain. Similar to these viewpoints, this level of visual impact would be reduced to Nil once the Project is completed.

15.5 CUMULATIVE IMPACTS

No cumulative impacts associated with the visual effects of the Project are anticipated to occur.

15.6 SUMMARY OF MITIGATION MEASURES

As outlined in the previous sections, the potential visual impact at the selected viewpoints range from Moderate to Nil, however would be reduced to Nil following the completion of the remediation works. The anticipated impacts will be phased, temporary and restricted to the life of the remediation works (approximately 14 months). The Project involves remediation, therefore the resulting landscape and

visual impacts will be positive in the longer term. As such no mitigation measures, apart from standard housekeeping and screening measures, are considered practicable to further reduce the level of impact. Ongoing stakeholder engagement will be undertaken and residents will be kept informed for the duration of the Project.

15.7 CONCLUSION

The Project will require the construction of temporary equipment and infrastructure during the course of the remediation activities. The physical presence of the remediation works therefore has the potential to impact on visual amenity from publicly accessible viewpoints and from neighbouring residential properties. The temporary loss of some visual amenity cannot effectively be mitigated and will therefore remain for the duration of the Project. Once the remediation works are completed, all temporary equipment and infrastructure will be removed.

Part of the proposed remediation works for Southern Remediation Areas SA3, SA4 and SA5 will involve the removal of surface materials (coal and coke) and rubbish that have accumulated on the beach and mangrove areas, and replacement with clean sand. These works will improve visual amenity of the beach and mangrove areas in the longer term for the benefit of the local community and visitors.

16. TRAFFIC AND TRANSPORT

This chapter discusses the potential impacts of the Project on the local road network and marine vessel movements during the life of the Project, and outlines mitigation measures that will be used to manage those impacts.

16.1 OBJECTIVES AND SCOPE

A Transport Impact Assessment (Appendix 14) was undertaken by GTA (May 2018) to assess the potential impacts of the Project on the surrounding road network and road users. The assessment also considered potential cumulative traffic impacts associated with recently completed and ongoing developments adjoining Tennyson Road and Hilly Street, Mortlake.

In addition, a Navigation Study (Appendix 15) was undertaken by RHDHV (May 2018) to assess potential impacts associated with marine based activities on the existing recreational and commercial vessel movements within the vicinity of the Project Area.

This chapter addresses the following SEARs:

SEARs Requirement – Traffic
Details of the land based and water based traffic that would be generated by the Project
Transport routes
Traffic management procedures for the Staging Site and parking requirements, including a construction traffic management plan and measures to manage and repair any damage to the local road network
Navigation and safety impacts on other water based traffic and ferry commuter services from any piping or barging of contaminated material, including details of any proposed measures to manage navigational conflicts
Cumulative impacts – particularly in relation to air, noise and traffic associated with other nearby industrial or commercial operations

This chapter does not consider emissions or potential noise impacts generated by vehicles as part of the Project, which are addressed in Chapter 8 Air Quality and Odour, and Chapter 9 Noise and Vibration.

16.2 ASSESSMENT METHODOLOGY

The assessment methodology involved the following key tasks:

- review of the existing land based traffic and transport environment, including:
 - road networks
 - vehicle access
 - traffic volumes
 - car parking
 - public transport; and
 - pedestrian and cycle infrastructure.

- review of the existing marine transport environment, including:
 - marine access
 - waterway conditions (bathymetry, wind and waves, currents, boat wash etc); and
 - waterway navigation (navigation rules, vessel use and traffic).
- review of the Project description and analysis of proposed loading and parking requirements, water based activities, vehicle type and movements, heavy vehicle routes, potential road dilapidation
- assessment of the potential change on the local road traffic network and the marine area from the current baseline conditions
- assessment of potential cumulative impacts
- assessment of alternative road transport routes; and
- development of mitigation measures to manage the potential impacts.

The assessment of land based and marine transport was undertaken having regard to the following legislation and policies:

- *Roads Act 1993*
- *Roads Regulation 2008*
- *Road Transport Act 2013*
- *Road Transport (General) Regulation 2013*
- *Marine Safety Act 1998*
- *Marine Safety Regulation 2016*; and
- Guide to Traffic Generating Developments Version 2.2 (RTA 2002)
- Australian Standard AS2890.2 Parking Facilities Set (2009b).

16.3 EXISTING ENVIRONMENT

16.3.1 BACKGROUND

The Staging Site will facilitate the unloading and handling of excavated sediments prior to being transported to an approved treatment facility. In addition, it will act as the unloading / loading location for all Project equipment and consumables, including Virgin Excavated Natural Material (VENM) and capping material. No treatment of excavated sediment will occur at the Staging Site.

The vast majority of vehicle traffic associated with the Project will occur within the road network surrounding the Staging Site and therefore the review of existing traffic conditions was focussed primarily on this area.

No parking or access to the Remediation Areas is proposed via Breakfast Point or Cabarita Park, with access provided via barges at all times. As such, traffic impacts associated with parking at, and truck traffic to and from, the Remediation Areas have not been considered. It is noted that licensed treatment facilities and landfills are accessed from the Staging Site via the M4 motorway.

The marine-based components of the Project will occur within the Remediation Areas, as well as the water-based corridor between the Staging Site and Kendall Bay.

16.3.2 ROAD NETWORK

A review of the existing road network immediately surrounding the Staging Site is provided in Table 16-1. The location of key roads where vehicle volume data was collected by Matrix Traffic and Transport Data (2017) is shown in Figure 16-1.

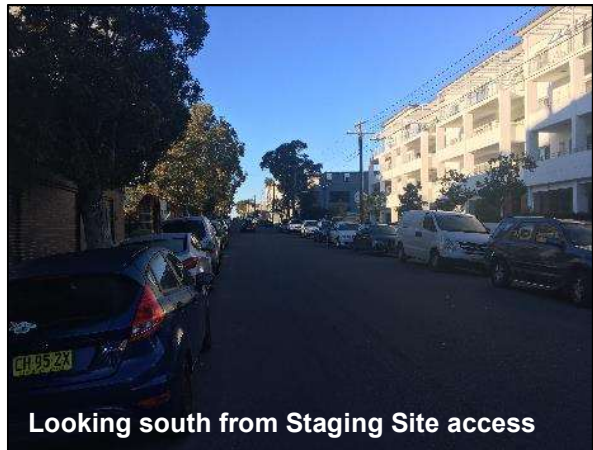
Table 16-1: Existing road network

Road	Description	Approximate vehicle counts per day ¹
Tennyson Road	Aligned in a north-south direction and functions as a collector road through the suburb of Mortlake, providing access to the Breakfast Point development on its eastern side (Plate 16-1). Two-way traffic (one lane in each direction) within 10.5 m-wide carriageway. There is no road marking, and unrestricted kerbside parking is permitted on both sides of the road near the Staging Site.	99 ¹ near the site access 1,749 ¹ between Northcote and Whittaker Street
Hilly Street	Located west of Tennyson Road and is aligned in a north-south direction and functions as a collector road through Mortlake (Plate 16-2). Two-way road (one lane in each direction) within a 10.5 m-wide carriageway. Kerbside parking generally permitted on both sides of Hilly Street subject to time restrictions.	1,300 ¹
Palace Lane	Local road. Aligned in an east-west direction which runs adjacent to the southern boundary of the Staging Site (Plate 16-3). Two-way traffic within 5 m-wide carriageway. Kerbside parking is not permitted.	Not counted ²
Peninsula Drive	Aligned in an east-west direction which narrows near intersections, functioning as the main vehicular access to the northern areas of the Breakfast Point development (Plate 16-4). Two-way road configured with one lane in each direction. Unrestricted kerbside parking is permitted on both sides of Peninsula Drive in designated parallel spaces.	Not counted ³
¹ Approximate vehicle counts per day is based on the vehicle volume data collected by Matrix Traffic and Transport Data from Sunday 14 May to Saturday 20 May, 2017. ² Small lane with minimal through traffic. ³ Project traffic considered unlikely to use this road.		

Traffic data was also collected on Broughton Street, which is located south of the Staging Site, along the proposed Project heavy vehicle transport route (see Section 16.5.1).



Looking north towards Staging Site



Looking south from Staging Site access

Plate 16-1: Tennyson Road

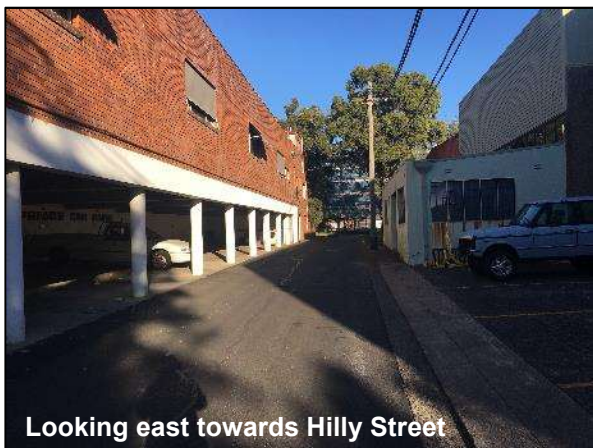


Looking north towards Whittaker Street

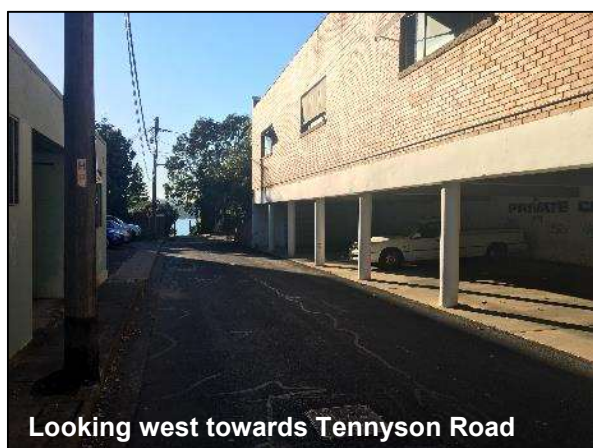


Looking south towards Northcote Street

Plate 16-2: Hilly Street

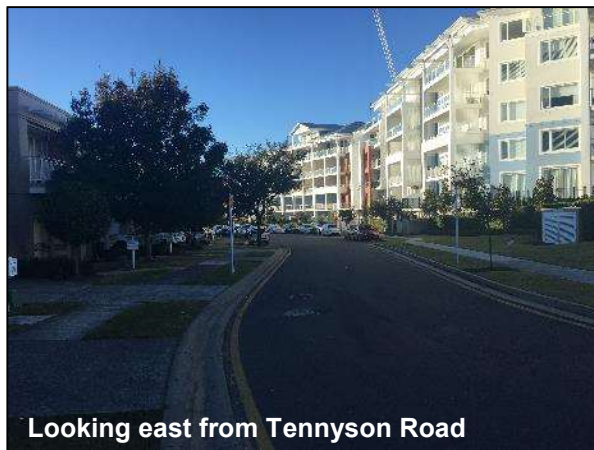


Looking east towards Hilly Street



Looking west towards Tennyson Road

Plate 16-3: Palace Lane



Looking east from Tennyson Road



Looking west towards Tennyson Road

Plate 16-4: Peninsula Drive



Figure 16-1: Existing road traffic volumes

16.3.3 VEHICLE AND PEDESTRIAN ACCESS

Vehicle and pedestrian access to the Staging Site is from a 6 metre wide, two-way access way from the northern end of Tennyson Road, adjacent to the intersection with Palace Lane as shown in Plate 16-5.

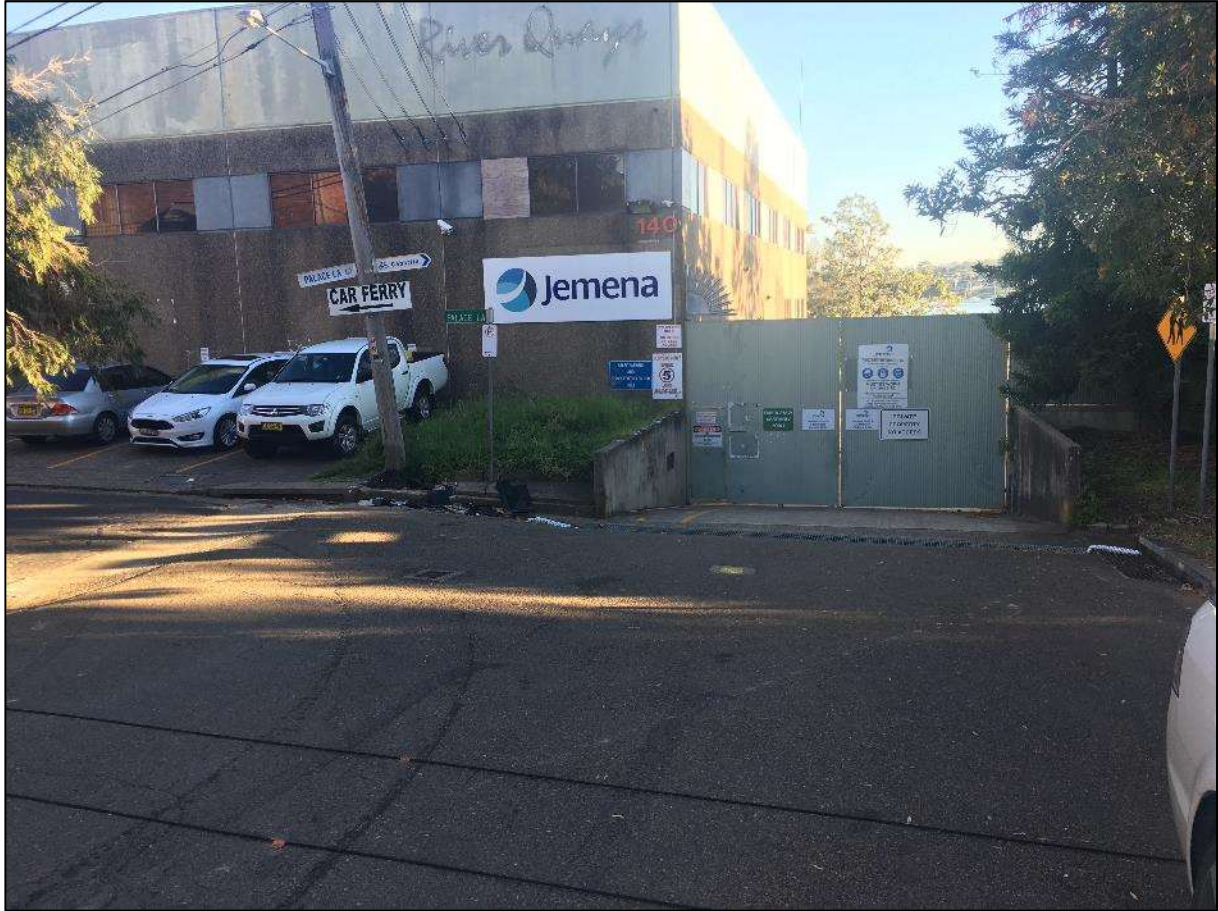


Plate 16-5: Existing vehicle access (looking north)

16.3.4 MARINE ACCESS

Marine vessel access to the Remediation Areas is from the private concrete wharf in Fairmile Cove, located on the north-eastern side of the Staging Site. No marine access to the Remediation Areas will be gained from Kendall Bay or Breakfast Point.

