

KENDALL BAY REMEDIATION PROJECT

RAP ADDENDUM

PREPARED FOR JEMENA LIMITED

Final | 22 June 2018



**IAN SWANE &
ASSOCIATES**

Kendall Bay Remediation Project for Jemena Limited

RAP ADDENDUM

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1. Executive Summary

On 25 May 2004 the NSW Environment Protection Authority issued a 'Declaration of remediation site', which declared the sediments that form the bed of Kendall Bay and the Parramatta River within 200 m of the land-based boundary of the former Mortlake gasworks site as a remediation site ('the Declared Area'), with a map of this area provided in **Figure 1-1**.

A remediation action plan (RAP) was subsequently prepared by Synnot & Wilkinson titled "*Kendall Bay Remediation Project, Remediation Action Plan*" (hereafter referred to as the 2018 RAP). The latest version of the RAP was issued in June 2018.

The main purpose of this report is to provide an independent assessment by a certified practitioner of the adequacy of the remediation method proposed by the 2018 RAP to justify the lifting of the Declaration if the 2018 RAP is implemented. The report also seeks to address review comments made on the 2018 RAP by stakeholders such as the NSW EPA and Site Auditor. This report forms a companion study to the Jacobs (April 2018) '*Assessment on Requirements to Lift EPA Declaration*' (Ref [80]), which focused on a study into the adequacy of the remediation area proposed by the 2018 RAP ('Remediation Area') based on the available contaminated sediment data.

The adequacy of the remediation method proposed by the 2018 RAP has been assessed in terms of the remedial objectives, remediation criteria, adequacy of the proposed Remediation Area, adequacy of the 2018 RAP remediation strategy, and remediation procedures.

Remedial Objectives

This report recommends three additional remedial objectives be adopted in order that the remediation work can fully comply with EPA guidance and regulatory requirements. These additional objectives are to:

- Undertake sufficient remediation work that is sufficient to justify the lifting of the Declaration. This goal is required because it is the main reason why Jemena is proposing to remediate contaminated sediments in Kendall Bay.
- Ensure the remediation work has regard to Ecologically Sustainable Development (ESD) principles; and
- Ensure the remediation strategy is practical and technically feasible. This goal is a requirement of EPA guidance and SEPP55 guidelines.

Remediation Criteria

The expanded remediation criteria adopted by the Jacobs (April 2018) study are summarised in **Table E-1**. Further assessment of the expanded remediation criteria has been undertaken in this report to address review comments made by stakeholders. The matters assessed comprised:

- Critical life stages; and
- The influence of recent US EPA toxicity reference values.

Adequacy of the 2018 RAP Remediation Strategy

The 2018 RAP advised that the preferred remediation strategy was designed from an assessment that linked location-specific conditions to contamination risks to remediation objectives. This process resulted in the definition of five southern sub-areas (SA1 – SA5) and the three northern sub-areas (NA1 – NA3). Remediation objectives for each of these sub-areas were then established, from which a preferred remediation strategy for each sub-area was determined. This analysis resulted in a range of technologies being applied to the different sub-areas, which was designed to achieve an optimal remediation strategy.



- Legend**
- Declared area
 - 0.0 LAT contour
 - Proposed S&W Remediation Area



Figure 1-1
Declared area
Kendall Bay remediation

Table E-1: Expanded Remediation Criteria

Criteria Type	Sediment Criteria	Application
(A) Protecting human health	(A1) Sediments adjacent to contaminant source area on tidal flat: BaP (TEQ) $\leq$ 1 mg/kg dry wt	Criteria applied to upper 500 mm of sediment in Declared Area
	(A2) Beach area on tidal flat: BaP (TEQ) $\leq$ 60 mg/kg dry wt	
	(A3) Mangrove area on tidal flat: BaP (TEQ) $\leq$ 120 mg/kg dry wt	
	(A4) Not relevant for permanently submerged areas	
(B) Aesthetic conditions	Unacceptable aesthetic impact defined as sediment being moderately to highly odorous, stained black from gasworks oils, and / or has a hydrocarbon sheen	Criteria applied to upper 400 mm of sediment in tidal flat part of Declared Area (bathymetry > LAT)
(C) Protecting the environment	(C1) Average total PAHs $\leq$ 25 mg/kg dry wt (at 1% TOC)	Criteria applied to upper 300 mm of sediment across Declared Area together with consideration of ESD criteria
	(C2) Maximum total PAHs $\leq$ 60 mg/kg dry wt (at 1% TOC)	
	(C3) Average TRH $\leq$ 4,000 mg/kg dry wt (at 1% TOC)	
	(C4) Maximum TRH $\leq$ 5,500 mg/kg dry wt (at 1% TOC)	
(D) ESD principles	(D1) Shallow sediments in the Declared Area need to be remediated where gasworks contamination exceeds the human health and/or aesthetic criteria	
	(D2) Shallow sediments in the Declared Area need to be remediated where gasworks contamination exceeds the ecological criteria in the dredge channels at the former coal wharf and in the south-western part of Kendall Bay because sediment accumulation rates at these locations are likely to be low and MNR processes will require more than 30 years to achieve baseline ecological conditions	
	(D3) The proposed remediation area should target those parts of the Declared Area where remediation of the shallow sediments will achieve a significant reduction in contaminant mass.	

This report has found that most of the remedial objectives proposed by the 2018 RAP for the 8 sub-areas are appropriate. However, some additional objectives need to be allocated to some of the sub-areas, which have been applied in this report. This report concludes that the proposed remediation strategy is capable of addressing these additional remediation objectives.

Remediation Procedures

This report concludes that the 2018 RAP describes remediation procedures to a level of detail required by NSW EPA guidelines and which represent good practice for the strategy proposed. Some additional requirements are recommended for inclusion in a Remediation Works Plan (**Section 7**).

Adequacy of the Proposed Remediation Area

One of the main outcomes of the Jacobs (April 2018) study was to provide a linkage between the sediment criteria, the remediation criteria and the Remediation Area proposed by the 2018 RAP. This was done by assessing the quality of all existing shallow sediment data provided by investigations reported in the 2006 – 2018 period, followed by the analysis of this data in a GIS model of the Declared Area.

The Jacobs study concluded that the Remediation Area contemplated by the 2018 RAP is sufficient to justify the lifting of the Declaration if the 2018 RAP is implemented. The minor exceedance of the health and aesthetic criteria on the southern tidal flat north of SA3 to the LAT bathymetric line could be addressed by either:

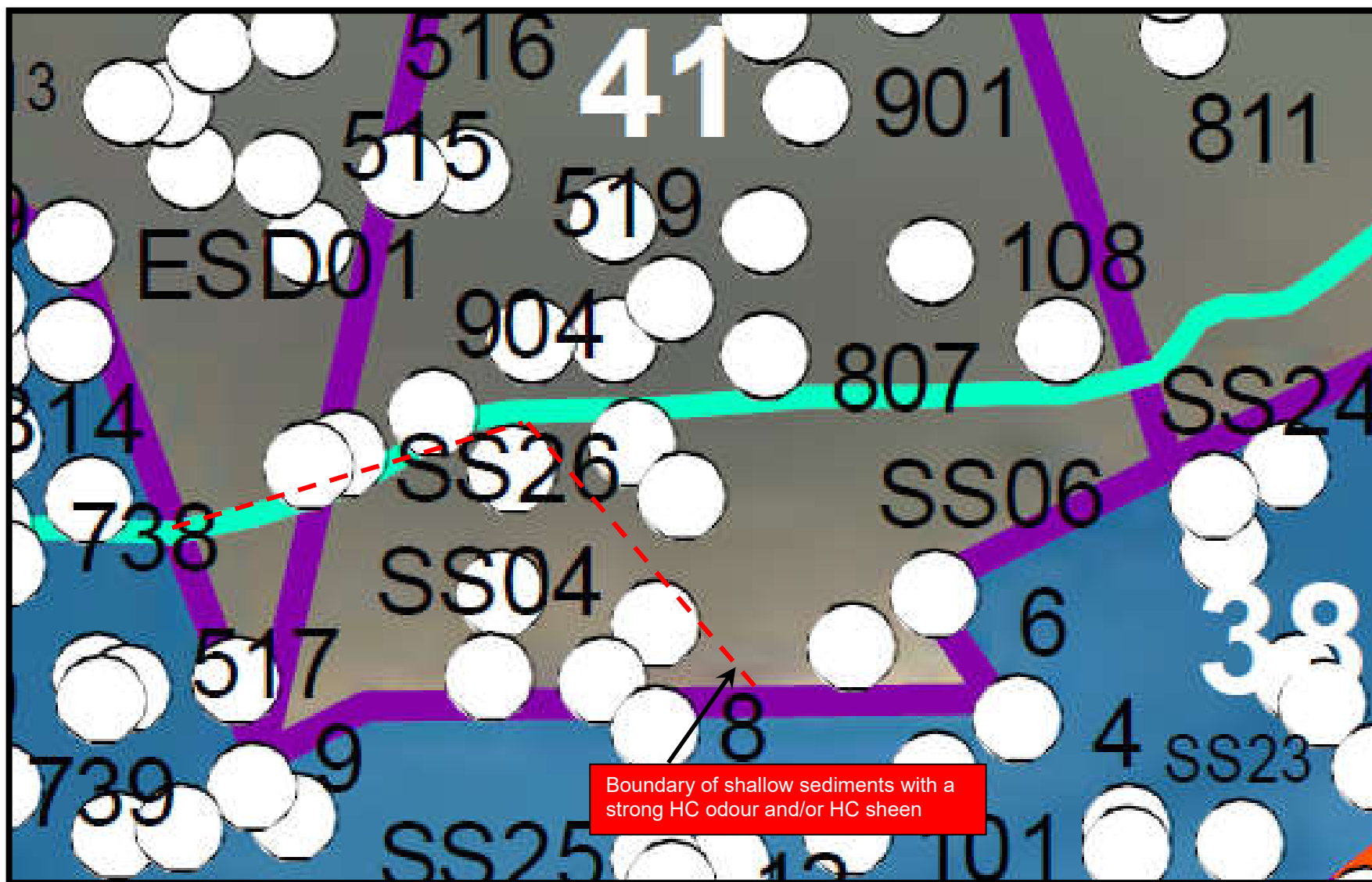
- Allowing Monitored Natural Recovery (MNR) to remediate this area; or
- Assessing the extent of this exceedance as part of the remediation program; or
- Slightly moving the SA3 boundary to include this area.

This report considers the part of the Remediation Area in the southern part of Kendall Bay should be slightly modified by moving the north-western boundary of remediation sub-area SA3 to include the south-western corner of Cell 41, as shown in **Figure 1-1**. Such an approach would result in sample locations SS04, HH2_10, B8, B11 and SHA15 being included in the Remediation Area. Such a change would:

- Increase the southern Remediation Area by 2,230 m², consisting of a 1,930 m² area from the southern part of cell 41 and a 300 m² area from the southern part of cell 39;
- Address the health risk exceedance at location SS04 together with aesthetic impacts in this area;
- Provide additional health protection for recreational users of Kendall Bay by addressing uncertainties associated with a transition from a 'source area' exposure scenario at sample location SS04 to a 'beach area' exposure scenario at sample locations HH2_10, B8 and B11;
- Address most of the aesthetic impacts that are located outside the present Remediation Area;
- All sediments in cell 39 would be permanently submerged;
- Provide additional improvements to ecological conditions by reducing the level of total PAH contamination remaining at the southern end of Kendall Bay; and
- Further reduce the mass of PAH contamination that causes the shallow sediments to exceed background PAH levels within the Declared Area.

MNR processes should then be allowed to provide a cover of clean sediment over sediments adjacent to the southern Remediation Area.

Figure 1-1 Suggested Increase to Remediation Sub-Area SA3



Conclusions

This report concludes that:

- The remediation method proposed by the 2018 RAP is adequate to justify the lifting of the Declaration if the 2018 RAP is implemented; and
- The review comments made on the 2018 RAP by stakeholders such as the NSW EPA and Site Auditor have been addressed.

The conclusions above were reached considering the following findings made in this report:

1. Adoption of the new remedial objectives;
2. Adoption of the expanded remediation criteria;
3. A minor change to remediation area in the vicinity of sample location SS04 (**Figure 1-1**);
4. Additional remediation procedures (**Section 7**) that should be included in a Remediation Works Plan; and
5. Steps have been taken to ensure the RAP Addendum and the 2018 work together, but in the unlikely event of any inconsistency between the two, it is the RAP Addendum that should prevail.

2. Introduction

2.1 Purpose

On 25 May 2004 the NSW Environment Protection Authority (EPA) issued a 'Declaration of remediation site' ('Declaration') under section 21 of the Contaminated Land Management Act 1997 (CLM Act). The Declaration declared the sediments that form the bed of Kendall Bay and the Parramatta River within 200 m of the land-based boundary of the former Mortlake gasworks site as a remediation site ('the Declared Area'), with a map of this area provided in **Figure 1-1**. The size of the Declared Area is 25.33 ha¹.

On 7 August 2017 the EPA issued a notice of approval of Voluntary Management Proposal (VMP) under Section 17 of the CLM Act to Jemena, which advised that the works proposed in the RAP will be regulated under this VMP. Steps are now being taken by Jemena to have the EPA cancel the previous VRA (which governed the lengthy investigation / risk assessment phase and is referenced in the 2018 RAP).

Since 2004, many sediment investigations and assessments have been commissioned by Jemena Limited ('Jemena'). Several remediation strategies have also been prepared, with the most recent developed by Synnot & Wilkinson (S&W) and documented in a Remediation Action Plan (RAP) issued in June 2018² ('2018 RAP'). The 2018 RAP proposed that sediments be remediated in two parts of the Declared Area, these being:

- A Southern Remediation Area covering 0.829 ha³ that consists of five sub-areas (SA1 – SA5); and
- A Northern Remediation Area covering 0.401 ha that consists of three sub-areas (NA1 – NA3).

The total area where sediments are proposed to be remediated by the 2018 RAP is 1.23 ha, which is 4.9% of the Declared Area. A plan showing the location of these two areas in Kendall Bay is provided in **Figure 2-1**, with more detailed plans of the Southern and Northern Remediation Areas provided in **Figures 2-2** and **2-3**, respectively.

The purpose of this report is to:

- Provide an independent assessment by a certified practitioner of the adequacy of the remediation method proposed by the 2018 RAP to justify the lifting of the Declaration if the 2018 RAP is implemented; and
- Address review comments made on the 2018 RAP by stakeholders such as the NSW EPA and Site Auditor.

This report forms a companion study to the Jacobs (April 2018) '*Assessment on Requirements to Lift EPA Declaration*' (Ref [80]), which focused on a study into the adequacy of the remediation area proposed by the 2018 RAP ('Remediation Area') based on the available contaminated sediment data⁴.

This report has relied on the available investigation data collected by environmental consultants, which is documented in the reports listed in **Appendix A**. Summary information on this data is provided in this report where relevant. The reader should review the source reports if more detailed information is required.

¹ Ref [81]

² Ref [80]

³ Ref [81]

⁴ Note that the only difference between the March 2018 and June 2018 versions of the RAP prepared by S&W was the removal of the draft stamp.

Figure 2-1 Remediation Areas Proposed by 2018 RAP

(Source: Fig 1.3, Ref [80])

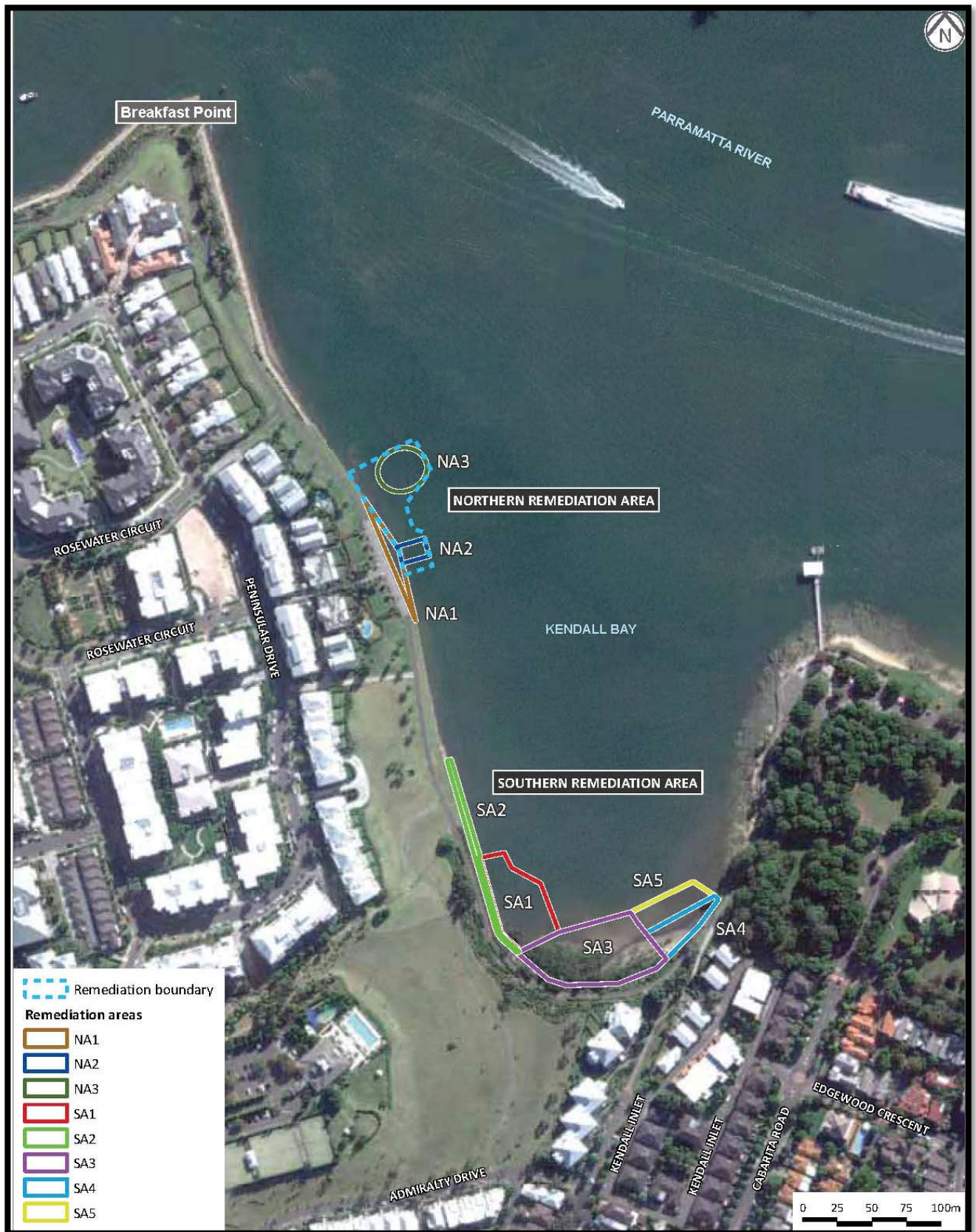


Figure 2-2 Southern Remediation Area Proposed by 2018 RAP

(Source: Fig 2, Ref [80])