16.3.5 CAR PARKING

The Staging Site currently has access to 10 off-street parking spaces along Palace Lane (Plate 16-6). These parking spaces are currently used by existing residential and commercial tenants near the Staging Site.



Plate 16-6: Palace Lane off-street parking

16.3.6 BUS SERVICES

The area surrounding the Staging Site is served by public buses, with the nearest bus stop located on the northern side of Whittaker Street, approximately 65 metres from the Staging Site. The Whittaker bus routes servicing this bus stop are outlined in Table 16-2 and illustrated in Figure 16-2.

Table 16-2: Bus service summary

Route number	Route description	Frequency on / off peak
439	Mortlake to City	30 minutes peak and off-peak
462	Ashfield to Cabarita and Mortlake	10 minutes peak and 30 minutes off-peak (daily early morning and evening service)
464	Ashfield to Cabarita and Mortlake	15 minutes peak and 30 mins off-peak (daily daytime service)
L39	Mortlake to City	20 minutes peak Monday to Friday



Figure 16-2: Sydney Bus Network map within vicinity of the Staging Site and Remediation Areas

16.3.7 PEDESTRIAN AND CYCLE INFRASTRUCTURE

The pedestrian network in the vicinity of the Staging Site is well established, with pedestrian paths located on the western side of Tennyson Road and Hilly Street (Figure 16-3). These pedestrian paths are interconnected within the vicinity of the Staging Site along Whittaker Street, Peninsula Drive and Northcote Street.

A shared pedestrian and cyclist path runs along the foreshore of Fairmile Cove and Kendall Bay providing access between Mortlake and Cabarita Park, along the northern and eastern sides of the Breakfast Point development (Plate 16-7). At the western end, the path connects with Tennyson Road adjacent to the vehicle entry to the Staging Site. Additional bicycle routes also exist within the broader Mortlake, Breakfast Point and Cabarita area (Figure 16-4).



Figure 16-3: Pedestrian network within the vicinity of the Staging Site.

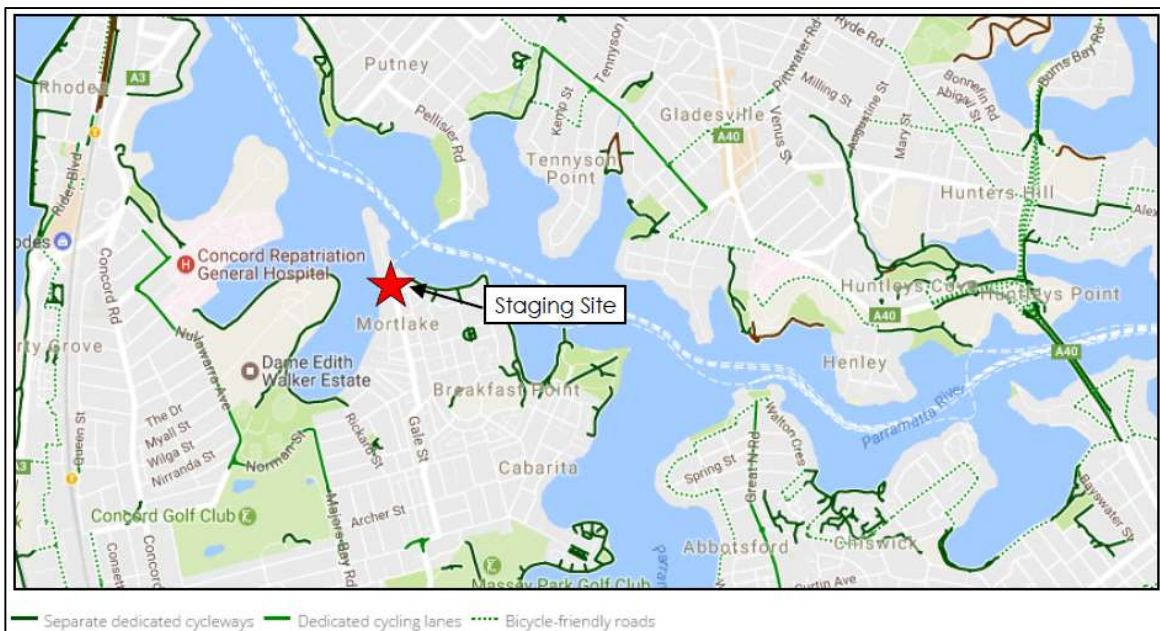


Figure 16-4: Regional bicycle network



Plate 16-7: Shared pedestrian and cyclist path along the foreshore of Kendall Bay (adjacent to Breakfast Point). (Source: JBS&G)

16.3.8 PROPOSED AND ONGOING LOCAL DEVELOPMENTS

A review of available information indicated that no new sites are proposed for development in the local area during the remediation works, however two separate sites are currently under construction as residential developments. An overview of the development sites around the Staging Site is provided in Table 16-3 and is illustrated in Figure 16-5.

Table 16-3: Summary of surrounding developments

Site	Address	Development Summary			
		DA details	Dwellings	Expected status at Project start ¹	Expected status at Project end ²
Site A	Hilly Street, Northcote Street and Bennett Street	DA 513/2013	430	Complete	Complete
Site B	18 Woodlands Avenue	NA	108	Complete	Complete
Total			538		
¹ Expected start of Project – Q1 2019					
² Expected end of Project – Q3 2020					

It is noted that the traffic counts undertaken (as described in Section 16.3.2) included the existing traffic generated by construction work currently being undertaken at Site A and Site B. Both developments will be completed by the proposed start of the Project with the total number of additional dwellings expected to total 538.

A Traffic Study completed for Site B by Colston Budd Hunt and Kafes (2013), indicated a peak traffic generation rate of around 0.45 movements per dwelling¹. Peak traffic was assumed to be 10% of the overall daily traffic generation (Table 16-4). Non-residential land uses in the area are understood to be

¹ The reported specifies a rate of 0.43 movements per 1 and 2 bedroom dwellings and 0.55 movements per 3+ bedroom dwellings. A weighted average of 0.45 movements per dwelling has been adopted for assessment purposes (assuming 85% of dwelling are 1 and 2 bedrooms)

small in nature and are not anticipated to generate vehicle movements to the broader road network additional to those of the surrounding residential development.

Table 16-4: Traffic generation overview from surrounding developments

Site	No of dwellings	Development summary		Traffic generation	
		Peak hour	Daily	Peak hour	Daily
Site A	430	0.45 movements per peak hour	4.5 movements per day	194	1,940
Site B	108			49	490
Total				243	2,430

The additional traffic from the surrounding developments is expected to be 243 vehicles during peak hour, a total of 2,430 daily movements to the surrounding road network, noting that the additional traffic would be distributed across the network (i.e. not concentrated to one particular route).



Figure 16-5: Overview of surrounding development sites

16.3.9 EXISTING MARINE CONDITIONS

The marine environment has been described in detail within Chapter 10 Hydrology and Chapter 11 Water Quality and Sediments. For the purpose of this Chapter, the existing conditions refer to anthropological inputs and excludes bathymetry and wave generated impacts.

Marine Navigation

The primary navigation route in the vicinity of the Project Area is the main channel located to the north of Kendall Bay and Fairmile Cove, which has depths of between 5 metres to 20 metres. A port hand mark (a maritime navigational aid) is located approximately 20 metres to the north-east of Breakfast Point, and an east cardinal mark is located within Kendall Bay at the location of the former coal loading wharf, both delineating shallow bathymetry less than 2 metres below Chart Datum.

A single lane public boat ramp and a floating pontoon ferry wharf (Cabarita Ferry Wharf) are both located at the point on the eastern side of Kendall Bay. The Mortlake Ferry is located to the north-west of the Staging Site, with a slipway to service the vessel located adjacent to the landing. There are also 20 commercial swing moorings within Fairmile Cove that are still leased to the company River Quays Marina Pty Limited (see Table 16-5).

The wreck of the 'Lady Edeline', located approximately 50 metres downstream of the old River Quays Marina and 20 metres from shore, is partly visible at lower tides and is marked with white marker buoys (Plate 16-8).

The Roads and Maritime Services Boating Handbook (RMS, 2016b) provides boating information for operating on NSW waters including water traffic rules. The water traffic rules include guidelines on preventing collision and the interaction of vessels, and the requirement to comply with the International Regulations for Preventing Collisions at Sea which are adopted in NSW and modified through the *Maritime Safety Regulation 2016*. The onus for safety rests with boat users.

An extract from the Roads and Maritime Services (RMS) boating map 9G (RMS, 2016a) which covers Kendall Bay and Fairmile Cove is shown in Figure 16-6 and identified a speed limit of 4 knots when within 100m of the Mortlake Ferry. No other boating restrictions are imposed around Kendall Bay and Fairmile Cove. Where not specifically stated, rules regarding speed, wash etc. are governed by the 'Safety on the Water' section from the RMS Boating Handbook.

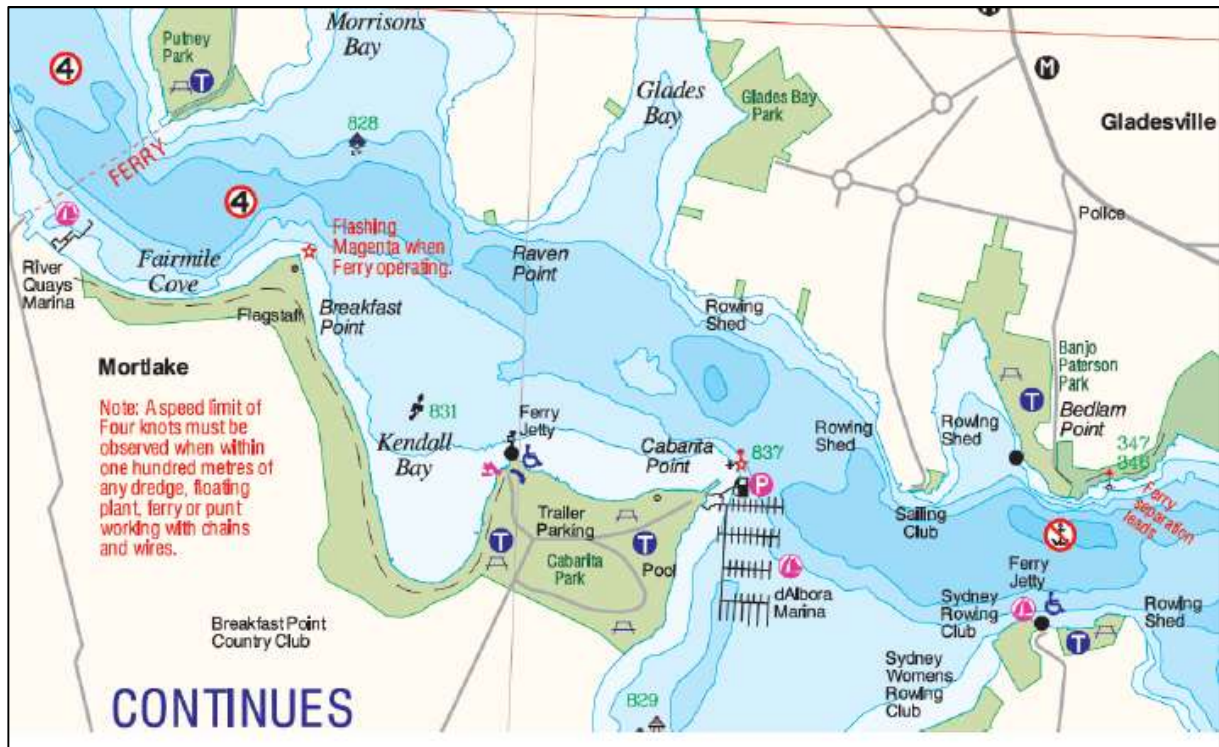


Figure 16-6: RMS boating map extract



Plate 16-8: Old River Quays Marina (while still in operation) and the 'Lady Edeline' wreck in the foreground. (Source: Royal HaskoningDHV 2018)

Marine Vessel Use

Marine vessel use within and in the vicinity of the Project Area is outlined in Table 16-5. Figure 16-7 shows the existing waterway navigation around Kendall Bay and Fairmile Cove and the proposed water based Project activities.

Table 16-5: Marine vessel use

Vessel Type	Description				
Public passenger ferry	The nearest passenger ferry wharf to the Project Area is Cabarita, located at the eastern end of Kendall Bay (refer Figure 16-6: RMS boating map). Cabarita wharf is served by the Sydney Ferries ‘F3 Parramatta River’ route. The downstream ferry route starting at Parramatta follows the main channel until it passes Breakfast Point, and then cuts across just out from the mouth of Kendall Bay into the Cabarita Wharf before continuing downstream towards Circular Quay. Ferries travelling upstream, (Circular Quay to Parramatta) follow a similar route to the downstream service. Other harbour based passenger cruise vessels also move along this stretch of river but generally do not deviate from the main channel. The F3 ferry service operates approximately every 10 minutes during peak times and every 30 minutes during off-peak times as follows:				
	Day	Route	First Ferry	Last Ferry	No of stops at Cabarita Wharf
	Weekday	Parramatta to Circular Quay	6:12 AM	10:50 PM	38
	Weekday	Circular Quay to Parramatta	6:23 AM	12:23 AM	38
	Saturday	Parramatta to Circular Quay	11:19 AM	10:50 PM	29
	Saturday	Circular Quay to Parramatta	7:48 AM	12:33 AM	29
	Sunday	Parramatta to Circular Quay	11:15 AM	7:50 PM	30
	Sunday	Circular Quay to Parramatta	7:48 AM	7:48 PM	29
	Mortlake Ferry	The Mortlake Ferry, located 100 metres north-west of the Staging Site, provides vehicle access between Mortlake and Putney, on the northern side of the Parramatta River. Vehicle access to the Ferry on the Mortlake (southern) side is from Hilly Street (Plate 16-8). The Ferry has capacity for 15 cars and is operated on twin cables from its respective landings. A speed limit of 4 knots applies to all vessels with 100 metres of the Ferry and its cables while in operation. A slipway located immediately downstream of the Mortlake approach ramp is used for the maintenance of all the RMS-owned vehicular ferries operating in the greater Sydney area and surrounds.			
Rowing boats	The Sydney Rowing Club, and several school rowing sheds, are located downstream of Kendall Bay in the Abbotsford and Gladesville areas. In discussions with the Sydney Rowing Club, it was confirmed that their rowing routes do not enter Kendall Bay and Fairmile Cove, but stay within the main channel. Sydney Rowing Club also commented that they did not expect, and have not seen, other rowing clubs and schools enter Kendall Bay and Fairmile Cove.				
Dragon boats	The Sydney Dragon Boat Club Association (based at Rhodes) confirmed that they rarely venture as far downstream along the Parramatta River as Kendall Bay.				
Sailing boats	Abbotsford 12ft Sailing Club is situated on the Parramatta River at the end of Great North Road, Abbotsford and generally operates every Saturday. During consultation with the Club, it was confirmed that the marine area in Kendall Bay or Fairmile Cove was not utilised.				
Kayaks	Kayakers are known to enter Kendall Bay and Fairmile Cove from time to time, however these waterways are not considered popular kayaking areas as there are no known kayak rental locations close by.				