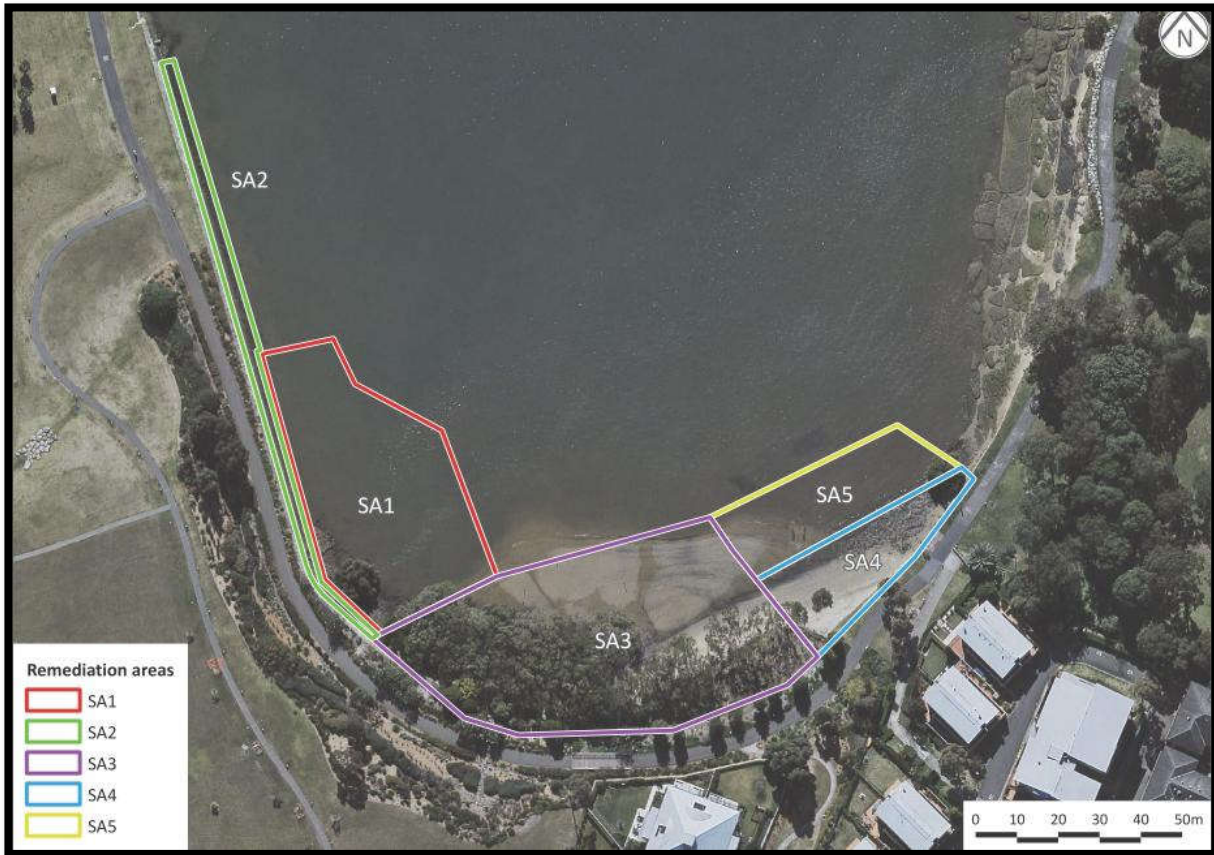
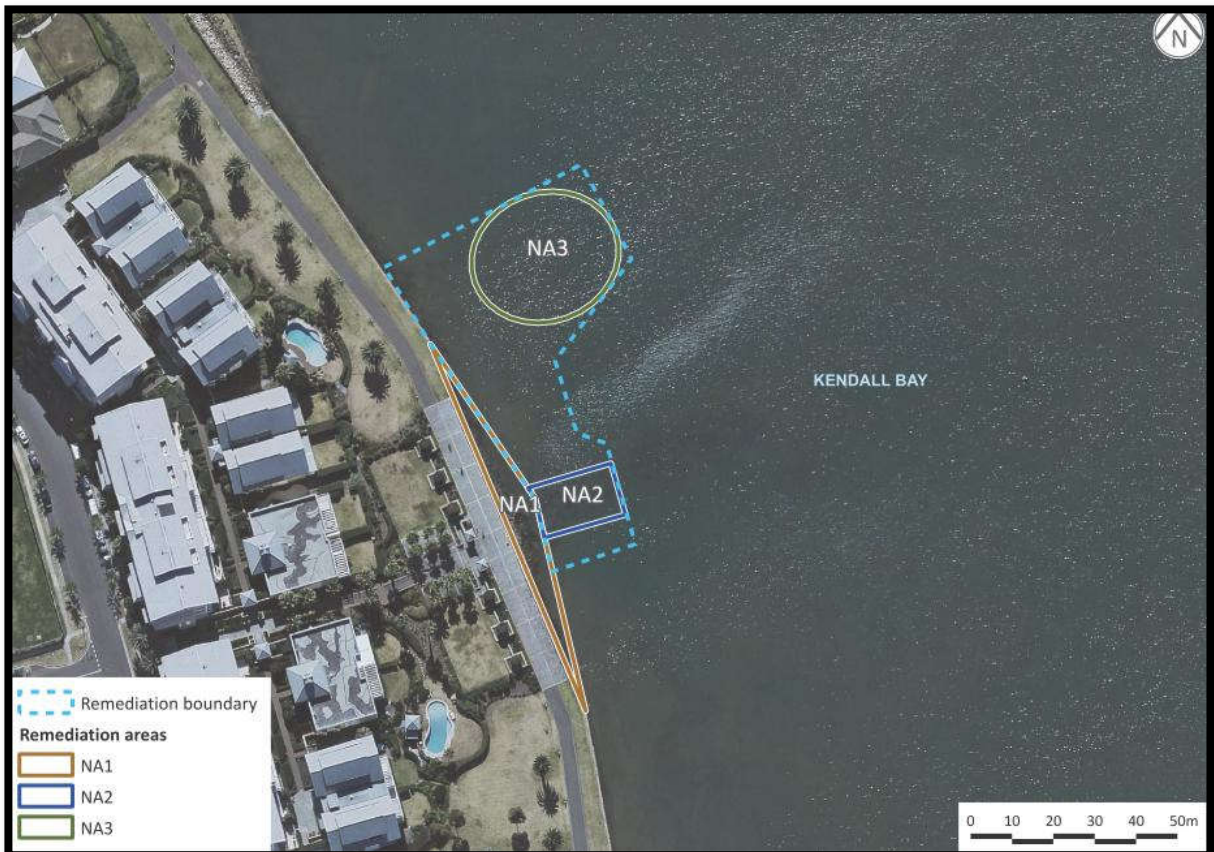


Figure 2-3 Northern Remediation Area Proposed by 2018 RAP

(Source: Fig 2, Ref [80])



2.2 Methodology

The assessment has been undertaken and the report prepared by Dr Ian Swane, a Director of Ian Swane & Associates (IS&A), a Certified SCPA Practitioner in Site Assessment and Management (Certification Number 17009) and a Certified Practicing Engineer (CPEng) with the Institution of Engineers Australia. He is also an EPA Contaminated Site Auditor in NSW, WA and the NT.

Dr Ian Swane is a Senior Principal contaminated land engineer with over 35 years professional experience specialising in the investigation, assessment, remediation and management of contaminated sites, health & ecological risk assessments, environmental audits & waste management in Australia & SE Asia. He has investigated & remediated many of the largest contaminated sites in Australia and been a Government-appointed technical adviser on major contaminated sediment / waterway remediation projects such as:

- Steel River Remediation Project (2010-ongoing): Chairman of expert panel set up by BHPB and NSW EPA to develop success criteria, success measures and remediation strategy for the former BHP Steelworks waste disposal area;
- Homebush Bay Dioxin Remediation Project (1999–2007): Remediation strategy assessment, tender assessment, detailed health and ecological risk assessment for the remediation of the Homebush Bay sediments and technical reviews to Maritime NSW and Dept Public Works. Project value >\$100M
- BHP Newcastle Steelworks Remediation Project (2005-2009): Expert technical advice to Hunter Development Corporation & NSW EPA on Hunter River contaminated sediment remediation, the design of the emplacement cell at Kooragang Island, and remediation work for the new coal loader;
- Contaminated sediment reviews (2001-2008) for NSW Maritime.

The assessment has been conducted in accordance with the management framework for contaminated land in NSW, which for the case of contaminated sediments in waterways is defined by the CLM Act⁵.

The adequacy of the remediation method proposed by the 2018 RAP has been assessed in terms of:

- Remedial objectives;
- Remediation criteria;
- Adequacy of the proposed Remediation Area;
- Adequacy of the 2018 RAP remediation strategy; and
- Remediation procedures.

2.3 Abbreviations

Some abbreviations have been adopted throughout this report and are detailed below:

ADCP - Acoustic Doppler Current Profiler

AEC – Area of Environmental Concern

AGL – The Australian Gas Light Company

AHD – Australian Height Datum (corresponds to a level of 0.925 m on the Fort Denison tide gauge⁶)

ANZECC – Australian New Zealand Environment and Conservation Council

ASS – Acid sulphate soil

BC – Black carbon

bgl – Below ground level

⁵ NSW EPA website at <http://www.epa.nsw.gov.au/your-environment/contaminated-land>

⁶ NSW Department of Lands (January 1976) “*Manual of the New South Wales Integrated Survey Grid*”

BTEX – Benzene, Toluene, Ethylbenzene, Xylenes
BaP – Benzo(a)pyrene
CLM Act– Contaminated Land Management Act 1997 (NSW)
CSM – Conceptual Site Model
CUTEP – Clean-up to the extent practical
D&M – Dames & Moore
DEC – Department of Environment and Conservation (NSW)
DECCW –Department of Environment, Climate Change and Water (NSW)
DGRs - Director General's Requirements (DPE, NSW)
DNAPL – Dense non-aqueous phase liquid
DPE – Department of Planning and Environment (NSW)
DP – Deposited Plan
DQI – Data Quality Indicator
DQO – Data Quality Objective
EIL – Environmental Investigation Level
EIS – Environmental impact statement
EP&A Act - Environmental Planning and Assessment Act (NSW)
EPA – Environment Protection Authority (NSW)
ERA – Environmental risk assessment
ESA – Environmental site assessment
ESD – Ecologically sustainable development
GPS - Global positioning system
HAT – Highest astronomical tide
HHRA – Human health risk assessment
HIL- Health Investigation Level
ISQG - Interim Sediment Quality Guideline
ITRC – Interstate Technology & Regulatory Council (USA)
LAT - Lowest Astronomical Tide (corresponds to approximately zero on the Fort Denison tide gauge⁷)
LEP – Local Environment Plan
LGA – Local Government Area
LNAPL – Light non-aqueous phase liquid
MHW – Mean High Water (corresponds to a level of 1.469 m on the Fort Denison tide gauge⁸)
MTL – Mean tide level
NAPL – Non-aqueous phase liquid
NATA - The National Association of Testing Authorities
NEPM – National Environment Protection Measure

⁷ NSW Transport Maritime (2012) “*NSW Tides 2012 – 2013*”

⁸ NSW Department of Lands (January 1976) “*Manual of the New South Wales Integrated Survey Grid*”

NHMRC – National Health Medical Research Council
NSW – New South Wales
OCP – Organochlorine Pesticide
OPP – Organophosphate Pesticide
PAHs – Polycyclic aromatic hydrocarbons
PID – Photo-ionisation Detector
POEO Act - Protection of the Environment Operations Act 1997 (NSW)
PQL - Practical Quantitation Limits
QA/QC – Quality Assurance/Quality Control
RAP – Remediation Action Plan
RL – Reduced Level
RMA – Roads and Maritime Authority (NSW)
RMS – Roads and Maritime Services
RPD – Relative Percentage Difference
RSL – Regional Screening Level
RWEMP - Remediation Works Environmental Work Plan
RWP - Remediation Works Plan
S&W - Synnot & Wilkinson
SAQP – Sampling and analysis quality plan
SEPP – State Environment Planning Policies (NSW)
SIL – Soil Investigation Level
SKM – Sinclair Knight Merz
SQGV - Sediment Quality Guideline Value
SRoH – Significant risk of harm (NSW)
TCLP – Toxicity characteristic leaching procedure
TOC – Total Organic Carbon
TPH – Total Petroleum Hydrocarbons
TRH – Total Recoverable Hydrocarbons
TRV – Toxicity Reference Value
UCL – Upper Confidence Limit
USA – United States of America
USEPA – Environmental Protection Agency (USA)
VENM – Virgin Excavated Natural Material
VRA – Voluntary Remediation Agreement
VM – Voluntary Management
VMP – Voluntary Management Proposal
VSAQP – Validation SAQP
WOE – Weight-of-evidence

3. Remedial Objectives

The 2018 RAP⁹ advises that the overall remedial objectives for the project are to:

1. Ensure long-term protection from potential impacts from gasworks-related contamination of the health of users of the foreshore of Kendall Bay, including the southern beach and adjacent mangrove area where gasworks-contaminated sediments are exposed at low tides;
2. Improve the health of the marine ecosystem of Kendall Bay in areas where it is adversely affected by acutely toxic gasworks-contaminated sediments;
3. Improve the amenity of readily accessible areas of Kendall Bay;
4. Ensure that a durable outcome is achieved that satisfies the requirements of the Voluntary Remediation Agreement (VRA), as amended, or any replacement Voluntary Management (VM) Plan¹⁰; and
5. Provide a remediation solution that is technically sound, environmentally justifiable and meets EPA requirements and community expectations.