Vessel Type	Description
	Jolly Roger Kayaks (who operate kayaking tours across Sydney) confirmed that tours were not run in the vicinity of the Project Area due to the potential danger posed by the Mortlake Ferry. During field investigations undertaken by Royal HaskoningDHV, one resident kayaker was observed launching a kayak from the beach area at Kendall Bay, and kayaking within the Bay (Plate 16-9). The resident is understood to often use the beach to launch his kayak.
Recreational Power Boats	Recreational power boats are known to enter Kendall Bay and Fairmile Cove from time to time, however they are not considered popular boating areas. It is assumed that power boats, if launched at the boat ramp at Kendall Bay, would navigate directly to the deeper water within the main channel of the Parramatta River, rather than towards Kendall Bay. A former owner of the Staging Site, stated that occasionally on weekends, fisherman drift around the marina structures for short periods of time before moving on to fishing around other hard structures on the river.
Swing Moorings	20 swing moorings are located within Fairmile Cove, consisting of a mixture of small sailing and powered vessels. The moorings are located immediately downstream of the former River Quays Marina, covering an area of around 200 metres by 100 metres, and are approximately 50 metres from shore in water depths of between 3 metres to 10 metres. It is understood that the vessels moored on the swing mooring are rarely used.

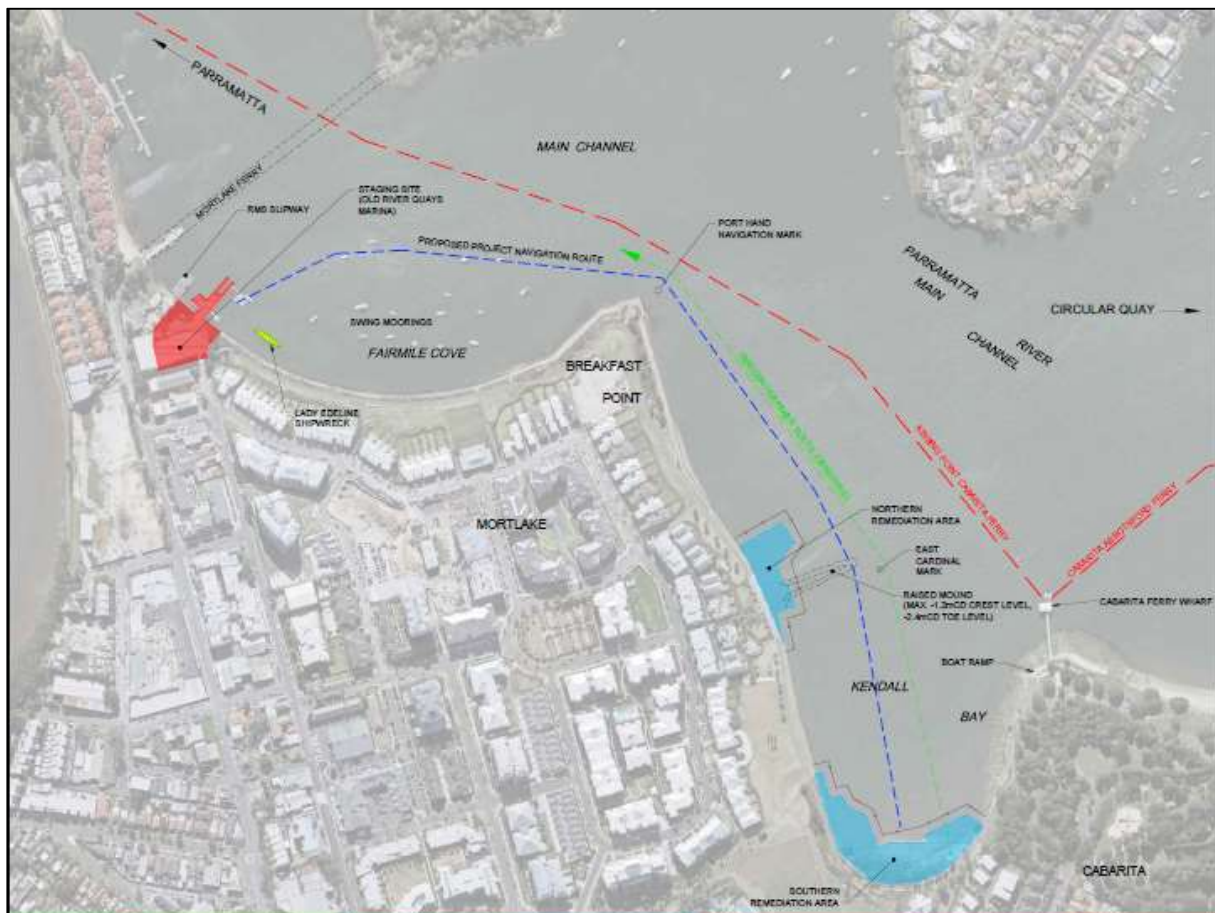


Figure 16-7: Existing waterway navigation and proposed water based activities



Plate 16-8: View from Mortlake Ferry landing (Mortlake Side)



Plate 16-9: Resident kayaker in Kendall Bay

16.4 STAKEHOLDER VIEWS

Traffic generation and subsequent management, is a concern that has been consistently raised in meetings with the Community Liaison Group and in broader consultation. More generally, community surveys have identified traffic as one of the most important issues for the EIS. The community issues have been two-fold, firstly associated with the management of construction traffic, and secondly, associated with the impacts on traffic movement / congestion, network infrastructure and surrounding residences and businesses.

State Significant Development projects require construction traffic to be controlled by a Construction Traffic Management Plan (CTMP), which will outline the key components of how traffic will be managed across the lifecycle of the Project. Further information regarding the CTMP is provided within Section 16.7.1 below, and Chapter 18 Environmental Management Framework.

With respect to the impact to congestion, network infrastructure and surrounding businesses, a Traffic Impact Assessment undertaken for the Project identified that the Project would contribute less than 1% of the total existing and expected traffic following completion of the existing developments.

16.5 POTENTIAL IMPACTS

16.5.1 LAND BASED TRAFFIC

Vehicle Movements

The Project is expected to generate approximately 9,600 tonnes of waste material, while requiring the importation of 12,500 tonnes of materials which includes cement, backfill and other capping material. Based on the loading capacity of a truck and trailer, estimated to be 30 tonnes, the Project is expected to generate a total average of 5.26 heavy vehicle movements per day. Based on the proposed working hours, and allowing for a 40% loading factor to account for peak daily vehicle volumes, this equates to a total of 10 heavy vehicle movements on weekdays and Saturday mornings.

In addition to truck movements, there will be light vehicle movements to the Staging Site associated with remediation activities. A total of 10 – 15 personnel are expected to be based at the Staging Site as part of the Project. Assuming that every employee drives, the Staging Site could be expected to generate 20 – 30 light vehicle movements on weekdays and Saturday mornings. The likely additional traffic movements during the Project are therefore expected to be up to 40 combined movements of light and heavy vehicles per day.

The proposed heavy vehicle routes were developed based on consideration of a number of factors, including a swept path analysis along the nominated roads, existing intersections and Local Area Traffic Management devices (road humps, chicanes and angled slow points), as well as sensitive land uses such as schools, parks and highly pedestrianised areas. The preferred and alternative routes selected for the Project aim to minimise the impact on the local road network. These routes and are shown on Figure 16-8.



Figure 16-8: Preferred and alternative heavy vehicle access routes

The preferred route utilises Tennyson Road, Gale Street, Mortlake Street, Cabarita Road, Frederick Street, Ian Parade, Broughton Street and Great Western Highway. The driving distance from the Staging Site to the M4 Motorway via this route is 4.4 km. This route joins the Great Western Highway at the Broughton Street signalised intersection.

Two alternative access routes are also shown on Figure 16-8 and include:

1. Tennyson Road, Gale Street, Brays Road, Majors Bay Road, Norman Street, Nullawarra Avenue, Hospital Road and Concord Road; and
2. The preferred route to Broughton Street and then Gipps Street and Concord Road.

The first alternate route is considered undesirable, given it passes Mortlake Public School. As shown on Figure 16-8, the presence of the low angled slow points has reduced the potential for other transport routes given they are difficult for large trucks to negotiate.

Given the low traffic volume of up to 10 heavy vehicle movements per day on the surrounding streets, the additional heavy vehicle traffic generated by the Project is not expected to compromise the safety, function or operational performance of the local road network. The potential 10 heavy vehicle

movements generated by the Project equate to less than 1% of the total vehicle traffic within the local road network.

Assuming all Project staff travel to the Staging Site by car, this will result in up to 30 light vehicle movements per day, which is slightly more than the 20 movements encountered during the former River Quays Marina operation when 10 staff were present. Based on the overall change in light vehicle movements being less than 1% of overall traffic, there is considered to be negligible additional impact on the local road network associated with light vehicle movements from the Project.

The overall impact of additional Project-related traffic volumes on the surrounding area is therefore considered to be negligible.

Bus Services

The Project will not disrupt or require changes to any bus routes in the vicinity of the Project Area and will therefore result in negligible impacts to bus services. In addition, the nearest bus stop to the Staging Site, located on Whittaker Street, will not be affected by the Project.

Pedestrian and Bicycle Facilities and Access

The Project works are not anticipated to affect any designated bicycle or pedestrian facilities. Temporary security / safety screening or fencing may be required in the vicinity of sections of the shared pathway which are adjacent to the Remediation Areas. Pedestrian and cyclist access to the shared pathway along the foreshore, on the eastern side of Tennyson Road, will be maintained at all times.

Vehicle Access

The existing 6 metre wide access way to the Staging Site is currently not wide enough to accommodate simultaneous use by vehicles travelling in opposite directions. As such, only a single vehicle at a time will be permitted to enter or exit the Staging Site. As this arrangement will apply mainly to heavy vehicles servicing the Project, other road users are not expected to be affected.

Public and Project Staff Parking

The Guide to Traffic Generating Developments (RMS 2013) does not include required car parking rates for construction projects. It is anticipated that up to 15 car spaces may be required to accommodate the number of anticipated staff travelling by car to the Staging Site each day. Ten car spaces are currently available in Palace Lane, with additional parking provided on-site when required, reducing the necessity for Project staff to utilise additional public parking areas within the vicinity of the Staging Site.

16.5.2 MARINE TRAFFIC

The waterway area to be used by the Project comprises the areas immediately around the Staging Site and wharf structures, the water-based corridor between the Staging Site and the Remediation Areas, as well as occupying the Remediation Areas themselves. In addition, a further 10 to 20 metres around the Remediation Areas will be used for the associated silt curtains and construction area marker buoys. Table 16-6 provides a summary of marine equipment that is expected to be utilised for the Project.

Table 16-6: Proposed Project marine-based equipment

Project Phase	Equipment
Site establishment / disestablishment	• barge-mounted piling rig for installation / removal of silt curtain piles • barge-mounted pile rig for installation / removal of sheet pile walls around Remediation Areas SA1 (and potentially NA2+NA3)

Project Phase	Equipment
	• barge-mounted crane or excavator for installation / removal of silt curtain (may include divers), silt curtain anchor blocks and construction area marker buoys; and • work boats for transfer of personnel.
In situ solidification, material excavation and overwater transport	• barge-mounted excavator • flat top barges with hoppers / skip bins for transport of excavated materials • barge-mounted drilling rig for deep sediment mixed columns • cement supply silo / tank, mixing plant and pump mounted on a floating barge • amphibious excavator for in situ solidification by mass mixing • landing barges for onshore deployment of small earthmoving equipment • work boats(s) for manoeuvring barges, general maintenance for items such as the silt curtains, and transfer of personnel • survey boat; and • water quality monitoring boat.
Cap construction, rock structures and beach filling	• barges (including work boat/s if not self-propelled) for delivering capping materials and rock for structures including the extension of the existing sandstone wall, spur walls and energy dissipation structures at stormwater outlets • barge-mounted crane or excavator for placement of geotextile fabric • barge-mounted excavator for placing / grooming capping material • amphibious excavator for use in areas where weak ground conditions exist • barge fitted with a slurry pump box and displacement pump for delivery of sand slurry into shallow nearshore areas (if hydraulic placement is proposed for beach filling) • workboat/s for manoeuvring barges, general maintenance for items such as the silt curtain, and for transfer of personnel • survey boat; and • water quality monitoring boat.

General

Waterway navigation impacts due to the Project would be limited to the duration of the Project. At its conclusion, all structures constructed for the purposes of carrying out the Project would be removed (noting sheet piles are to be cut off below or at the seabed level).

An exception to this exists at Remediation Area NA2+NA3 where penetration of hard surfaces over the footprint of the former coal wharf may not be possible. In this case, a capping layer of cobbles / sand would be placed over the top of the existing mounded area to provide substrate for re-establishment of viable benthic communities. This could locally raise bed levels by 200-300 mm. However, the existing hazard to navigation posed by the mounded seabed in the former wharf area is already identified by a cardinal mark. This navigation aid would continue to alert boaters of the shallow inshore depths in the area following completion of the remediation works.

The position of a number of the existing swing moorings within Fairmile Cove may need to be temporarily relocated to facilitate the Project navigation route, but could remain within their designated lease area.

It is not anticipated that over-water activities will interfere with seagoing ships / commercial vessels.

Kendall Bay

Waterway traffic within Kendall Bay is minimal with the public passenger ferries passing across the mouth of the bay, well away from the proposed construction activities. The boat ramp and associated route to the main channel is also isolated from the proposed construction activities.

For the duration of the Project, the resident kayaker who uses the bay would not be able to launch at the beach area due to remediation works (which include excavation and beach filling in Remediation Areas SA4 and SA5). However, the public boat ramp less than 200 metres away and a beach adjacent to Cabarita Ferry Wharf would be available for launching. It is understood the resident kayaker's typical navigation route would not be greatly affected, and launching from the boat ramp and / or beach would provide separation of the kayaker from the proposed construction activities.

The proposed Project navigation route through Kendall Bay is at a safe distance from the existing ferry route to Cabarita Ferry Wharf such that interaction of construction traffic with ferries is unlikely to occur within Kendall Bay.

Fairmile Cove

As previously described, waterway traffic within Fairmile Cove is minimal. Any modifications to the former River Quays Marina to establish the Project Staging Site would be within the existing lease boundary and would therefore not encroach further into the Parramatta River. The Mortlake Ferry and associated slipway is upstream of the former River Quays Marina and would not be impacted upon by the proposed construction activities.

The proposed Project navigation route may partially impact some of the existing swing moorings. However, based on discussions with the former lessee (River Quays Marina Pty Limited), temporary relocation of these moorings is feasible. Based on an examination of local bathymetry and the existing mooring configuration, it would be possible to relocate swing moorings if required, subject to RMS approval.

Breakfast Point

The majority of waterway traffic in the area is contained within the main channel of the Parramatta River. The proposed Project navigation route would pass by Breakfast Point on the outside of the port hand marker and along the edge of the main channel. Passing vessels are typically located well away from Breakfast Point and towards the centre of the main channel. Based on site observations, the passenger ferry did not appear to deviate from the main channel to and from the Cabarita Ferry Wharf until it was positioned downstream of Breakfast Point. Therefore, there would appear to be sufficient waterway area to allow for safe passage of construction traffic without impeding the existing ferry route. In addition, the ferry timetable would be known and overwater transport of construction vessels could be scheduled to accommodate ferry movements.

However, the proposed navigation route is likely to require vessel speeds to be limited to 4 knots to allow for a careful approach to Breakfast Point from both directions. This speed limit is already imposed upstream of Breakfast Point due to the operation of the Mortlake Ferry. Two-way passing of construction vessels approaching from either side of Breakfast Point will generally be avoided at Breakfast Point with right of way being given to vessels approaching from within Kendall Bay. Construction vessels will be in frequent radio contact with each other and with ferries on approach to Breakfast Point.

16.6 CUMULATIVE IMPACTS

As discussed above, the Project will generate up to 40 vehicle movements per day, including up to 10 heavy vehicle movements per day. The anticipated land-based traffic volume generated by the Project,

when compared to the Breakfast Point development and surrounding construction works (including Sites A and B), accounts for less than 1% of the traffic within the surrounding road network. It should also be noted that this traffic will be short term (approximately 14 months) and limited to the life of the Project. The potential cumulative impacts are thus anticipated to be negligible.

16.7 MITIGATION AND MEASURES

16.7.1 CONSTRUCTION TRAFFIC MANAGEMENT PLAN

A Construction Traffic Management Plan (CTMP) will be developed that outlines the traffic management measures to be implemented during the remediation works and Staging Site operations. The CTMP is also discussed in the context of the overall Project environmental management framework in Chapter 18. Key measures to be addressed in the CTMP include:

- management measures to minimise the impact of truck movements on existing road users and the community, including:
 - scheduling haulage and delivery during off peak periods where possible and confining deliveries / haulage to and from the Staging Site to designated haulage routes
 - implementation of a community information and awareness programme prior to and during construction to ensure that local residents are fully aware of the construction activities
 - a route to offsite facilities that avoids (where possible) sensitive areas such as schools or residential areas.
- pedestrian and cycling management plans to address the safety of site personnel and the general public
- installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist e.g. entrance to the Staging Site
- contingency and emergency planning in the event of a truck transporting contaminated material breaking down or road traffic incident.

16.7.2 DILAPIDATION REPORT

A road dilapidation report will be prepared prior to work commencing, for comparison purposes during and post construction.

16.7.3 MARINE WORKS

In coordination with RMS, a 'Marine Notice' will be issued to advise the boating community of the extent, nature and duration of the construction activities. Special marker buoys (including lighting for night-time navigation) and appropriate signage will be installed to delineate the construction areas in accordance with RMS requirements and in consultation with the Harbour Master. The signage will include an 'All Hours' contact number to the Harbour Master for use during the remediation works.

Construction vessels will be selected to suitably, and safely, navigate the shallow waters of Kendall Bay. Where required, an alternate navigation route on the eastern side of the cardinal mark may be used by deeper draughted vessels so as to avoid the potential navigation hazard posed by the raised mound.

As required, the swing moorings adjacent to the Staging Site can be temporarily relocated to facilitate marine construction traffic to and from the Staging Site.

A Navigational Management Plan will be developed which details the navigation routes and rules for travel between the Remediation Areas and the Staging Site, as well as procedures for dealing with on-water incidents and interface with other marine traffic. Vessels will be instructed to maintain an approximate easterly heading when approaching Breakfast Point from within Fairmile Cove, improving the site distance to and for vessels approaching from within Kendall Bay. In addition, vessel speeds will be limited to 4 knots to promote safe navigation, and reduce wash for passing watercraft.

Where barges are travelling in the opposite direction, right of way will be given to vessels approaching from within Kendall Bay to avoid two-way passing. Construction vessels will always be in frequent radio contact with each other and with other marine craft.

Consultation with the resident kayaker(s) will be undertaken to inform them of the Kendall Bay Remediation Project, and to discuss temporary modifications to landing and retrieval locations, such as the boat ramp and beach areas adjacent to Cabarita Ferry Wharf.

16.8 POTENTIAL IMPACTS AND MITIGATION MEASURES SUMMARY

A summary of the proposed management and mitigation measures to be implemented by the Project are presented in Table 16-7.

Table 16-7: Summary of potential impacts and mitigation measures

Potential impact	Mitigation and management measures
Increase in heavy vehicle movements causing operational and / or safety impacts to the surrounding road network via congestion and heavy vehicle presence, or via deterioration of the road infrastructure	• preparation of a Traffic and Pedestrian Management Plan (TPMP) incorporating relevant traffic, pedestrian and cyclist control plans. The CTMP will incorporate the requirement for traffic control personnel at the Staging Site to control the movement of heavy vehicles entering and exiting the site. • road dilapidation report completed prior to works beginning, with ongoing monitoring and a post remediation dilapidation report for comparison purposes. • installation of security or safety fencing / screening (if required) will ensure pedestrian and cycling access is maintained to the shared pathway.
Potential congestion / safety impacts at the access way into the Staging Site caused by the entry / exit of heavy and light vehicles.	
Potential disruptions to bus services in the vicinity of the Staging Site and wider Project Area.	
Potential disruptions to local transport services in the vicinity of the Staging Site and wider Project Area including: • pedestrian and cycleway access to Kendall Bay; • access to Cabarita Ferry Wharf; and • access disruptions to the Mortlake Ferry.	
Reduction in the availability of car parking supply within the road network surrounding the Staging Site.	• at least five car spaces will be made available within the Staging Site for personnel. This will be in addition to the ten available car spaces in Palace Lane.
Waterway users navigating near the proposed remediation works and Project navigation route.	• in coordination with RMS, a 'Marine Notice' will be issued to advise the boating community of the extent, nature and duration of the construction activities • provision of special marker buoys (including lighting for night-time navigation) and appropriate signage to delineate construction areas in accordance with RMS

Potential impact	Mitigation and management measures
	requirements and in consultation with the Harbour Master - contractor to provide an 'All Hours' contact number to the Harbour Master for use during the remediation works - should the Contractor anticipate that over-water activities could interfere with seagoing ships / commercial vessels then a Marine Traffic Management Plan will be prepared for submission to Jemena and the Harbour Master for approval prior to commencement of works
Navigation of construction vessels through the shallow water depths within Kendall Bay and in the vicinity of the Northern Remediation area where a raised mound exists on the seabed at the demolition site of the former coal wharf.	- selection of construction vessels with an appropriate draught to navigate safely within the shallow waters of Kendall Bay - use of an alternate navigation route on the eastern side of the cardinal mark by deeper draught vessels to avoid the potential navigation hazard posed by the raised mound
Interaction of the proposed project navigation route with the existing swing moorings within Fairmile Cove.	temporary relocation of swing moorings as required to facilitate construction traffic to and from the Staging Site
Limited sight distance for construction vessels approaching along the proposed navigation route from either side of Breakfast Point.	- limiting vessel speeds to 4 knots to promote safe navigation, and reduce wash for passing watercraft - vessels will maintain an approximately easterly heading when approaching Breakfast Point from within Fairmile Cove to improve site distance to and for vessels approaching from within Kendall Bay - two-way passing of construction vessels approaching from either side of Breakfast Point will generally be avoided at Breakfast Point with right of way being given to vessels approaching from within Kendall Bay - construction vessels will be in frequent radio contact with each other and with ferries on approach to Breakfast Point
Launching of kayaks from the beach at the head of Kendall Bay will not be possible for the duration of the proposed remediation works.	consultation with the resident kayaker(s) to inform them of the Project and to agree temporary modifications to landing and retrieval locations, such as the boat ramp and beach areas adjacent to Cabarita Ferry Wharf

16.9 CONCLUSION

The Project is likely to temporarily generate only very minor increases in heavy vehicle traffic, and is not expected to cause congestion or safety related impacts to the surrounding road network. Impacts to public transport services in the vicinity of the Project Area are not expected to occur. Impacts to pedestrian and cycling access on the shared pathway are also expected to be negligible.

Recreational kayakers who utilise the beach area at Kendall Bay to launch their watercraft will be temporarily unable to launch their watercraft along the beach area during the Project. However, there are alternative and suitable launching locations at the nearby Cabarita Boat Ramp and the adjacent beach area.

Although a low level of impacts is anticipated, as good practice, management measures for Project related vehicle movements and marine navigation will be put in place to ensure the Project does not have an adverse impact on community road and maritime based users in the vicinity of the Project Area.

17. WASTE MANAGEMENT

This chapter provides an overview of the anticipated waste streams to be generated during the Project including the classification, treatment, handling and disposal of waste materials, from the Southern and Northern Remediation Areas, as well as waste materials generated from the Staging Site.

17.1 OBJECTIVES AND SCOPE

The objective of the waste assessment was to determine all potential waste streams generated during Project activities, classify the waste streams and identify management procedures for their storage and disposal in accordance with:

- *Protection of the Environment and Operations Act 1997* (POEO Act)
- *Protection of the Environment Operations (Waste) Regulation 2014* (POEO Waste Reg)
- *Waste Classification Guidelines Part 1: Classifying Waste* (NSW EPA 2014a) and *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (NSW EPA, 2014a) including associated exemptions, orders and approvals; and
- *Waste Avoidance and Resource Recovery Act 2001* (WARR Act), including the *Waste Avoidance and Resource Recovery Strategy 2014-2021* (NSW EPA 2014b), and the *National Waste Policy: Less Waste More Resources* (EPHC 2009).

This chapter addresses the following SEARs:

SEARs Requirement – Waste Management

Waste management including details of the classification, treatment, handling and disposal of all waste materials, including wastewater generated by the development.

17.2 ASSESSMENT METHODOLOGY

The NSW EPA (2014a) *Waste Classification Guidelines Part 1: Classifying Waste* provides the framework for classifying waste for the purpose of storing, transporting and disposing of waste in NSW. Waste material is classified into six separate classes using a six-step identification process. The six classes are:

- special waste
- liquid waste
- hazardous waste
- restricted solid waste
- general solid waste (putrescible); and
- general solid waste (non-putrescible).

In addition, consideration is also given to Immobilisation Approvals (IA), which allow a generator who complies with the terms of an approval to classify waste as set out in the approval, rather than classification by way of the Guidelines. General IAs exist for common media / contaminants, such as

granular activated carbon waste, however site-specific IAs may be required if certain parameters of the general IAs are not met.

To minimise waste generated during the Project, the anticipated waste materials will be managed under the waste hierarchy criteria established under the WARR Act. The WARR Act establishes the waste hierarchy to ensure management options are considered for the effective management of resources against the following criteria:

- avoidance of unnecessary resource consumption
- resource recovery including reuse, reprocessing, recycling and energy recovery; and
- disposal to assess how waste will be effectively disposed to minimise any adverse impacts on the environment.

As the Project is State Significant Development, development control plans do not apply. However, consideration has been given to the City of Canada Bay Council Development Control Plan (DCP) and DCP – Special Precincts documents, published in March 2017 (City of Canada Bay Council 2017a; 2017b), which outline specific controls relating to waste management within the Canada Bay LGA.

17.3 EXISTING ENVIRONMENT

The Project Area is divided into three separate areas (namely the Southern Remediation Area, Northern Remediation Area and the Staging Site), each of which will generate and be influenced by different types of waste throughout the Project.

17.3.1 REMEDIATION AREAS

The Northern and Southern Remediation Areas are located offshore, or within the intertidal zone, adjacent to the seawall on the western side of Kendall Bay, with the Southern Remediation Area extending across the southern beach to the east. Access to both areas is exclusively via Kendall Bay, limiting interaction with the seawall and adjacent foreshore areas.

Remediation will include the production of ISS sediment (upper portion to be disposed off-site from SA1 and NA2+NA3), as well as non-stabilised sediment and rubble from within the intertidal area. Other waste generated will include waste oil associated with remediation equipment, general waste and surplus remediation material generated by the contractors. If dewatering of excavated sediment is required prior to acceptance at landfill, it will occur at an off-site facility. Some minimal wastewater will be produced from the wheel wash and decontamination / washdown of equipment. This water will be stored in tanks at the Staging Site and a liquid waste contractor will be contracted to dispose of wastewater off-site.

Minimal vegetation clearing will be undertaken during the remediation works, with the proposed removal of one mature mangrove in the south-west of Kendall Bay. This clearing is necessary to allow for sufficient removal of contaminated sediment and replacement of clean material to achieve the remediation objectives (refer Chapter Project Description of Project Activities).

17.3.2 STAGING SITE

The Staging Site will be a shared facility, occupied by the core Jemena Project management team and the Contractor. The Staging Site retains existing infrastructure as set out in Table 17-1 below.