These remedial objectives are considered appropriate and consistent with EPA guidance and regulatory requirements¹¹. However, some additional remedial objectives need to be included in order that the remediation work can fully comply with EPA guidance and regulatory requirements. These are to:

6. Undertake sufficient remediation work that is sufficient to justify the lifting of the Declaration. This goal is required because it is the main reason why Jemena is proposing to remediate contaminated sediments in Kendall Bay.
7. Ensure the remediation work has regard to Ecologically Sustainable Development (ESD) principles. This goal is required because the CLM Act¹² requires the EPA to have regard to ESD principles in the exercise of its functions under the Act and to seek the implementation of those principles in the management by other persons of contaminated land. The EPA¹³ has also stated this should be a goal of the remediation work. These principles include, among others that:
 - Implementation of the precautionary principle requires the remediation to be practicable and for remediation options to be based on an assessment of the risk-weighted consequences;
 - Application of the Clean-up to the Extent Practical (CUTEP) principle specified in EPA guidance; and
 - Environmental goals should be pursued in the most cost-effective way.
8. Ensure the remediation strategy is practical and technically feasible. This goal is a requirement of EPA guidance and SEPP55 guidelines. This means that the remediation strategy must have a high confidence of success, which can be measured in a well-defined and practical manner.

These eight objectives have been used by this report to assess the adequacy of the remediation method proposed by the 2018 RAP to justify the lifting of the Declaration if the 2018 RAP is implemented.

⁹ Section 1.4.1, Ref [80]

¹⁰ A replacement VMP was accepted by EPA in 2017, and it is understood that steps are now being taken to cancel the VRA

¹¹ Refer Section 2.3 in NSW EPA (August 2011) reporting guideline, Sections 3.5.4 & 3.5.5 in SEPP 55 guidelines, and Section 4.3.1 in EPA (October 2017) site auditor guideline

¹² Sections 3(2)d and 9, CLM Act

¹³ Ref [67]

4. Remediation Criteria

4.1 Overview

The Jacobs (April 2018) study¹⁴ considered there are four main types of remediation criteria that the NSW EPA would need to consider when assessing whether a remediation area was sufficient to justify the lifting of the Declaration following remediation. These types of criteria are:

- Protecting human health;
- Aesthetic conditions;
- Protecting the environment; and
- Application of ESD principles.

The Jacobs study then assessed the adequacy of remediation criteria adopted by the 2018 RAP and determined whether they could define a remediation area sufficient to justify the lifting of the Declaration following remediation. The Jacobs study considered the remediation criteria adopted by the 2018 RAP were generally appropriate but identified data gaps in how the criteria should be applied. The expanded set of remediation criteria proposed by the Jacobs study are summarised in **Table 4-1**.

This report has undertaken further assessment of the remediation criteria to address issues raised by stakeholders. These issues comprise:

- Critical life stages for assessing health risks to recreational users of the Declared Area;
- Selection criteria for applying health risk exposure scenarios to sediment sample locations;
- Retention of mangroves at the southern end of Kendall Bay; and
- Influence of recent US EPA toxicity reference values.

4.2 Critical Life Stages

The health risks posed by contaminated sediments in Kendall Bay have been studied by risk assessors, the NSW Department of Health and the EPA for over 11 years. The 2007 HHRA¹⁵ prepared by URS advised that the agreed life stages for assessing risks to human health would be:

- Young children (aged 1 – 5 years);
- Older children (5 – 15 years); and
- Adults.

The risks derived for each life stage were considered separately and were not summed over all life stages. The risk assessment considered it was reasonable to assume that a person was only exposed to the contaminated sediments at Kendall Bay during one of the three life stages given the relatively low exposure frequency and period compared to exposures associated with a residential land use.

¹⁴ Section 4, Ref [81]

¹⁵ Sections 6.3, 6.5, Appendices G & F, Ref [28]

Table 4-1: Expanded Remediation Criteria Adopted by Jacobs Study

Criteria Type	Sediment Criteria	Application
(A) Protecting human health	(A1) Sediments adjacent to contaminant source area on tidal flat: BaP (TEQ) $\leq$ 1 mg/kg dry wt	Criteria applied to upper 500 mm of sediment in Declared Area
	(A2) Beach area on tidal flat: BaP (TEQ) $\leq$ 60 mg/kg dry wt	
	(A3) Mangrove area on tidal flat: BaP (TEQ) $\leq$ 120 mg/kg dry wt	
	(A4) Not relevant for permanently submerged areas	
(B) Aesthetic conditions	Unacceptable aesthetic impact defined as sediment being moderately to highly odorous, stained black from gasworks oils, and / or has a hydrocarbon sheen	Criteria applied to upper 400 mm of sediment in tidal flat part of Declared Area (bathymetry > LAT)
(C) Protecting the environment	(C1) Average total PAHs $\leq$ 25 mg/kg dry wt (at 1% TOC)	Criteria applied to upper 300 mm of sediment across Declared Area together with consideration of ESD criteria
	(C2) Maximum total PAHs $\leq$ 60 mg/kg dry wt (at 1% TOC)	
	(C3) Average TRH $\leq$ 4,000 mg/kg dry wt (at 1% TOC)	
	(C4) Maximum TRH $\leq$ 5,500 mg/kg dry wt (at 1% TOC)	
(D) ESD principles	(D1) Shallow sediments in the Declared Area need to be remediated where gasworks contamination exceeds the human health and/or aesthetic criteria	
	(D2) Shallow sediments in the Declared Area need to be remediated where gasworks contamination exceeds the ecological criteria in the dredge channels at the former coal wharf and in the south-western part of Kendall Bay because sediment accumulation rates at these locations are likely to be low and MNR processes will require more than 30 years to achieve baseline ecological conditions	
	(D3) The proposed remediation area should target those parts of the Declared Area where remediation of the shallow sediments will achieve a significant reduction in contaminant mass.	

A similar approach was used by the 2018 HHRA¹⁶ prepared by EnRisks, although the risks to a young child were increased to account for the mutagenic potential of BaP. This was done using age dependant adjustment factors obtained from US EPA guidance. This approach followed NEPM¹⁷ guidelines and the latest US EPA¹⁸ BaP toxicological report issued in 2017. The health remediation criteria derived by the 2018 HHRA should therefore be more protective than criteria that would have been derived using the 2007 HHRA approach that was approved by NSW regulatory authorities.

¹⁶ Section 7.2, Ref [79]

¹⁷ Section 1.4.2, NEPM (2013) Schedule B7 Appendix A2 guideline

¹⁸ Section 2.5, US EPA (January 2017) 'Toxicological Review of Benzo[a]pyrene'. Document No: EPA/635/R-17/003Fa

4.3 Selection Criteria for Applying Health Risk Exposure Scenarios to Sample Locations

EnRisks determined health risk criteria for sediments at the Declared Area using exposure scenarios based on four environmental conditions. These exposure scenarios / environmental conditions are:

- Source areas located on tidal flats adjacent to former gasworks contaminant sources;
- Beach areas located on tidal flats;
- Mangrove areas located on tidal flats; and
- Permanently submerged areas where the seabed is located below the LAT.

The selection criteria used by the Jacobs study to assign a health risk exposure scenario to each sediment sample location is summarised in **Table 4-2**.

Table 4-2: Criteria Used to Allocate Health Exposure Scenarios to Sediment Sample Locations

Health Exposure Scenario	Selection Criteria	Sediment Criteria [BaP (TEQ) in mg/kg dry wt]
Source areas located on tidal flats adjacent to former gasworks contaminant sources	• Riverbed above LAT • Located at / adjacent to source of gasworks contamination • Shallow sediments muddy (silt / clay)	1
Beach areas located on tidal flats	• Riverbed above LAT • Not located at / adjacent to source of gasworks contamination • Shallow sediments sandy • No mangroves present	60
Mangrove areas located on tidal flats	• Riverbed above LAT • Mangroves established at location and surrounding area	120
Permanently submerged areas where the seabed is located below the LAT	• Riverbed below LAT	Not applicable

The exposure scenario that applies to most of the Declared Area is the permanently submerged scenario, since most of the riverbed level for most of the Declared Area is below the LAT. The main exception is the southern part of Kendall Bay where a tidal flat exists. In this part of the Declared Area, all four exposure scenarios are present. A detailed analysis of the health exposure scenarios assigned to each sediment sample location used in the GIS is provided in **Sections 5.3 and 5.4**.

4.4 Retention of Mangroves at Southern End of Kendall Bay

The 'Mangrove area' health exposure scenario was adopted by the 2018 RAP in response to:

- A program of community consultation, which is documented in the Jacobs study¹⁹;
- A more detailed investigation of the mangrove ecology undertaken by S&W, which is documented in the 2018 RAP and referenced studies; and
- A health risk analysis by EnRisks.

¹⁹ Appendix C, Ref [81]

It is understood that the removal of all mangroves was considered unacceptable by community stakeholders. Currently the proposed remedial works are only expected to require the removal of one mature mangrove in the south-western corner of Kendall Bay.

4.5 Influence of Recent US EPA Toxicity Reference Values

The Toxicity Reference Values (TRVs) used by the 2018 HHRA were based on a peer-review of non-threshold slope factors provided by Level 1 Australian and International sources released between 1999 and 2016. Two non-threshold slope factors were adopted, namely:

- 0.233 mg/kg-day⁻¹ for ingestion and dermal exposure at beach and mangrove areas and ingestion at locations adjacent to contaminant source areas; and
- 25 mg/kg-day⁻¹ for dermal exposure at locations adjacent to contaminant source areas.