Table 17-1: Staging Site infrastructure

Infrastructure	Use
Wharf	Marine access and berthing of marine vessels for unloading and loading of materials required to facilitate the remediation works
Jetties	Personnel access to marine work areas and the mooring of small vessels
Remediation Staging Site	Establishment of static plant and equipment and for the handling of non-odorous materials and other remediation support activities
Offices / meeting rooms	Use by the remediation contractor for administrative and Project support for the remediation works
Ablutions / kitchen	Shared amenities for use during the carrying out of the works
Onsite parking area	Shared parking area for use during the carrying out of the works
Entrance driveway	Active vehicle area which will be maintained at all times to ensure unimpeded access is available for the Works and other purposes

The Staging Site will be used for mobilising plant, equipment and materials to the Remediation Areas in Kendall Bay and for receiving excavated materials from Kendall Bay for transfer to trucks for further off-site treatment if required prior to off-site disposal. There will be no stockpiles of excavated materials as the Staging Site will be utilised only for the acceptance of sealed containers of sediment and limited holding until collection and transport to off-site facilities for further treatment if required and then disposed off-site.

17.3.3 CLASSIFICATION OF EXCAVATED MATERIALS

The classification of excavated materials is subject to discussion and approval by the NSW EPA, especially as this is a unique project, but the general principles are described below.

Sediment excavated from the Remediation Areas NA2+NA3 and SA1 will have been cement stabilised in-situ and sediments, sand, rocks, coke, coal etc. from the Remediation Areas NA1 and SA2 to SA5 will be excavated raw and untreated.

The material will need to be treated to a standard considered suitable for disposal to landfill, in accordance with the requirements of a Specific IA (Internal Approval), similar to the NSW EPA General IA 2005/14 (NSW EPA 2005). A Specific IA is required for the Project due to:

- total recoverable hydrocarbons (TRH) C₁₀-C₃₆ concentrations exceeding General Solid Waste (GSW) criteria; and
- the fact that this material is sediment, not soil with an Ultimate Compressive Strength (UCS) post treatment above 1MPa consistently achieved.

Excavated material from Remediation Areas for off-site disposal will be transported in sealed skips or bins on barges to the Staging Site, transferred to trucks by crane and then sent off-site to an EPA-licensed facility.

Testing will be undertaken to confirm treatment has been completed to a level consistent with the requirements of the Specific IA for ISS treated material (SA1 and NA2+NA3) and untreated material meets landfill acceptance criteria (SA2 and NA1) and then sent to an EPA licensed landfill. Excavated material from SA3 to SA5 is planned to be re-used in the capping layers of SA1 and NA2+NA3 given suitability.

The final ISS design will be based on field-scale trials, as such, the characteristics of the material excavated from the raft slab within Remediation Areas NA2+NA3 and SA1 are yet to be determined. This material may or may not require additional stabilisation at an off-site waste facility before disposal to a EPA licensed landfill site. The offsite treatment and disposal to landfill will be carried out in accordance with the Environment Protection Licences of the respective facilities.

Further detail on the nature and quantities excavated materials and other waste is in Chapter 4 Project Description.

17.3.4 CLASSIFICATION OF OTHER WASTE STREAMS

All other waste streams generated during the Project are anticipated to be classified as 'general solid waste' aside from waste oil, which will be classified as 'liquid waste'.

Wastewater is addressed in Chapter 11 Water Quality and Sediment.

17.3.5 SUMMARY OF WASTE STREAMS

All anticipated waste streams, predicted quantities and waste classification are outlined in Table 17-2. These quantities are indicative estimates only and may change following the remediation trial and as works progress.

Table 17-2: Anticipated waste materials

Waste type	Description	Estimated volume / mass
Stabilised sediment	Excavated treated sediment from the raft slab up to - 0.5 metres LAT within Remediation Areas NA2+NA3 and SA1	~6,400 m ³
Non-stabilised sediment	Excavated sediment from remaining Remediation Areas (considered PASS)	~500 m ³
Oversized material from Remediation Areas	Oversized material collected from the shoreline and bed of the Remediation Areas, which may include: - rocks / large stones. - submerged wooden structures associated with the former wharf with in the Northern Remediation Area	1 – 5 tonnes
General waste	General non-putrescible waste General putrescible household waste generated from workforce personnel	2 m ³ bin / week
Building and construction waste	Building and construction waste is anticipated to include: - waste timber, steel and concrete slabbing generated during the construction works and decommissioning works at the Staging Site; and - old piles adjacent to the Staging Site wharf which obstruct movement of barges	50 tonnes
Green waste	Green waste should be limited to minimal mangrove removal from mangrove stand in the southern area of SA2.	10 m ³
Waste oil	Potential waste oil from the servicing of plant and equipment.	10 m ³

17.4 STAKEHOLDER VIEWS

Waste generation and subsequent management was raised during community engagement for the Project. Initial concerns in early consultation on the Project included transport of uncovered contaminated material in trucks and alternative transport by barge for off-site disposal. Community members are concerned about the generation, amount and fate of waste, however it is generally acknowledged that it will be an inevitable by-product of the overall Project with the anticipated volume of waste noted in Table 17-2.

With respect to the fate of waste material generated as part of the Project, all waste will be sent to a suitably licensed waste handling and disposal facility. Excavated material from the Remediation Areas will be transported in sealed skips or bins on barges to the Staging Site, before being transferred to trucks by crane and then sent off-site to an EPA-licensed waste facility. Where possible and suitable to do so, material will be reused on site (e.g. as capping material) or sent to a recycling facility.

17.5 POTENTIAL IMPACTS

The Project impact assessment for the anticipated waste materials is outlined in Table 17-3. The assessment has been undertaken in accordance with the WARR Act, the *Waste Avoidance and Resource Recovery Strategy 2014-2021* (NSW EPA 2014b), and the *National Waste Policy: Less Waste More Resources* (EPHC 2009) which has established the waste hierarchy to ensure management options are considered for the effective management of resources.

Impacts from the discharge of wastewater are discussed in Chapter 11 Water Quality and Sediments.

Table 17-3: Assessment of waste streams against waste hierarchy criteria

Waste type	Potential impact	Waste Hierarchy Criteria		
		Avoidance	Resource recovery	Disposal
Stabilised sediment	Disposal of sediment to a facility not licensed (and therefore unequipped to receive classification of material) causing environmental harm	No feasible opportunities exist to avoid removal and treatment of the contaminated sediment.	No feasible opportunities exist to reuse the stabilised sediment for other purposes on or off the site.	The stabilised sediment will be transported to the Staging Site in sealed skips or bins and then to an EPA-licensed facility for further stabilisation (as required), and from there to an EPA-licensed landfill. The offsite treatment and landfilling will be carried out in accordance with the Environment Protection Licences of the respective facilities. At all times, the stabilised sediment will be accompanied with relevant waste materials tracking documentation. The stabilised sediment is to be handled and transported in accordance with approval documentation.
Un-stabilised sediment	Disposal of contaminated sediment to a facility not licensed (and therefore unequipped to receive classification of material) causing environmental harm	No feasible opportunities exist to avoid removal and treatment of the contaminated sediment.	No feasible opportunities exist to reuse the sediment for other purposes on or off the site.	The un-stabilised sediment will be transported to the Staging Site in sealed skips or bins and then to an EPA licensed facility. The sediment will be tested to confirm the sediment classification. As required the sediment will be stabilised, prior to transfer to an EPA-licensed landfill. If the sediment meets the GSW requirements, the sediment will be transferred directly to an EPA-licensed landfill without stabilisation. The off-site treatment and landfilling will be carried out in accordance with the Environment Protection Licences of the respective facilities. The stabilised sediment will be accompanied with relevant waste materials tracking documentation at all times.

Waste type	Potential impact	Waste Hierarchy Criteria		
		Avoidance	Resource recovery	Disposal
Oversized material from remediation areas	Disposal of large material impacting the landfill liner causing environmental harm	Oversized material free of contamination will be reused as capping material. No feasible opportunities exist to avoid the removal of oversized material coated in coal tar, for example, from the Remediation Areas.	Oversized material free of contamination will be reused as capping material. No feasible opportunities exist to avoid the removal of oversized material coated in coal tar, for example, from the Remediation Areas.	All oversized material will be segregated and stockpiled at the Remediation Areas prior to disposal at an approved waste facility.
General waste (non-putrescible and putrescible)	Disposal of general waste causing environmental harm	Generation of office waste such as paper from unnecessary printing is to be avoided as far as practicable.	All waste should be separated and placed in bins accordingly to maximise recycling of materials such as paper, cardboard, glass, and aluminium.	All remaining office waste classified as 'general solid waste (non-putrescible)' and as 'general solid waste (putrescible)' is to be disposed of in accordance with the <i>Waste Classification Guidelines Part 1: Classifying Waste</i> , at an approved licensed facility.
Building and construction waste	Disposal of building waste causing environmental harm	Building and construction waste generated during the site establishment, remediation and decommissioning / site re-establishment phases is to be minimised as far as practicable.	Where applicable all efforts to be made to reuse / recycle the following materials at an approved facility: - metal waste - brick material; and - timber. All materials proposed for reuse / recovery should be adequately decontaminated prior to transportation to an approved recycling facility.	All remaining building and construction waste will be classified as 'General Solid Waste (non-putrescible)' and will be disposed of in accordance with the <i>Waste Classification Guidelines Part 1: Classifying Waste</i> , at an approved licensed facility.
Green waste	Disposal of green waste causing environmental harm	A mangrove in the south-west of Kendall Bay is required to be removed to allow for the accurate removal of contaminated sediment and replacement of clean material to achieve the remediation objectives.	No opportunity remains to reuse the mangrove, particularly given that it has been exposed to impacted sediments.	The mangrove requiring removal will be classified in accordance with the <i>Waste Classification Guidelines Part 1: Classifying Waste</i> , at an approved licensed facility.

Waste type	Potential impact	Waste Hierarchy Criteria		
		Avoidance	Resource recovery	Disposal
Waste oil	Disposal of waste oil causing environmental harm	Waste oil generation will be minimised as far as practicable by ensuring that plant and equipment are in sound operating conditions and regularly serviced. Appropriate operational measures will be implemented to minimise the generation of oily wastes.	No opportunities exist to recycle or reuse waste oil generated from the Project.	Waste oil will be stored in appropriately banded drums prior to disposal at an approved facility capable of receiving liquid waste.

17.6 CUMULATIVE IMPACTS

There are no expected waste-related cumulative impacts associated with the Project, as all waste and temporary infrastructure will be removed as part of site decommissioning and re-establishment.

17.7 MITIGATION MEASURES

An overview of the waste management measures that will be implemented during the Project are outlined below. Mitigation measures in relation to wastewater are discussed in Chapter 11 Water Quality and Sediments.

17.7.1 WASTE MANAGEMENT PLAN (WMP)

Prior to the commencement of the Project, an updated WMP will be prepared and will include all anticipated waste streams and their waste classification. In addition, the WMP will include appropriate procedures for the management of waste, specifically the requirements to monitor and report the type and volume of waste streams generated, and the fate and transport of each waste type.

Waste management procedures will be developed in accordance with the principles embodied in the WARR Act, and with consideration to Part 3 (*Records, measurement of waste and monitoring at scheduled waste facilities*), Part 4 (*Tracking of certain waste transported within, out of and into NSW*), and Part 10 (*Classification of waste containing immobilised contaminants*) of the POEO Waste Regulation. In addition, consideration will be given to PASS which may exist in the Remediation Areas. PASS will be managed under a separate Acid Sulfate Soil Management Plan as described in Chapter 18. The ASSMP and WMP will form part of the Remediation Works Environmental Management Plan (RWEMP).

17.7.2 WASTE DISPOSAL AND RECYCLING

Site induction will be undertaken to educate contractors on efficient use of resources to reduce consumption, minimise the generation of waste, and to outline the processes in place regarding waste separation for recycling.

All waste materials which meet the specification to be reused / recycled will be taken to an approved facility, capable of accepting those materials. All other waste is to be disposed in accordance with the classification of the waste material at an approved facility.

If necessary to comply with the receiving off-site facility's requirements, some large rocks, concrete, metal materials and rubbish will be manually removed from the sediments.

17.7.3 TRANSPORT OF WASTE

Only appropriately licensed transport contractors will be engaged to transport waste material off-site. The contractors appointed to transport waste will be required to demonstrate and ensure:

- they are licensed to transport the type of waste they are contracted to receive / handle
- they transport the waste to a licensed facility capable of receiving the type of waste and quantity they are carrying
- that waste is adequately covered during transport; and

- waste data forms are provided to the waste facility upon arrival.

17.7.4 WASTE REPORTING AND AUDITING

Reports will be routinely prepared documenting the waste that has been generated. These will be prepared using waste receipts that have been retained and will include:

- waste classification data to assess compliance with the *Waste Classification Guidelines Part 1: Classifying Waste* (NSW EPA 2014a)
- a review of licences held by the facilities where waste has been disposed to assess / ensure their ability to accept the waste in accordance with relevant legislation. Licences will be reviewed periodically to ensure ongoing compliance
- any incident reports relating to waste (i.e. spills) which have occurred over that month. Any corrective actions undertaken should also be included; and
- daily records to be provided to the superintendent confirming tonnage of waste carted offsite and received at the licensed waste facility.

17.7.5 CAPPING AND FILL MATERIAL

Where suitable (i.e. meet re-use criteria), some excavated rocks and sand from areas disturbed by remediation activities on the shoreline will be used to supplement imported capping and fill material. Imported capping and fill material will be purchased on an 'as needed' basis to ensure that waste is minimised. Imported capping and fill material will only be Virgin Excavated Natural Material (VENM).

17.7.6 TEMPORARY WASTE STORAGE

Waste materials may be stored in designated areas at the Staging Site, based on material type, but will preferably be transferred directly from barges to waiting trucks. The WMP will clearly define any potential storage areas for each waste type as well as handling protocols from the time the waste is generated, until the time it is received at the appropriate handling facility.

17.8 POTENTIAL IMPACT AND MITIGATION MEASURES SUMMARY

A summary of the potential impacts of waste management together with the mitigation and management measures to be implemented are outlined in Table 17-4.

Table 17-4: Summary of impacts and mitigation measures

Potential impact	Mitigation and management measures
Disposal of contaminated sediment to a facility not licensed (and therefore unequipped to receive classification of material) causing environmental harm	Prepare and implement a Remediation Works Environmental Management Plan including a Waste Management Plan, Materials Tracking Plan and Acid Sulfate Soils Management Plan The Materials Tracking Plan will address waste materials tracking, including a review of receiving facility licences to ensure they are suitably licensed to receive excavated sediment.
Disposal of large material impacting the landfill liner causing environmental harm	Oversized material not suitable for reuse as capping material will be segregated at the Remediation Area and barged to the Staging Site for transport to a suitably licensed waste facility.

Potential impact	Mitigation and management measures
Disposal of general waste causing environmental harm	Detailed WMP to provide locations of on-site waste bins for site operations general waste; describe procedures for storing and disposing of general waste; and identify responsible persons for overseeing implementation of the WMP.
Disposal of building waste causing environmental harm	Educate site personnel in the reduction of building waste during site induction and encourage reduce / reuse / recycle where possible through internal environmental management system. Detailed WMP to provide procedures for storage and classification of generated building waste.
Disposal of green waste causing environmental harm	Green waste generation expected be limited to the mangrove in the Remediation Area SA2. A review and update of the WMP to be completed if additional green waste generation is required to meet the remediation objectives.
Disposal of waste oil causing environmental harm	Waste oil to be stored in a bunded area prior to disposal at an approved facility capable of receiving liquid waste. Waste oil generation, storage and disposal to be tracked in accordance with the detailed WMP.

17.9 CONCLUSION

This chapter has detailed preliminary waste management strategies, outlining the anticipated waste streams, as well as the predicted quantity and waste classification of likely generated wastes.

The total volume of solid waste generated during the Project is expected to be almost entirely associated with contaminated sediment material. Additional waste streams exist associated with general construction waste, wastewater and project consumables.

A comprehensive WMP will be formulated in consultation with the appointed remediation contractor prior to the commencement of the Project, which will collate the management options, and assist in managing waste and avoiding potential impacts to human health and the environment during the Project.

18. ENVIRONMENTAL MANAGEMENT AND KEY COMMITMENTS

This chapter provides a summary of the Project-specific Environmental Management Plans that will be prepared to ensure the Project is able to meet the remediation objectives, while protecting human health and the environment. Measures for the identification and management of unexpected issues or events that may occur during the remediation works are also provided.

The chapter also provides a consolidated summary of key commitments in the EIS and the proposed environmental management and monitoring measures.

18.1 OBJECTIVES AND SCOPE

As noted in Chapter 4 Description of Project Activities, environmental management of the Project will be through Project-specific Environmental Management Plans (collectively referred to as EMPs) which will provide the overall framework for the management of environmental risks and impacts.

The EMPs will cover all stages of the Project including site establishment, remediation works, demobilisation and rehabilitation. EMPs will be prepared consistent with the *Guidelines for the Preparation of Environmental Management Plans* (Department of Infrastructure, Planning and Natural Resources, 2004).

Mitigation measures identified throughout this EIS (and summarised in Table 18.15) will be incorporated into the EMPs discussed below. The EMPs will:

- act as an environmental operations manual for staff and contractors throughout the life of the Project
- identify potential impacts associated with the key issues addressed in this EIS and the measures proposed to mitigate these impacts
- detail how, and at what stage of the Project, environmental safeguards are to be implemented
- detail the timing for the implementation of mitigation measures
- clearly define the allocation of environmental responsibilities to staff and contractors
- outline monitoring and reporting requirements subject to approval, to demonstrate compliance with licensing and approval requirements; and
- provide procedures for review and updating EMPs as required.

This chapter addresses the following SEARs:

SEARs Requirement – General
• Consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS. • A description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment

18.2 ENVIRONMENTAL ADMINISTRATIVE FRAMEWORK

Jemena is committed to conducting all its operations and activities in an environmentally sound and responsible manner. Jemena will conduct all its activities to ensure compliance with all applicable laws, regulations and standards. Operations are undertaken in accordance with the Jemena Environmental Management System which is consistent with the principles of ISO 14001, in order that the company's environmental footprint can be monitored and reduced, and environmental performance continuously improved.

18.2.1 PROJECT ROLES AND RESPONSIBILITIES

The successful implementation of each Project phase requires a commitment from Jemena as well as its employees and contractors. It is essential that the roles and responsibilities for the implementation of the suite of plans which comprise the environmental management framework are clearly defined.

Similarly, specific roles and responsibilities will be defined for contractors and sub-contractors. During site establishment and remediation works, contractors will be the key implementers of mitigation measures as defined in the management plans and will also be responsible for ensuring compliance with the Project objectives and commitments.

The key Project roles and responsibilities are set out below.

Project Manager

The Jemena Project Manager will be responsible for the management of the contractual relationship with the remediation contractor and liaison with the regulatory authorities, stakeholders and the public. The Jemena Project Manager will also be accountable to Jemena management for the progress and successful completion of the Project.

The Project Manager will be responsible for ensuring that all relevant planning and environmental consents, permits and also licences are obtained for the remediation works (whether obtained by Jemena itself or by the contractor) as well as approving the Remediation Works Environmental Management Plan (RWEMP) and monitoring its implementation (refer Section 18.6).

Remediation Contractor

The remediation works will be delivered by the remediation contractor to be engaged by Jemena. The remediation contractor will prepare and implement the Remediation Works Plan (RWP), Remediation Works Contingency Plan (RWCP) and RWEMP. The remediation contractor will be responsible for day to day management and carrying out of the remediation works, the monitoring of the remediation works, including review and / or collection of environmental monitoring data, and assist with sampling required for the delivery of the Validation Sampling Analysis and Quality Plan (VSAQP) (see Section 18.13).

It is also intended that the remediation contractor will assist with management of day-to-day community relations during the course of the remediation works, however Jemena will continue to drive the overall stakeholder engagement program (refer Chapter 6 Stakeholder Engagement). All non-conformances and complaints will be reported to Jemena as soon as practicable.

Validation Consultant

Jemena will engage the validation consultant to manage analytical works and document the construction QA/QC measures as required by the RAP. The validation consultant will develop the VSAQP and prepare the validation report with assistance from the remediation contractor.

Site Auditor

An EPA-accredited Site Auditor has been engaged by Jemena and is responsible for:

- certifying that the RAP will meet the objectives of the remediation works and satisfy the requirements of the VMP
- review of the preparatory documents and detailed works plans; and
- reviewing the progress of the remediation works to ensure that all works are being completed in accordance with the RAP requirements.

At the completion of the remediation / validation works to the satisfaction of the Site Auditor, the Site Auditor will produce a Site Audit Statement certifying that the remediation works have satisfied the objectives as per the RAP, so that steps may then be taken by the EPA to lift the Declaration.

18.2.2 COMPLAINTS PROCEDURE

During remediation works, communication and engagement with local residents and other stakeholders will be the responsibility of the Jemena Project Manager, assisted by the Jemena Community Liaison Manager. It is intended that the stakeholder engagement measures outlined in the Stakeholder Management Plan will identify and address issues promptly and satisfactorily (refer Section 18.11 and attached at Appendix 5).

The RWEMP will provide details of the complaints recording and handling procedure to be followed in the event of complaints by members of the public and by regulatory authorities. This will address complaint investigation and resolution and include agreed timeframes and responsibilities for responding to complaints and maintenance of a detailed complaint tracking and recording system.

18.3 REMEDIATION ACTION PLAN

The Remediation Action Plan (RAP) for the Project (see Appendix 2) sets out the requirements for the Project management plans to be developed and implemented by the remediation contractor during the remediation works. These include the:

- Remediation Works Plan (see Section 18.4)
- Remediation Works Contingency Plan (see Section 18.5).
- Remediation Works Environmental Management Plan (see Section 18.6).
- Construction Noise and Vibration Management Plan (see Section 18.7).
- Marine Traffic Management Plan (see Section 18.8).
- Water and Sediment Management Plan (see Section 18.9).
- Traffic and Pedestrian Management Plan (see Section 18.10).
- Stakeholder Management Plan (see Section 18.11).
- Work Health and Safety Plan (see Section 18.12).

The RAP also defines the Validation Sampling Analysis and Quality Plan (Section 18.13) and sets out the monitoring which may be included in the post remediation Site Management Plan (Section 18.14)

and which may be required following completion of the remediation works. These plans and an outline of their purpose and contents are detailed in the following sections.

18.4 REMEDIATION WORKS PLAN

The RAP requires that on completion and issue to Jemena of the detailed design and specification for the remediation works, the remediation contractor will prepare the overarching Remediation Works Plan (RWP). The RWP will describe in detail the remediation works, management requirements and mitigation measures required for the over-water works, land-based works and operational works required at the Staging Site.

The RWP provides the necessary engineering design information required to undertake the remediation works, the commissioning and proof of performance requirements.

The RWP will demonstrate that:

- the design, specifications and methodologies for construction of the remediation works meet the requirements set out in the RAP
- measures (detailed design, specifications) are in place to minimise the volume of excess spoil and waters generated during works
- sufficient measures are in place to mitigate potential impacts on the environment and human health as a result of the works
- the works program minimises impacts to the amenity of Kendall Bay and the duration of the works at the Remediation Areas, during transport of materials to and from the Remediation Areas and at the Staging Site
- the appropriate approvals, licences and permits for the remediation works have been obtained and are current for the life of the Project
- quality control and quality assurance procedures have been developed for implementation during construction to demonstrate that design specifications have been met.

The RWP will be required to be endorsed by the Site Auditor.

18.5 REMEDIATION WORKS CONTINGENCY PLAN

Chapter 10 of the RAP requires the preparation of a Remediation Works Contingency Plan (RWCP), outlining procedures for the identification and management of unexpected issues or events that may occur during the remediation works. The RWCP will contain contingency measures for the following key risks that have been identified as having potential to arise during the remediation works:

- construction issues in the Remediation Areas
- unexpected contamination or obstructions
- heritage items are discovered and / or disturbed
- unfavourable weather conditions
- unfavourable wave conditions, including Rivercat wake
- water quality issues due to spills of fuel and / or disturbed or excavated sediment

- generation of excessive odours
- circumstances in which remediation works fail to achieve the remediation criteria and goals.

The remediation contractor will prepare and provide a copy of the RWCP to the Jemena Project Manager for endorsement, either separately or as part of the remediation contractor's standard workplace management documentation.

18.6 REMEDIATION WORKS ENVIRONMENTAL MANAGEMENT PLAN

The Remediation Works Environmental Management Plan (RWEMP) will be prepared by the remediation contractor prior to commencement of physical remediation works

The objective of the RWEMP is to ensure that:

- appropriate control measures are implemented to protect the environment at the Remediation Areas, along the transport corridor in Kendall Bay and at the Staging Site.
- works that require disturbance of sediments are undertaken in a manner that protects the health of the workers and users of the areas adjacent to the Remediation Areas.
- any potentially contaminated materials that have been excavated are appropriately stored, handled, treated and disposed of offsite.
- appropriate monitoring is undertaken to identify compliance with the RWEMP and corrective actions, if required.

No sediment disturbance works or other intrusive works for the full-scale remediation are to be undertaken until the RWEMP is endorsed by the Site Auditor and by the Jemena Project Manager, and until the environmental management measures set out in the RWEMP are installed and functional to the satisfaction of the Jemena Project Manager.

In accordance with *Guidelines for Consultants Reporting on Contaminated Sites* (OEH 2011b), Jemena will provide a monthly progress report to the Department of Planning and Environment and the Environment Protection Authority on the progress of work, environmental monitoring and compliance with the conditions of the project approval.

The RWEMP will also provide a protocol for the process to be followed in the event of complaints by members of the public and by regulatory authorities.

The Project-Specific EMPs included in the RWEMP are set out in Table 18-1. Mitigation measures identified through the assessment of potential impacts undertaken in this EIS will be incorporated in the EMPs (refer Table 18-3).

Table 18-1: Project-specific EMPs within the RWEMP

Plan	Coverage
Materials Tracking Plan	The movement of materials during the remediation works will be tracked and records of the following will be kept and maintained: • any materials imported onto the Staging Site; • any movement and placement of materials within the Staging Site; • any movement of materials from the Remediation Areas to the Staging Site; • any movement of materials from the Staging Site to the Remediation Areas; and

Plan	Coverage
	any materials disposed of off-site. Waste materials tracking is also discussed Chapter 17 Waste Management.
Air Quality Management Plan	The remediation contractor will prepare and implement a comprehensive Air Quality Management Plan that details the measures that will be used to control odour and suppress dust during the Project. This will include measures for monitoring odour and dust, including locations, equipment, personnel and frequency. Further information relating to air quality is provided in Chapter 8 Air Quality and Odour.
Excavation Management Plan	The remediation contractor will prepare and implement a comprehensive Excavation Management Plan that details the excavation processes for all excavation areas that segregate, to the extent practicable, the sediments and wastes into their various categories. The Excavation Management Plan will also document procedures and designs to ensure that the seawall is protected during excavation works, as well as provide a vegetation removal plan for the removal of the mangrove within Remediation Area SA2.
Acid Sulfate Soil Management Plan	As it is anticipated that excavated sediments will be classified as potential acid sulfate soils (PASS), the remediation contractor or validation consultant will prepare an Acid Sulfate Management Plan. The plan will include procedures for handling, transfer, stockpiling, treatment and disposal of sediments generated during the overwater works in order to avoid oxidation of PASS, and impacts on the surrounding environment from the oxidation of PASS sediment. The Plan will also include any treatment and disposal requirements that will be undertaken in order to manage the PASS.
Backfilling Management Plan	The remediation contractor will prepare and implement a comprehensive backfilling management plan that details the process for sourcing, placing and validating backfill.
Waste Management Plan	The remediation contractor will prepare a comprehensive waste management plan detailing the waste classification and handling procedures for all waste streams generated during the Project. This plan will take into account the principles embodied in the <i>Waste Avoidance Resource and Recovery Act 2001</i> (NSW), including associated policies and strategies, Further information relating to waste management is provided in Chapter 17.
Pollution Incident Response Management Plan	The remediation contractor will prepare a Pollution Incident Response Management Plan in accordance with the EPA Environmental Guidelines <i>Preparation of Pollution Incident Response Management Plans</i>. The plan will set out procedures for pollution incident reporting, risk identification and actions to manage and minimise those risks.
Spill Response Plan	All vessels associated with the construction works will have Response Plans for emergencies and spills. A detailed Emergency Response Plan will also be prepared by the remediation contractor.