The 0.233 mg/kg-day⁻¹ non-threshold slope factor corresponds to the value used in the NEPM (2013) guidelines to derive the Health Investigation Levels (HILs). The 25 mg/kg-day⁻¹ non-threshold slope factor corresponds to the value recommended in studies by Knafla et al (2006, 2011), which is also referred to but not adopted by the NEPM (2013) guidelines. The higher the non-threshold slope factor, the higher the risk and the lower the health sediment criteria.

The 2018 HHRA explained that the higher non-threshold slope factor for dermal exposure near source areas was adopted to account for the BaP (TEQ) contamination being present in the form of coal tars rather than coke or weathered coal as typically occurs at the other types of environments in the Declared Area. The adoption of this higher slope factor is considered to provide lower and more conservative health sediment criteria than if the slope factor used in the NEPM (2013) guideline was adopted.

A more recent toxicological report on BaP was issued by the US EPA in January 2017²⁰. The US EPA report recommended a higher slope factor for the ingestion pathway of 1 (mg/kg-day)⁻¹, which would result in the calculation of a high health risk. However, the report made no recommendation concerning the dermal exposure pathway. Consequently, the significance of the new US EPA ingestion slope factor on the sediment criteria derived by EnRisks depended on the relative importance of the two exposure pathways.

The EnRisks HHRA²¹ results show that the dermal exposure pathway poses a much greater health risk compared to the ingestion pathway by a factor of more than 10 times, with the results summarised in **Table 4-3**.

Table 4-3: Non-Threshold Risks to a Young Child Calculated by EnRisks HHRA

Area	Exposure pathway	BaP (TEQs) Non-Threshold Slope Factor (mg/kg-day) ⁻¹	Sediment BaP (TEQ) concentration (mg/kg)	Calculated Non-Threshold Risk	Total Calculated Non-Threshold Risk
Beach	Ingestion	2.30E-01	60	2.30E-07	8.6E-06
	Dermal exposure	2.30E-01		8.40E-06	
Central Mangroves	Ingestion	2.30E-01	120	4.60E-07	8.9E-06
	Dermal exposure	2.30E-01		8.40E-06	
Western Mangroves	Ingestion	2.30E-01	1	1.90E-08	7.5E-06
	Dermal exposure	2.50E+01		7.50E-06	

The significance of using the new US EPA ingestion slope factor on the EnRisks health sediment criteria derived was assessed by using the US EPA ingestion slope factor in the risk assessment calculations. The results of this calculation are provided in **Table 4-4**. The results show that using the higher US EPA ingestion slope factor of 1 (mg/kg-day)⁻¹ has no significant influence on the sediment criteria derived by the EnRisks HHRA and does not require any change in the sediment criteria. This is because the total non-threshold risks remain at or below the acceptable risk level of 1 x 10⁻⁵.

²⁰ US EPA (January 2017) 'Toxicological Review of Benzo[a]pyrene'. Document No: EPA/635/R-17/003Fa

²¹ Appendix B, Ref [79]

Table 4-4: Non-Threshold Risks to a Young Child Using US EPA (2017) Ingestion Slope Factor

Area	Exposure pathway	BaP (TEQs) Non-Threshold Slope Factor (mg/kg-day) ⁻¹	Sediment BaP (TEQ) concentration (mg/kg)	Calculated Non-Threshold Risk	Total Calculated Non-Threshold Risk
Beach	Ingestion	1.00E+00	60	1.00E-06	9.4E-06
	Dermal exposure	2.30E-01		8.40E-06	
Central Mangroves	Ingestion	1.00E+00	120	2.00E-06	1.0E-05
	Dermal exposure	2.30E-01		8.40E-06	
Western Mangroves	Ingestion	1.00E+00	1	8.26E-08	7.6E-06
	Dermal exposure	2.50E+01		7.50E-06	

5. Adequacy of the Proposed Remediation Area

5.1 Overview

One of the main outcomes of the Jacobs (April 2018) study was to provide a linkage between the sediment criteria, the remediation criteria and the Remediation Area proposed by the 2018 RAP. This was done by assessing the quality of all existing shallow sediment data provided by investigations reported in the 2006 – 2018 period, followed by the analysis of this data in a GIS model of the Declared Area.

The shallow sediment depth considered by the Jacobs study varied depending on the remediation criteria being considered. These depths and the basis for their selection were:

- **Health criteria: Sediments in upper 500 mm²²** – This depth interval was adopted as representing a reasonable limit on potential sediment exposure from recreational activities or environmental disturbance across tidal areas (defined by the LAT bathymetric line). This depth is based on:
 - The ANZECC & NHMRC (1992) ‘*Guidelines for the assessment and management of contaminated sites*’ and the ANZECC (September 1999) ‘*Guidelines for the assessment of on-site containment of contaminated soil*’ recommend that soil caps should have a minimum thickness of 0.5 m;
 - The NEPM (2013) guideline on contaminated land management advises that hazardous materials (such as asbestos) can be managed by covering the contamination with a minimum 0.3 m thick layer of clean soil when combined with other protective or warning layers as well as institutional controls (eg environmental management plan, memorials on land titles)²³; and
 - The Homebush Dioxin Remediation Project adopted a 0.5 m thick cap and considered that this thickness would provide an acceptable level of protection to recreational users of the waterway from the underlying contaminated sediments²⁴.
- **Aesthetic criteria: Sediments in upper 400 mm²⁵** – This depth interval was adopted for similar reasons as used by the health criteria, except that the sediment data indicated some areas in the Declared Area showed aesthetic impacts commencing from a depth of 400 mm and the significance of aesthetic impacts was less than the importance of protecting human health.
- **Ecological criteria: Sediments in upper 300 mm²⁶** – This depth interval was adopted because it represented the depth where most benthic organisms live. This depth interval is based on:
 - Research by Irvine (1980)²⁷ into Sydney Harbour sediments found that bioturbation rates are highest in the top 50 – 100 mm of sediment. Deeper sediments are reworked more slowly because there are fewer species. A maximum bioturbation depth of 600 mm was reported;
 - Research reported by the US EPA (December 1998)²⁸ found that some organisms in the Great Lakes can burrow 100 - 400 mm in soft silt or clay sediments;
 - More recent and extensive studies into the effects of bioturbation²⁹ on sediment cap designs have been undertaken by the Dredging Operations and Environmental Research (DOER) Group at the US Army Corp of Engineers. Their most comprehensive study (USACE, August 2001)³⁰ is

²² Section 4.2.3, Ref [81]

²³ Refer Section 9.1.3 in the NEPM (2013) “Schedule B2 Guideline on Site Characterisation

²⁴ Ref [9b]

²⁵ Section 4.3, Ref [81]

²⁶ Sections 5.4 & 5.5, Ref [81]

²⁷ Sections 4.5 & 6.5.6, Irvine I (1980) “*Sydney Harbour: Sediments and Heavy Metal Pollution*”

²⁸ US EPA (1998) “*Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*”. Document No: 905/B-96/004

²⁹ Bioturbation is defined as the stirring or mixing of sediment or soil by organisms, especially by burrowing or boring

³⁰ USACE (August 2001) “*Subaqueous Cap Design: Selection of Bioturbation Profiles, Depths, and Process Rates*”. ERDC TN-DOER-C21

referenced by the US EPA (December 2005)³¹ contaminated sediment remediation guidelines. The study reported that in most coastal or marine environments, bioturbation can be predicted to extend down to 200 - 600 mm, whereas in freshwater environments, comparable depths would be 200 – 400 mm; and

- The US National Research Council³² reported bioturbation depths of 200 - 400 mm.
- ESD remediation criteria³³: The sediment depth ranges adopted by the other three criteria were considered to be reasonable and practical.

The GIS model was initially used to identify sample locations that exceeded the sediment health and aesthetic criteria. The model was then used to subdivide the Declared Area into 43 cells to form an Ecological Model for the Declared Area. This model was used to assess maximum and average concentrations within each cell that were compared against the sediment ecological criteria. The ESD remediation criteria were then applied to the Ecological Model. The sample locations used by the GIS Model and the cells that make up the Ecological Model are shown in **Figure 5-1** from the Jacobs report.

Summary tables of the sediment data used by the GIS and Ecological Models are provided in **Appendix B** arranged on a cell by cell basis.

The Jacobs study found that:

- Practically all sample locations that exceeded the sediment health criteria were located within the Remediation Area proposed by the 2018 RAP, as shown by **Figure 5-3** from the Jacobs report. The only exception is sample location SS04 located close to the SA3 boundary in the western mangrove area. The BaP (TEQ) concentration at this location was measured at 55 mg/kg, which exceeds the health criteria of 1 mg/kg. This health risk could be addressed by either assessing the extent of this exceedance or by slightly moving the SA3 boundary to include this location.
- No remediation is required in the area east of the SA1 boundary because the Jacobs study³⁴ shows all sample locations to the east of the SA1 boundary to have contaminant concentration less than the health criteria.
- Remediation is not required for practically all of the 2014 RAP³⁵ Area A located north of the Remediation Area proposed by the 2018 RAP. This is because most of this area is not part of the tidal flat, since the available bathymetry data indicate that the seabed is below the LAT and will remain submerged at all times. The remainder of the area north of the SA3 boundary meets the health sediment criteria except for sample location SS04, as previously discussed.
- Practically all sample locations that exceeded the sediment aesthetic criteria were located within the Remediation Area proposed by the 2018 RAP, as shown by **Figure 5-4** from the Jacobs report. The one exception was an area of tidal flat located north of SA3 to the LAT bathymetric line.
- The sample locations that most exceeded the sediment ecological criteria were mainly located within the Remediation Area proposed by the 2018 RAP, as shown by **Figure 5-5** from the Jacobs report.
- The most critical ecological criteria was the average normalised total PAH ecological criteria in upper 300mm of sediment, as calculated using the 43 cell Ecological model. The cells that exceeded this criterion are shown by **Figure 5-7** from the Jacobs report.