18.7 CONSTRUCTION NOISE AND VIBRATION

Relevant noise and vibration mitigation measures that may implemented are to be included in a Construction Noise and Vibration Management Plan (RAP Section 11.4.4) approved by Jemena prior to commencement of works which will include noise and vibration monitoring requirements as outlined in Chapter 9, Noise and Vibration. Remediation work will be undertaken to comply (where relevant) with the guidance provided in the *DECC (2009) Interim Construction Noise Guideline* and the *AS 2436-2010*

Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (2010), and Protection of the Environment Operations (Noise Control) Regulation 2017.

18.8 MARINE TRAFFIC MANAGEMENT PLAN

The remediation contractor will prepare and implement a comprehensive Marine Traffic Management Plan (RAP Section 11.4.3) that details the navigation routes and rules for travel between the Remediation Areas and the Staging Site, as well as procedures for dealing with on-water incidents and interface with the Mortlake car ferry, the Rivercat ferry and other marine traffic. This document is to be submitted by Jemena for approval by the Harbour Master prior to the commencement of works.

18.9 WATER AND SEDIMENT MANAGEMENT PLAN

The remediation contractor will prepare a Water and Sediment Management Plan which details erosion and sediment control measures to protect municipal drains and / or the Parramatta River, from the discharge of sediment laden or contaminated water. The Water and Sediment Management Plan will also consider turbidity and water quality issues associated with the excavation of sediment and placement of backfill. The plan will include a program of sampling and analysis of potentially impacted waters.

Further information relating to water quality and sediment is provided in Chapter 11.

18.10 TRAFFIC AND PEDESTRIAN MANAGEMENT PLAN

The remediation contractor will prepare and implement, prior to the commencement of remediation works, a comprehensive traffic management plan that details the traffic management measures to be implemented during the Project operations, to minimise the impact of traffic movements on existing road users and the community (RAP Section 11.4.2).

It will also outline implementation of a community information and awareness programme prior to and during construction, to ensure that local residents are fully aware of the construction activities, with particular regard to construction traffic accessing the Staging Site.

The plan will address, but not be limited to:

- ingress and egress of vehicles to the Staging Site
- loading and unloading, including construction zones
- predicted traffic volumes, types and routes; and
- pedestrian and traffic management methods and controls.

Further information relating to traffic management is provided in Chapter 16 Traffic and Transport.

18.11 STAKEHOLDER MANAGEMENT PLAN

Jemena will maintain an up-to-date Stakeholder Management Plan setting out how Jemena will implement its communications strategy for the Project, so that:

- information is shared in a complete and understandable manner
- contact details for the Project are clearly accessible; and
- Jemena Project team members are responsive to comments and concerns raised.

The Stakeholder Management Plan summarises the various stakeholder engagement processes that will be undertaken to communicate with Project stakeholders and respond to matters raised by stakeholders associated with the Project. This Plan also summarises the modes of contact with stakeholders during the life of the Project, including the period leading up to commencement of the remediation works.

The Stakeholder Management Plan is attached at Appendix 5.

18.12 WORK HEALTH AND SAFETY PLAN

The remediation contractor will develop and implement a site-specific Work Health and Safety Plan (WHS Plan) that outlines measures that are protective of the remediation contractor's workers' health (including sub-contractors and Project-related site visitors) particularly those in close proximity to the sediments when excavated above the water surface of the bay.

The remediation contractor will prepare the WHS Plan and will be required to have the plan endorsed by a qualified and experienced occupational health and safety expert.

18.13 VALIDATION SAMPLING, ANALYSIS AND QUALITY PLAN

Successful completion of the remediation works will be demonstrated by the outcomes of monitoring under the Validation Sampling Analysis and Quality Plan (VSAQP). The VSAQP will be prepared by an independent and suitably qualified and experienced Validation Consultant and implemented with assistance from the remediation contractor following guidance provided in Chapter 14 of the RAP. Prior to its implementation, the VSAQP will be provided for endorsement by the Site Auditor.

The VSAQP is based on a combination of a range of physical measurements, made by qualified professionals, and by a program of sampling and chemical analyses, which will be undertaken by the Validation Consultant with assistance from the remediation contractor. Validation work and associated activities described in section 14 of the RAP will be completed throughout the Project and includes surveys, sampling and testing of ISS and excavated and placed material.

The Validation Consultant will undertake validation requirements in accordance with the VMP, RAP, RWP, any validation requirements of the development consent for the remediation works and all relevant guidelines and legislation.

All remediation validation works requiring chemical analyses of samples collected from within the Remediation Areas will be completed using strict field and laboratory quality control (QA / QC) protocols, which will include the collection and analysis of quality control samples. QA / QC will be in accordance with *Guidelines for Consultants Reporting on Contaminated Sites* (OEH 2011b) and the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC 1999).

A post-remediation monitoring event will be undertaken by the Validation Consultant to assess the conditions after the completion of the works within the Remediation Areas, and to obtain a data set that can then be compared to the pre-remediation monitoring. Monitoring will include water quality, tidal fluctuations, wave climate, currents, weather conditions and stormwater flow and quality. A separate component of validation is related to waste materials tracking.

A final Validation Report will be provided to the Site Auditor for review to enable a Site Audit Statement, certifying that the remediation works have been completed in satisfaction of the goals and objectives of the RAP / VMP, to be issued by the Site Auditor.

18.14 POST REMEDIATION SITE MANAGEMENT PLAN

Following completion of the remediation works, a Site Management Plan (SMP) will be implemented to detail any ongoing monitoring and management (including inspection, sampling and testing) of the Remediation Areas and surrounding parts of the bay that may be required to ensure that the objectives of the RAP have been maintained in the period after remediation is completed.

The SMP will be prepared to the satisfaction of Roads and Maritime Services (RMS), the EPA and the Site Auditor in accordance with the requirements of EPA and the *Guidelines for the NSW Site Auditor Scheme* (DEC 2006c) and in accordance with the *Guidelines for the Preparation of Environmental Management Plans* (DPE 2004). The specific requirements of the SMP are yet to be confirmed and will be determined in consultation with RMS, EPA and the Site Auditor. It will provide guidance for inspections, sampling and testing for each of the Remediation Areas.

The criteria to be met for validation and Site Auditor sign-off of the completed remediation works will be agreed with the Site Auditor and EPA at the outset of the remediation works. The criteria will reflect the objectives of the remediation proposed (refer Chapter 4 Description of Project Activities). Key elements that may be included in the SMP are set out in Table 18-2 below:

Table 18-2: Potential elements of the Site Management Plan

Monitoring	Description
Bathymetric Survey	A follow up bathymetric survey, completed as part of the Validation Sampling Analysis and Quality Plan, will be undertaken after the completion of the Project. If no significant changes are detected in the follow up bathymetric survey, no further bathymetric surveys will be conducted. If significant changes are observed, a further survey of the bathymetry will be completed. The intervals between completing the remediation and the follow up bathymetric survey (and any subsequent surveys) are yet to be confirmed.
Seasonal Water Quality Monitoring	Seasonal water quality monitoring of the Remediation Areas and Kendall Bay, as well as established background sites in Exile and Majors Bays, is proposed to be completed at three month intervals following completion of the remediation works. The requirement for this monitoring and the duration is yet to be confirmed. The results would then be assessed to determine if any additional water quality monitoring is required. If no significant changes have occurred over the agreed monitoring period, no further water quality monitoring surveys will be conducted. If significant changes have occurred over the agreed monitoring period as a consequence of the remediation works, further seasonal monitoring will be undertaken.
Cap Inspection and Integrity Testing	In order to confirm that no gasworks-related contaminants have migrated through the capping materials, the robustness and chemical quality of the capping materials used in the remediation will be inspected and / or sampled over an agreed time period. Sediment sampling will also occur at nominated background locations to establish the environmental condition of sediments in the Parramatta River to enable assessment of the nature and extent of impact from gasworks waste in Kendall Bay. The data will be reassessed to determine if further sampling is required.

Monitoring	Description
Biota Recolonisation Assessment	Sampling and analysis of the benthic communities in the Remediation Areas and established background sites may be undertaken post-completion of remediation works. Analyses of the benthic fauna may be considered to determine if the newly settled biota is representative of the background and adjacent benthic communities in terms of abundance and species diversity. However, the use of recolonisation of benthic communities within the remediation areas as a measure to assess that remediation has met the objectives will need to be reviewed further. It is noted that the marine benthic assessment undertaken by Alison Hunt & Associates (S&W 2018b) concluded that there were no clear patterns to the abundance and diversity of infaunal communities across Kendall Bay and no strong and clear link to physio-chemical data. Recolonisation of remediation areas by benthic communities may not be a suitable measure of meeting remediation objectives.
Reporting	Reporting of results for any surveys undertaken will be made to Roads and Maritime Services, the Site Auditor and EPA. Any recommendation concerning cessation or modification of the monitoring will be discussed with the relevant parties prior to any change to the SMP being approved.

18.15 KEY COMMITMENTS

This section summarises the key management and mitigation measures identified in the EIS. It forms part of the overarching environmental management framework for the Project, that will govern protection of the environment and human health during remediation works.

Some mitigation measures identified will be applicable to a number of different aspects and impacts. To avoid repetition specific mitigation measures have only been mentioned once.

Table 18-3: Summary of the key management and mitigation measures identified in the EIS

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
Air Quality and Odour	Odour impacts from remediation activities on receptors in the surrounding area	• Prepare and implement an Air Quality Management Plan with measures to be used to control odour and suppress dust	✓	✓	✓	
		• Limit remediation activity to daytime hours			✓	
		• Only excavate / expose the minimum area of sediment necessary at any one time (where practical)			✓	
		• Cover each skip bin of excavated material immediately once filled			✓	
		• Minimise drop height of excavator (i.e. limiting height through which material is dropped into bin)	✓			
		• Regular cleaning of excavator arm and any surfaces soiled with potentially odorous material	✓	✓		
		• Prepare and implement Stakeholder Management Plan		✓	✓	✓

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
Noise and Vibration	Noise impacts from remediation activities on receptors in the surrounding area	Prepare and implement a Construction Noise and Vibration Management Plan with measures to mitigate noise and vibration impacts	✓	✓	✓	✓
		- Adhere to the following standard construction hours: - Monday to Friday 7am to 5pm - Saturdays 8am to 1pm; and - No works on Sundays or Public Holidays. Given approval from City of Canada Bay Council consent may be provided to enable extension of work hours until 3pm on Saturdays.		✓	✓	✓
		Review manufacturer's data and where practicable select plant and equipment that achieve Sound Power Levels (L_w) below those used in the assessment	✓			
		Where necessary erect temporary mobile screens			✓	
		Ensure management of construction vehicles (e.g. idling, revving engines, use of exhaust brakes)		✓	✓	✓
		Conduct noise and vibration monitoring where required			✓	
		Consider respite periods where appropriate		✓	✓	
		Implement Stakeholder Engagement Plan	✓	✓	✓	✓

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
Hydrology	Potential alteration of hydrological processes leading to: - altered morphology of Kendall Bay - modified sediment transport processes - destabilisation of the existing seawall - potential failure of silt curtains and / or sheet pile wall - potential loss of sand from the shoal and/or undermining of mangroves - potential scour channels and debris associated with stormwater outlets	Prepare and implement Excavation Management Plan to avoid direct impact to seawall structures.	✓	✓	✓	
		Prepare and implement Water and Sediment Management Plan	✓	✓	✓	
		Conduct visual monitoring of seawall for signs of instability during works		✓	✓	
		Undertake pre-remediation and post remediation Dilapidation Surveys to identify any existing seawall instability	✓			✓
		In accordance with AS 4997-2005, temporary structures will be designed to withstand wave loads associated with a 20 year ARI wave condition (to be advised by consulting engineer)	✓	✓	✓	
		Installation methodology of sheet pile walls to limit concentration of tidal flows			✓	
		Schedule silt curtain pile installation and other particular activities during high tides where practical.			✓	
		Implement ongoing water quality monitoring as agreed in SMP in consultation with EPA, RMS and Site Auditor				✓
		Monitor sand movement within western area of mangroves		✓	✓	✓
		Undertake bathymetric survey prior to remediation works (as part of the VSAQP), and after the completion of the Project (as part of the SMP)	✓			✓

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
Water Quality and Sediments		Extension of existing sandstone wall in Remediation Area SA4 and installation of spur walls through the mangrove area of Remediation Area SA3 to redirect stormwater flows.	✓		✓	
		Construction of energy dissipation structure at stormwater outlet in Remediation Area SA4.	✓		✓	
		Implement any agreed post remediation Site Management Plan (SMP) for ongoing monitoring and management of remediation areas				✓
	- Turbidity plumes / release of contaminants into water column - Cross-contamination outside of designated remediation areas - Oxidisation of potential acid sulfate soils (PASS) - Unplanned events with operation of silt curtains - Spillage / spreading of material during barge loading / transit / unloading	- Prepare and implement a Remediation Works Environmental Management Plan including: - Excavation Management Plan - Acid Sulfate Soils Management Plan - Backfilling Management Plan - Pollution Incident Response Management Plan - Spill Response Plan	✓	✓	✓	
		Prepare and implement Water and Sediment Management Plan	✓	✓	✓	
		Use of primary and secondary silt curtains, oil boom or continuous sheet pile wall and an oil boom, providing 3 layers of protection			✓	
		Utilise sealed bins in barges for contaminated sediment and covered trucks to transport materials on and offsite			✓	

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
	- Release of contaminated water or dust offsite or into Parramatta River - Localised scour of capping layer - Poor long-term stability and performance of capping material	Implement appropriate navigation measures, utilise suitable lifting techniques and appropriate equipment, and implement decontamination measures			✓	
		Design the capping materials to satisfy appropriate performance criteria (i.e. cobble size)	✓			
		Undertake Cap Inspection and Integrity Testing (as per any SMP requirement)				✓
		Implement ongoing Water Quality Monitoring (as per any SMP requirement)				✓
Biodiversity	- Loss of mangrove habitat - Disturbance to marine fauna from remediation activities - Impacts to water quality from seabed disturbance - Accidental spills into the marine environment	Remediation methodology designed to minimise impacts to mangrove habitat. One mature mangrove expected to be removed	✓		✓	
		Rubbish, debris, coke and coal present in the mangroves will be manually removed to minimise any impacts to the mangroves			✓	
		Clean sand (VENM) distributed throughout mangroves by hand using wheelbarrows, spades and rakes or similar to protect the integrity of the mangroves			✓	
		'Soft starts' will be implemented during sheet pile installation to allow marine and terrestrial fauna to move away from Remediation Areas.			✓	
		Management measures relating to water quality and sediments will be implemented to manage potential impacts to marine species.			✓	