³¹ US EPA (December 2005) "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites". Document No: EPA-540-R-05-012

³² Section 4, US National Research Council (1997) 'Contaminated Sediments in Ports and Waterways, Cleanup Strategies and Technologies'

³³ Section 5.5, Ref [81]

³⁴ Figure 5-3, Ref [81]

³⁵ Ref [57]



Legend

- Declared area
- 0.0 LAT contour
- Proposed S&W Remediation Area
- Cell in ecological model
- Remediation sample sites



Figure 5-1
GIS and ecological models for Declared Area
Kendall Bay remediation



Legend

- Declared area
 0.0 LAT contour
 Proposed S&W Remediation Area
-  Remediation sample sites
 Exceedance of health criteria

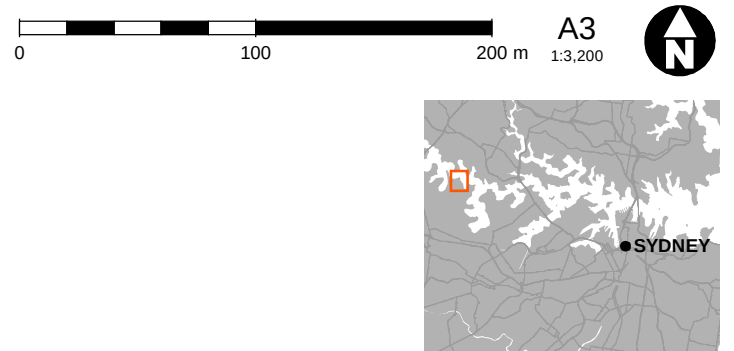


Figure 5-3
Exceedances of shallow sediment health criteria
Kendall Bay remediation

Figure 5-4
Aesthetic impacts in upper 400mm
Kendall Bay remediation



Legend

- Declared area
- 0.0 LAT contour
- Proposed S&W Remediation Area

- Highest normalised total PAHs (mg/kg) in upper 300mm
- 0 - 10
 - 10 - 25
 - 25 - 60
 - 60 - 120
 - > 120



Figure 5-5
Highest normalised total PAHs in upper 300mm
Kendall Bay remediation



- Legend**
- Declared area
 - 0.0 LAT contour
 - Proposed S&W Remediation Area
 - Cell in ecological model
- Average total PAHs**
- Concentration > 2 x criteria
 - Criteria < Concentrations ≤ 2 x criteria
 - ≤ 25mg/kg (ecological criteria)



Figure 5-7
Exceedance of average normalised total
PAH ecological criteria in upper 300mm
Kendall Bay remediation

When the ESD criteria were applied, the Jacobs study found that:

- The ESD criteria relating to health requirements are met at practically all sample locations by the Remediation Area proposed by the 2018 RAP. The one exception is sample location SS04 located close to the SA3 boundary in the western mangrove area;
- The ESD criteria relating to aesthetic requirements are met at practically all sample locations by the Remediation Area proposed by the 2018 RAP. The one exception was an area of tidal flat located north of SA3 to the LAT bathymetric line;
- The total mass of gasworks contamination across the Declared Area that caused the shallow sediment to exceed the human health, aesthetic and/or ecological criteria was estimated to be 62.5 kg of PAHs, which corresponds to 50% of a single 205 L drum of coal tar³⁶. This was considered to be a very small amount compared to the 30,000,000 L of coal tar that was removed from the former dam in the early stage of the Mortlake gasworks remediation project; and
- The Remediation Area proposed by the 2018 RAP (cells 28 & 38) would realise a 37.3% reduction in the mass of PAH contamination that causes the shallow sediments to exceed the ecological criteria and corresponds to 20.4 % of the part of the Declared Area that exceeds the ecological criteria.

5.2 Inclusion of Additional Sediment Data

The sediment database used in the RAP Addendum report was taken from the Jacobs study. The Jacobs study advised that the chemical data was taken from the laboratory summary tables provided by the past sediment investigation reports, with a copy of these summary tables was provided in the Jacobs report³⁷. Subsequent reviews of the past investigation reports identified some additional data, which has been included in the GIS database with a copy of the updated GIS database provided in **Appendix B**.

The additional chemical data has not resulted in any additional exceedances of the health sediment criteria outside the Remediation Area. In terms of the environmental criteria, the outcome for practically all cells has not changed when the additional chemical data has been included. The one exception was the southern part of Cell 41, which now exceeds the average total PAH, maximum total PAH and maximum TPH criteria. A copy of the spreadsheet summarising the ecological model results is provided in **Appendix C**.

5.3 Allocation of Health Exposure Criteria to Sediment Sample Locations

The Jacobs GIS model allocated health exposure scenarios to each sediment sample location using the selection criteria summarised in **Table 4-2**. The types of scenarios allocated to each sediment sample location used in the Jacobs GIS database are summarised in the spreadsheets provided in **Appendix B**.

The exposure scenario that applies to most of the Declared Area is the permanently submerged scenario, since most of the riverbed level for most of the Declared Area is below the LAT. The main exception is the southern part of Kendall Bay where a tidal flat exists. In this part of the Declared Area, all four exposure scenarios are present. The types of scenarios allocated to sediment sample locations in the southern Kendall Bay area are shown in **Figures 5-8 to 5-12**.

5.4 Health Risk Exposure Scenarios North of Remediation Sub-Area SA3

Figures 5-8 to 5-12 show a 'Source area' exposure scenario has been assigned to the shallow sediments in the south-western corner of Kendall Bay because:

- The riverbed is above LAT;
- The area is located at / adjacent to a source of gasworks contamination, which corresponded to migration / flows from the historic coal tar dam; and
- The shallow sediments are described on the logs as muddy (silt / clay).

³⁶ Coal tar consists of 50% of PAHs (refer USEPA at <https://www3.epa.gov/npdes/pubs/coaltar.pdf>)

³⁷ Section 3.6.1 & Appendix E, Ref [81]

The figures also show a 'Beach area' exposure scenario has been assigned to the shallow sediments to the east of the 'Source area' and north of the 'Mangrove area' because:

- The riverbed is above LAT;
- The area is not located at / adjacent to a source of gasworks contamination'
- The shallow sediments are described on the logs as sandy; and
- No mangroves are present.

The area north of sub-area SA3 in Cell 41 represents the location where a transition occurs between the 'Source area' and the 'Beach area' exposure scenarios in the southern part of Kendall Bay. **Figure 5-13** shows a detail view of the exposure scenarios assigned to the sample locations in the area. Summary descriptions of the upper 500 mm of sediment in this area are provided in **Figure 5-14**.

Legend for Figures 5-8 to 5-12

Exposure scenario	
---	Source areas located on tidal flats adjacent to former gasworks contaminant sources
---	Beach areas located on tidal flats
---	Mangrove areas located on tidal flats
---	Permanently submerged areas where the seabed is located below the LAT

Figure 5-8: Exposure Scenarios adopted for URS 2006 & 2007 Samples in Southern Area

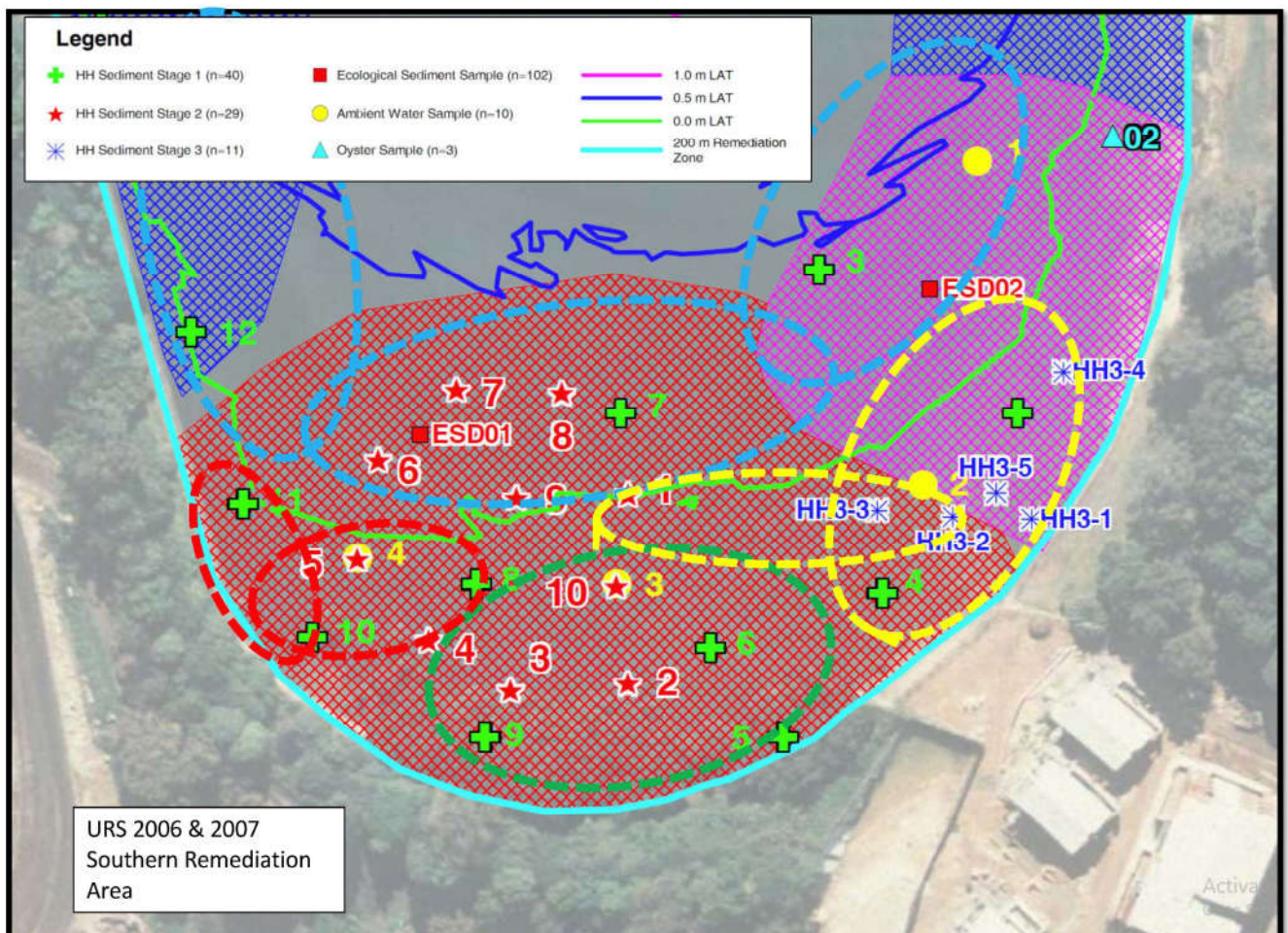


Figure 5-9: Exposure Scenarios adopted for URS 2007 HHRA Samples in Southern Area

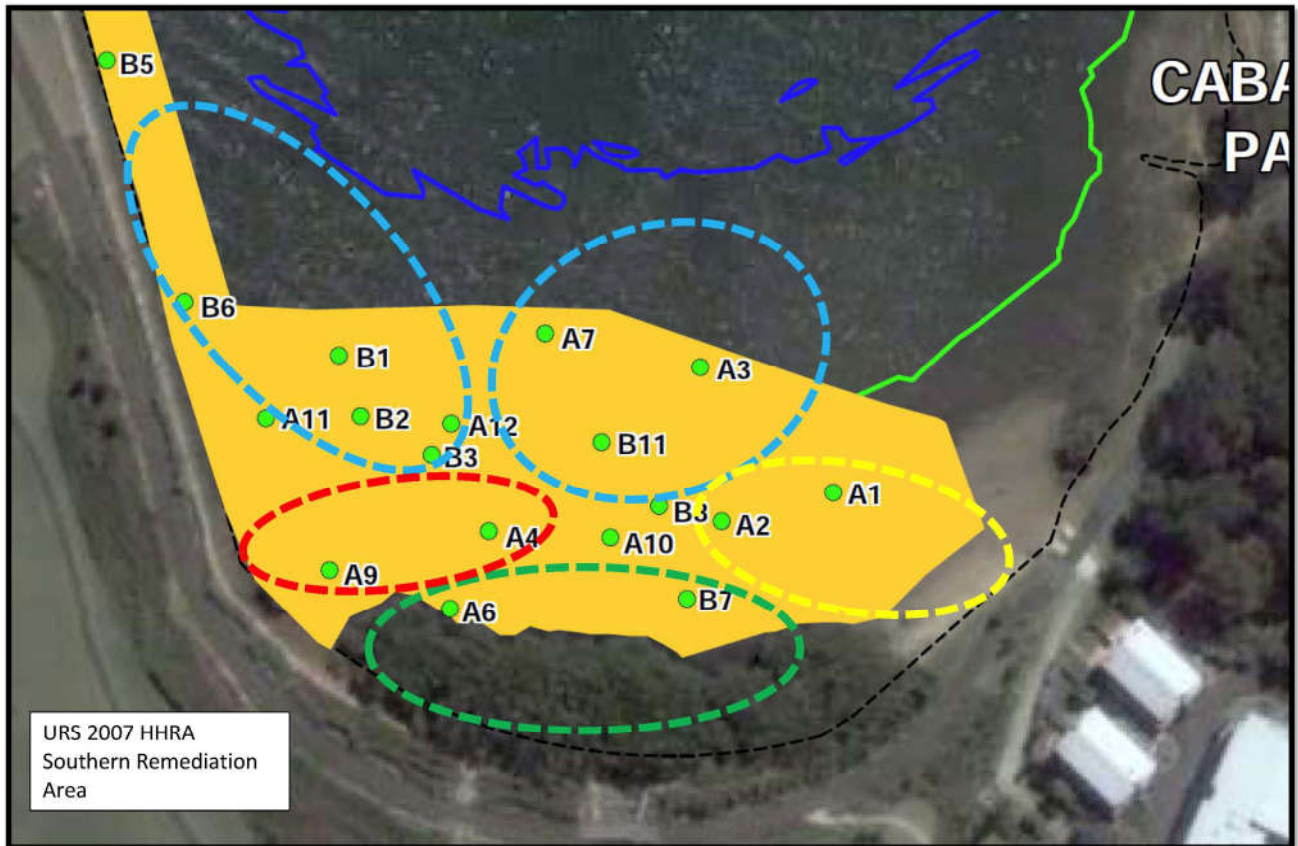


Figure 5-10: Exposure Scenarios adopted for E3 Consult 2011 Samples in Southern Area

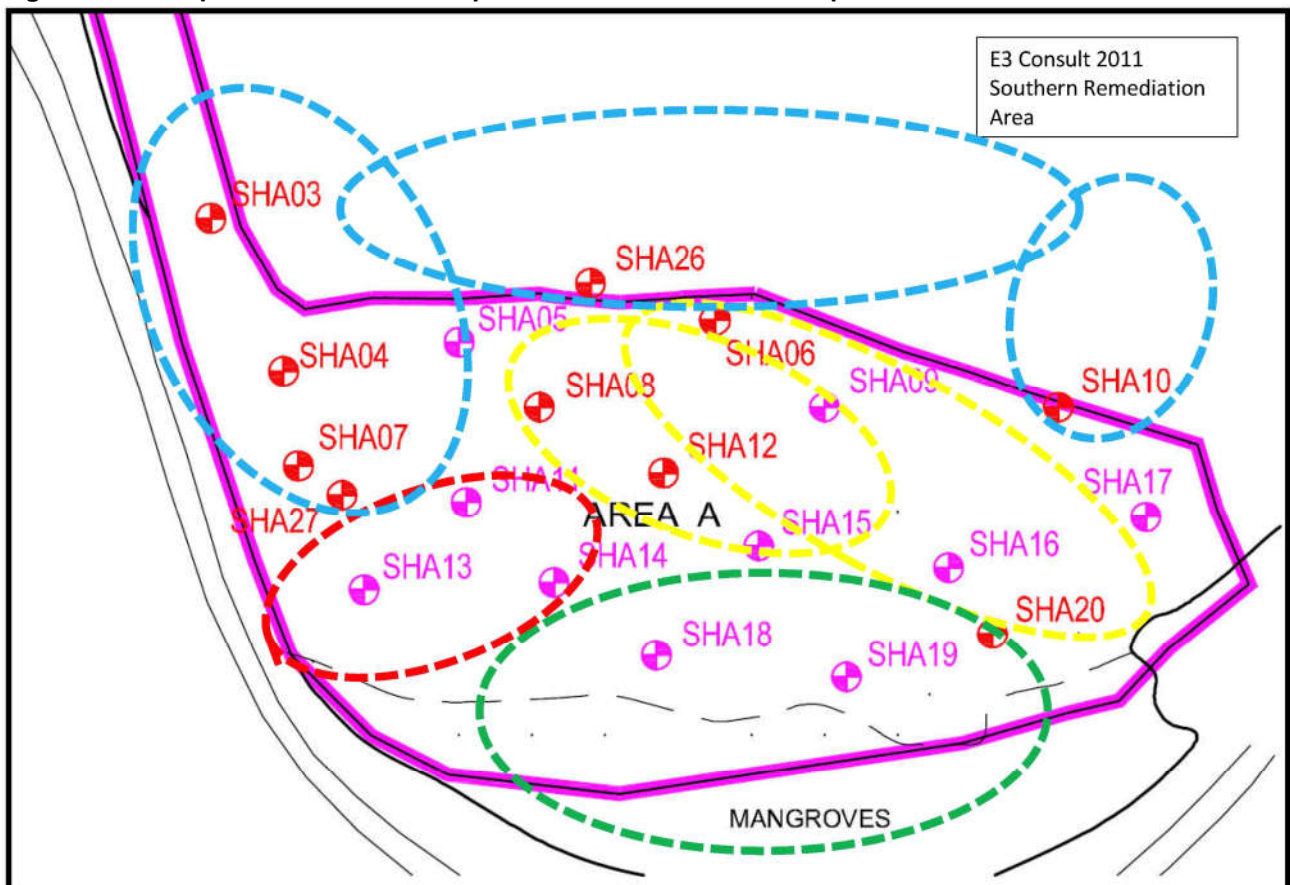


Figure 5-11: Exposure Scenarios adopted for SKM 2013 Samples in Southern Area

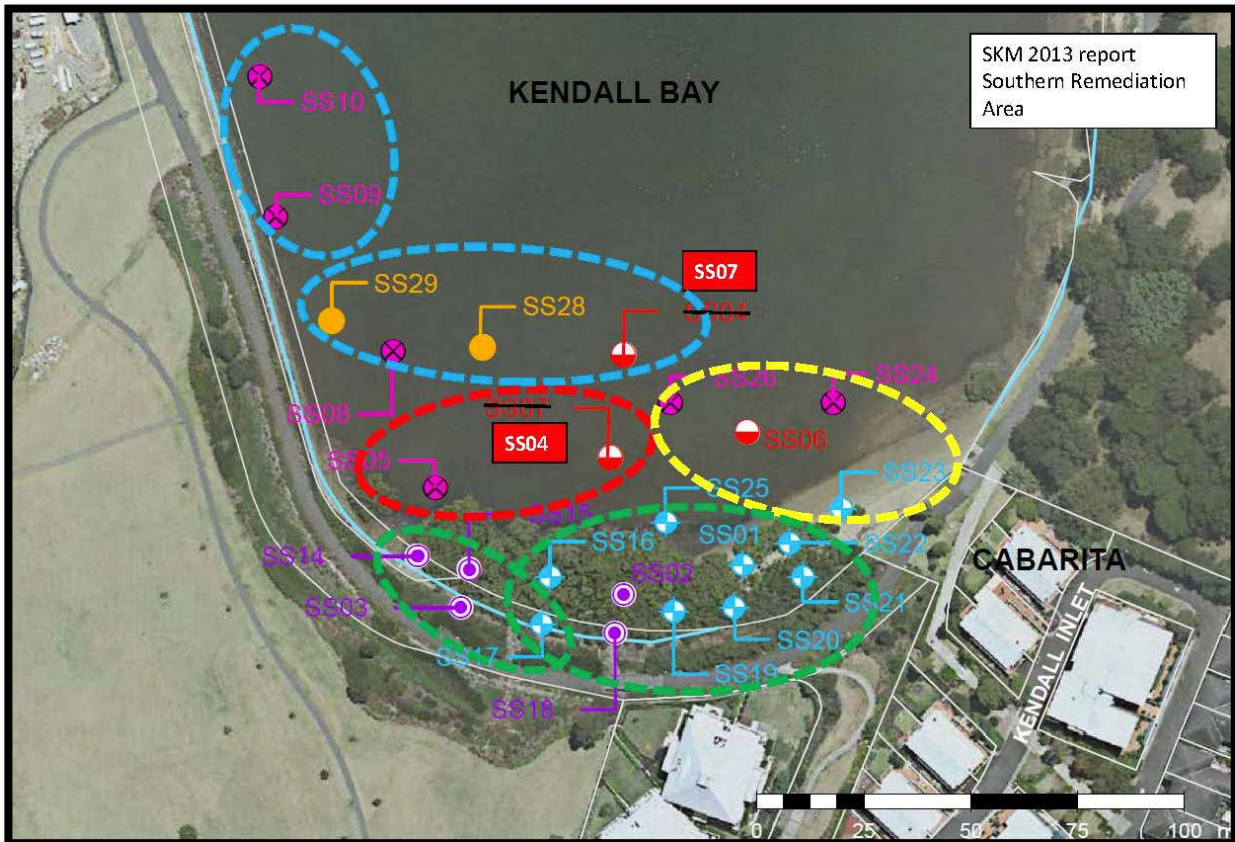
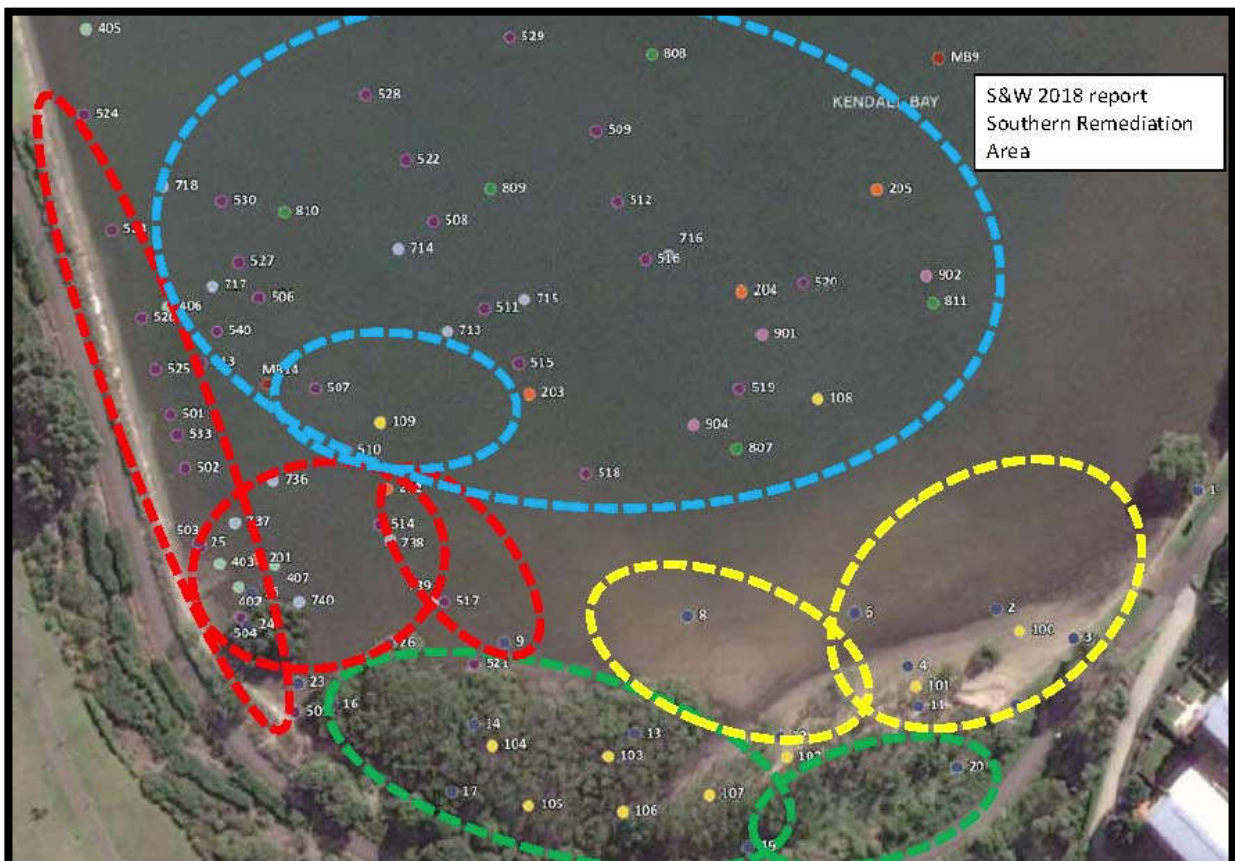