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
Cultural Heritage	Potential unplanned impacts to heritage items during remediation activities, including those of cultural significance previously unrecorded.	Cultural heritage induction for contractors prior to commencement of Project activities		✓		
		Establish a 5 m buffer zone by use of buoys placed around exposed remains of 'Lady Edeline' wreck			✓	
		If a suspected Aboriginal object is found during works, activities in that location will stop immediately and OEH notified		✓	✓	
		In the event that human skeletal remains are uncovered, work will cease immediately in that area and the area secured (fenced or marked). Jemena will notify the NSW Police and OEH immediately		✓	✓	
		Remediation Works Contingency Plan (RWCP) outlines procedures for identification and management of unexpected issues or events that may occur during the remediation works, including heritage items	✓			
Human Health	Potential dermal contact or accidental ingestion of contaminated sediment via: - unrestricted access - sediment spills during activities or transport - offsite tracking of sediment - poor performance of capping material	Preparation and implementation of a Remediation Works Plan	✓	✓	✓	✓
		Site fencing installed where practical in areas where public are most likely to enter to restrict public access to active Remediation Areas.		✓	✓	
		Loading of hoppers or skip bins to maintain a suitable freeboard to minimise likelihood of material spilling over sides under prevailing environmental conditions (wind waves, passing ferry wake etc.). Bins will also have tight-fitting lids.			✓	
		Prepare and implement a Work Health and Safety Plan to address the site-specific requirements to manage risks to the health and safety of workers on the Project	✓	✓	✓	✓

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
	potential occupational exposure of Project workers to contaminated material.					
Landscape and Visual	Potential impacts to the visual amenity caused from the physical presence of the Project in Kendall Bay and at the Staging Site.	The identified visual impacts will be phased, temporary and limited to the length of the Project (approximately 16-28 months). Good housekeeping will be practiced at all sites and areas will be screened, where practical, to reduce any potential visual impacts.	-	-	-	-
Traffic and Transport	Potential land based traffic impacts associated with: - increase in heavy vehicle movements - reduction in car spaces - safety and congestion issues.	Prepare and implement Traffic and Pedestrian Management Plan which will incorporate the requirement for traffic control personnel at the Staging Site to control the movement of heavy vehicle entering and exiting the site	✓	✓	✓	
		At least five car spaces will be made available within the Staging Site for personnel. This will be in addition to the ten available car spaces in Palace Lane, equating to a total of 15 available spaces to meet the anticipated demand of the Project		✓	✓	
		Road dilapidation report completed prior to works beginning, with ongoing monitoring and a post remediation dilapidation report for comparison purposes		✓	✓	✓
	Potential marine based traffic impacts caused from the physical presence of the Project in Kendall Bay and the movement of Project related vessels	Develop and implement a Marine Traffic Management Plan	✓	✓	✓	✓
		In coordination with RMS, a 'Notice to Mariners' will be issued to advise the boating community of the extent, nature and duration of the marine based Project activities		✓	✓	

Aspect	Potential Impact	Mitigation / Management Measure	Project Phase			
			Planning and Design	Site Establishment	Remediation Works	Decommissioning
	between the Staging Site and Kendall bay.	- Provision of special marker buoys (including lighting for night-time navigation) and appropriate signage to delineate construction areas in accordance with RMS requirements and in consultation with the Harbour Master - Swing moorings potentially impacted by marine based Project activities will be identified and relocated prior to the commencement of the Project			✓	
Waste Management	Environmental harm caused by improper waste management (including disposal of contaminated sediment)	Prepare and implement comprehensive Waste Management Plan detailing the waste classification, storage and handling procedures for all waste streams generated during the Project, and identify responsible persons to oversee implementation of the WMP	✓	✓	✓	
		Prepare and implement Materials Tracking Plan recording the movement of materials during the remediation program	✓	✓	✓	
		Review of receiving facility licenses to ensure they are suitably licensed to receive the various waste streams	✓	✓	✓	
		Site personnel educated in the reduction of building waste during site induction and encouraged through internal environmental management system to reduce/reuse/recycle where possible		✓	✓	

Ch 1- Introduction

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Abbreviation	Full Definition
ADCP	Acoustic Doppler Current Profiler
AGL	The Australian Gas Light Company
AHD	Australian Height Datum
AHD	Australian Heritage Database
AHIMS	Aboriginal Heritage Information Management System
ANZECC	Australian and New Zealand Environment Conservation Council
ARI	Average Recurrence Interval
AS	Australian Standards
ASC	Assessment of Site Contamination
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASSMP	Acid Sulfate Soils Management Plan
BAPCA	The Bay and Park Communities Alliance
BaP TEQ	Benzo[a]pyrene Toxic-Equivalents
BC Act	BC Act Biodiversity Conservation Act 2016
BoM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene (volatile organic compounds)
CBD	Central Business District
CD	Chart Datum
CIFS	Community information and feedback sessions
CLG	Community Liaison Group
CLM Act	Contaminated Land Management Act 1997
CMA	Catchment Management Authorities
COPCs	Contaminants of Potential Concern
CoRTN	United Kingdom 'Calculation of Road Traffic Noise'
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
CTMP	Construction Traffic Management Plan
dB	Decibel
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DP&E	Department of Planning and Environment

DO	Dissolved Oxygen
DPI	Department of Primary Industries
EIS	Environmental Impact Statement
EMNR	Enhanced Monitored Natural Recovery
EMP	Environmental Management Plan
EP&A Act	Environment Planning and Assessment Act 1979
EP&A Reg	Environmental Planning and Assessment Regulation 2000
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environmental Protection License
ERA	Ecological Risk Assessment
ERM	Environmental Resources Management Australia Pty Ltd
ESD	Ecologically Sustainable Development
FAQs	Frequently asked questions
FIDOL	Frequency, Intensity, Duration, Offensiveness and Location
FM Act	Fisheries Management Act 1994
GIS	Geographic Information System
GPS	Global Positioning System
GPT	Gross Pollutant Trap(s)
GSW	General Solid Waste
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HILs	Health Investigation Levels
HSLs	Health Screening Levels
IA	Immobilisation Approvals
ICNG	Interim Construction Noise Guideline
ICOMOS	International Council on Monuments and Sites
INP	Industrial Noise Policy
ISS	In situ solidification
KFH	Key Fish Habitat
KTP	Key Threatening Processes
LAT	Lowest Astronomical Tide
LEP	Local Environmental Plan
LGA	Local Government Area
LoE	Lines of evidence

LP	Sound Pressure Levels
LW	Sound power level
MAHs	Monocyclic Aromatic Hydrocarbons
MMBRAG	Mortlake and Majors Bay Resident Action Group
MNES	Matter of Environmental Significance
MNR	Monitored Natural Recovery
MP	Member of Parliament
N/A	Not Applicable
NATA	National Association of Testing Authorities Australia
NEPC	National Environment Protection Council
NEPMs	National Environment Protection Measures
NMP	Noise Management Plan
NSW	New South Wales
NTU	Nephelometric Turbidity Units
OEH	Office of Environment and Heritage
OH&S	Occupational Health and Safety
OU	Odour unit
PAC	Planning Assessment Commission
PAHs	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PCBs	Polychlorinated biphenyl
POEO Act	Protection of the Environment Operations Act 1997
POEO Waste Reg	Protection of the Environment Operations (Waste) Regulation 2014
PSI	Pounds force per square inch
PVC	Polyvinyl chloride
QA/QC	Quality assurance and quality control
RAP	Remediation Action Plan
RBL	Rating Background Level
RMS	Roads and Maritime Services
RME	Reasonable Maximum Exposure
RNP	Road Noise Policy
RSLs	Regional Screening Levels
RWCP	Remediation Works Contingency Plan
RWEMP	Remediation Works Environmental Management Plan

RWP	Remediation Works Plan
S&W	Synnot & Wilkinson
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No. 55 – Remediation of Land
SHI	NSW State Heritage Inventory
SHR	NSW State Heritage Register
SMP	Site Management Plan
SoHI	Statement of Heritage Impact
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfate
SREP	Sydney Regional Environmental Plan
SSD	State Significant Development
TAPM	The Air Pollution Model
TCEs	Trichloroethylene
TOC	Table of Contents
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TSC Act	Threatened Species Conservation Act 1995
TSS	Total Suspended Solids
UCS	Ultimate Compressive Strength
USA	United State of America
USEPA	United States Environmental Protection Authority
VDV	Vibration Dose Value
VENM	Virgin extracted natural material
VMP	Voluntary Management Proposal
VOCs	Volatile organic compounds
VP	Viewpoint
VRP	Voluntary Remediation Proposal
VSAQP	Validation Sampling Analysis and Quality Plan
VSQP	Validation Sampling and Quality Plan
WARR Act	Waste Avoidance and Resource Recovery Act 2001
WHO	World Health Organisation
WHS Plan	Work Health and Safety Plan
WMP	Waste Management Plan
WOE	Weight of evidence

Glossary of terms

Term	Description
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed.
Bathymetry	The measurement of depth of water in oceans, seas, or lakes.
Biodiversity	The diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
Biota	The plant and animal life of a region.
Contaminated sediment	Sediment that contains chemical substances at concentrations that could potentially harm sediment-dwelling organisms, wildlife, or human health.
Contamination	Concentration of substances above that naturally present that poses, or is likely to pose, an immediate or long-term risk to human health or the environment.
Council	The representative body of a local government area. The applicable Council for Breakfast Point, the Staging Site and other land adjacent to Kendall Bay is the City of Canada Bay. Note: the Bay itself is not part of any local government area.
Cumulative impact	Effects on the environment which are caused by the combined results of past, current and future activities.
dB	Decibel; the unit used to describe sound levels and noise exposure.
dB(A)	The unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
dB(C)	The unit used to measure 'A-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
dB(Z) or dB(L)	The unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.
Declaration	A declaration made by the NSW EPA that land is contaminated and the contamination is significant enough to warrant regulation under the CLM Act. A Declaration applies to Kendall Bay and surrounding waters is described in Chapter 3 of the EIS.
Declared Area	The area of the EPA's Declaration, as further described in Chapter 3 of the EIS.
Development consent	Consent under Part 4 of the Environmental Planning and Assessment Act 1979 to carry out a development.
Dewatering	The process of removing water.
Emission	A substance discharged into the air.

Environment	The general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
Environment Protection and Biodiversity Conservation Act 1999	The Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in this Act as “matters of national environmental significance”.
Environmental Impact Statement	A publicly available document which describes and details the effects a development proposal will have on the environment and advises on how best to manage environmental impacts arising. An EIS must include a description of the project, the main effect(s) the proposal is likely to have on the environment, a description of the measures envisaged to avoid, reduce or remedy significant adverse environmental effects and an outline of the main alternatives studied by the proponent.
Environmental Planning and Assessment Act 1979	This act sets out the legal framework governing development-related decision making in New South Wales The Minister responsible for the Act is the Minister for Planning.
Environmental risk	The actual or potential threat of adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc., arising from a project's activities.
Ground-Borne Vibration	Vibration experienced by direct transmission through the ground.
Harbour SREP	Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.
Hedonic tone	A property of an odour relating to its pleasantness or unpleasantness.
Hydrology	The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.
Impact	Impact on sensitive receptors as a result of effected pathways.
In situ	In the original or natural place or position.
Jemena	The proponent, Jemena Limited.
L_{eq}	This level represents the equivalent or average noise energy during a measurement period. The Leq, 15min noise descriptor simply refers to the Leq noise level calculated over a 15-minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. L10, 15 minute) as required.
Local Environmental Plans	LEPs regulate development at a local government level, including specifying land use zones, development that is permitted with consent, development that is prohibited, and those that do not need development consent.
Methodology	The systematic, theoretical analysis of the methods applied to a field of study.
Mitigation	Lessening the force or intensity of a harmful impact.
Monitoring	Systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts.
Morphology	The study of the form and structure of organisms or any of its parts.

Noise	A sound, especially one that is loud or unpleasant or that causes disturbance or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.
Odour	A sensation resulting from the reception of a stimulus by the olfactory sensory system.
Pore water	The water that occupies the spaces between sediment particles.
Project	The Kendall Bay sediment remediation project, as described further in this EIS.
Project Area	The area in which the Project is to be carried out, as described further in Chapter 3 of the EIS.
Proponent	The person, company or other party applying for development consent.
Public amenity	Resources, conveniences, facilities or benefits continuously offered to the general public for their use and/or enjoyment, with or without charge (e.g., parks, beaches, restrooms, information displays, public telephones, rain shelters, drinking fountains, etc.).
Ramsar Convention	The intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Rehabilitation	The act of restoring an area or land back to its original state.
Remediation Action Plan	A plan which sets remediation goals and strategy, and documents the process to remediate a site.
Remediation Areas	Each of the Northern Remediation Area and Southern Remediation Area, in each case as further described in Chapter 3 of the EIS.
Remediation work	A work in, on or under contaminated land, that: (a) removes the cause of the contamination of the land, or (b) disperses, destroys, reduces, mitigates or contains the contamination of the land, or (c) eliminates or reduces any hazard arising from the contamination of the land (including by preventing the entry of persons or animals on that land).
Resource	Naturally occurring substance that is considered valuable in their relatively unmodified (natural) form.
Risk assessment	A systematic process of evaluating the potential risks that may be involved in a projected activity or undertaking.
Sediment	Particulate material that usually lies below water.
Sensitive receptor	A receptor is a person, animal, plant, ecosystem, property or controlled water that is likely to be impacted by a project. Each receptor must be identified and their sensitivity to the project must be established.
Shoreline	The line along which a large body of water meets the land.
Staging Site	The property located at 140 Tennyson Road Mortlake, comprising land owned by Jemena, and a wharf area leased by Jemena from RMS.
State and Regional Development SEPP	State Environmental Planning Policy (State and Regional Development) 2011.

State Environmental Planning Policies	SEPPs provide State-wide planning controls for particular issues and/or types of development.
State Significant Development	The Government has identified certain types of development that are deemed to have State significance due to the size, economic value or potential impacts that the development may have, for example: • new educational establishments, hospitals and correctional centres, • chemical and other manufacturing, • mining and extraction operations, • tourist and recreation facilities, • some port facilities, • waste management facilities, and • energy generating facilities. A development proposal for any of the identified development types is SSD if it: • is over a certain size, • is located in a sensitive environmental area, or • will exceed a specific capital investment value.
Validation	The process of determining whether the objectives for remediation and any conditions development consent have been achieved.
Vapour	A substance diffused or suspended in the air, especially one normally liquid or solid.
Vibration	The oscillating movement of any object. The impact of noise on objects can lead to vibration of the object.
Wetland	An area of land where water covers the soil, all year or just at certain times of the year.