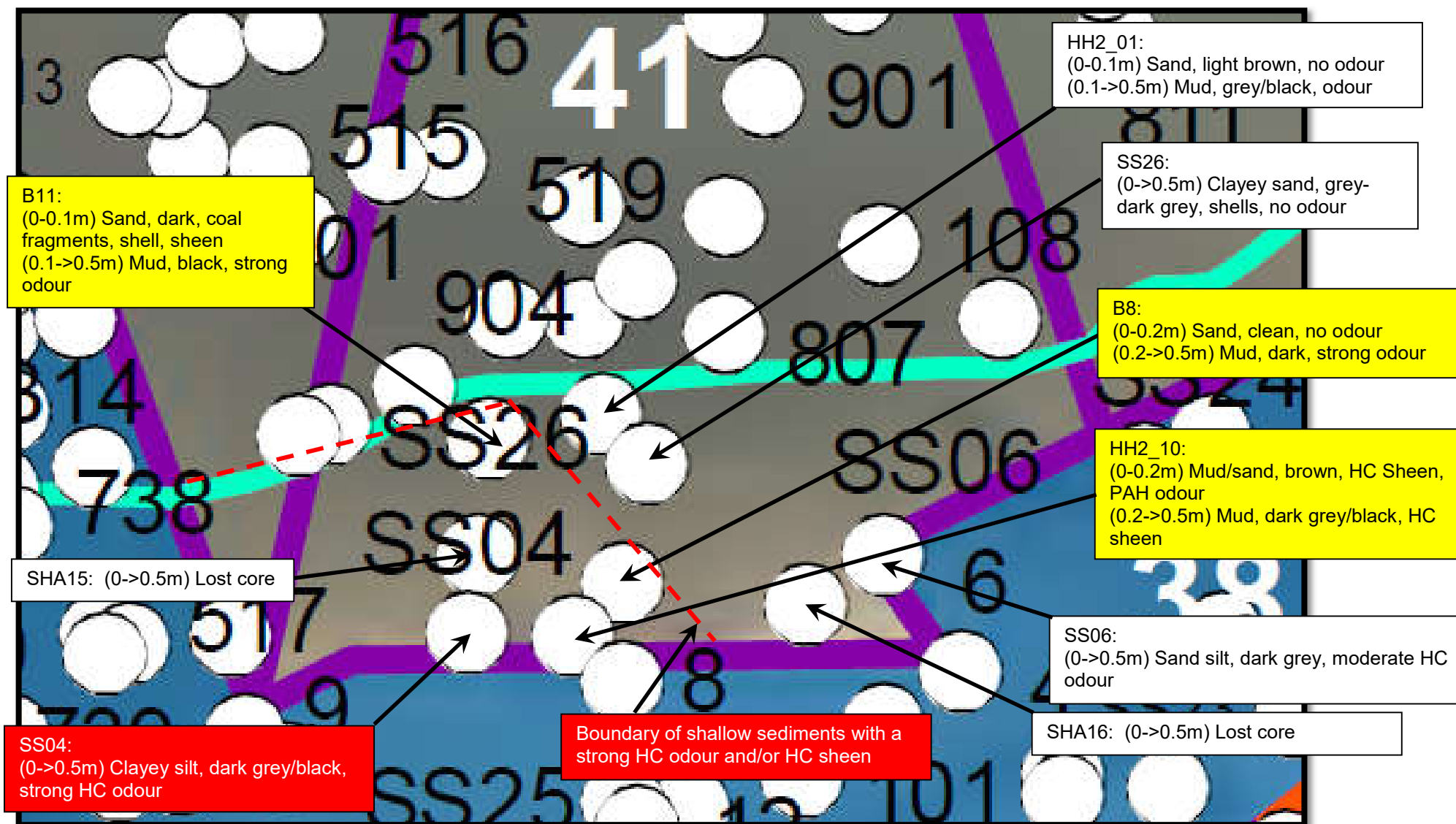
Figure 5-12: Exposure Scenarios adopted for S&W 2018 Samples in Southern Area



Legend for exposure scenarios

	Source areas located on tidal flats adjacent to former gasworks contaminant sources
	Beach areas located on tidal flats
	Mangrove areas located on tidal flats
	Permanently submerged areas where the seabed is located below the LAT

Figure 5-14 Shallow Sediment Descriptions in Cell 41 Tidal Flat Area



5.5 Aesthetic Conditions North of Remediation Sub-Area SA3

5.5.1 Shallow Sediments

The sediment aesthetic criteria (**Table 4-1**) defines 'Unacceptable aesthetic impact' as sediment being moderately to highly odorous, stained black from gasworks oils, and / or has a hydrocarbon sheen, with this criterion applied to the upper 400 mm of sediment in tidal flat part of Declared Area (ie riverbed above the LAT)

The GIS model analysed the aesthetic conditions of the shallow sediment across the Declared Area, with the results summarised in **Figure 5-4**. The analysis showed that the majority of the Declared Area that exceeded the aesthetic criteria is located within the Remediation Area. The exceptions were a few sample locations situated immediately north of sub-area SA3, with a more detailed view of this area provided in **Figure 5-14**.

The data indicate that a relatively small area of shallow sediments with a strong hydrocarbon odour and/or hydrocarbon sheen exists outside the Remediation Area in the south-western corner of Cell 41.

This report considers the part of the Remediation Area in the southern part of Kendall Bay should be slightly modified by moving the north-western boundary of remediation sub-area SA3 to include the south-western corner of Cell 41, as shown in **Figure 5-14**. Such an approach would result in sample locations SS04, HH2_10, B8, B11 and SHA15 being included in the Remediation Area. Such a change would:

- Address the health risk exceedance at location SS04 together with aesthetic impacts that exist in this area;
- Provide additional health protection for recreational users of Kendall Bay by addressing uncertainties associated with a transition from a 'source area' exposure scenario at sample location SS04 to a 'beach area' exposure scenario at sample locations HH2_10, B8 and B11;
- Address most of the aesthetic impacts that are located outside the present Remediation Area;
- All sediments in cell 39 would be permanently submerged;
- Provide additional improvements to ecological conditions by reducing the level of total PAH contamination remaining at the southern end of Kendall Bay; and
- Further reduce the mass of PAH contamination that causes the shallow sediments to exceed background PAH levels within the Declared Area.

MNR processes should then be allowed to provide a cover of clean sediment over sediments adjacent to the southern Remediation Area.

5.5.2 Protection of Aesthetically Impacted Sediments below Remediation Depth

Remediation proposed in sub-areas SA3, SA4 and SA5 will result in some residual aesthetic (slight odour) impacts that will remain below the sand that is to be replaced. The 2018 RAP proposes to mitigate aesthetic impacts from these underlying sediments by:

- The remediation strategy includes the construction of stormwater controls such as the extension of the seawall (between SA3 and SA4), installation of spur walls (in SA3), and addition of rock blanket energy dissipater (referred to as revetment blanket at SA4). Preliminary designs for these structures have been prepared. Final design of these control measures is intended to be included in the RWP, following detailed design from Ventia and their consultants. This will include design input from Geosyntec (remediation), Royal Haskoning (structural engineering) and JK Geotechnics (geotechnical engineering); and

- Final design of the sediment protection structures is to be prepared as described above and documented in the RWP.

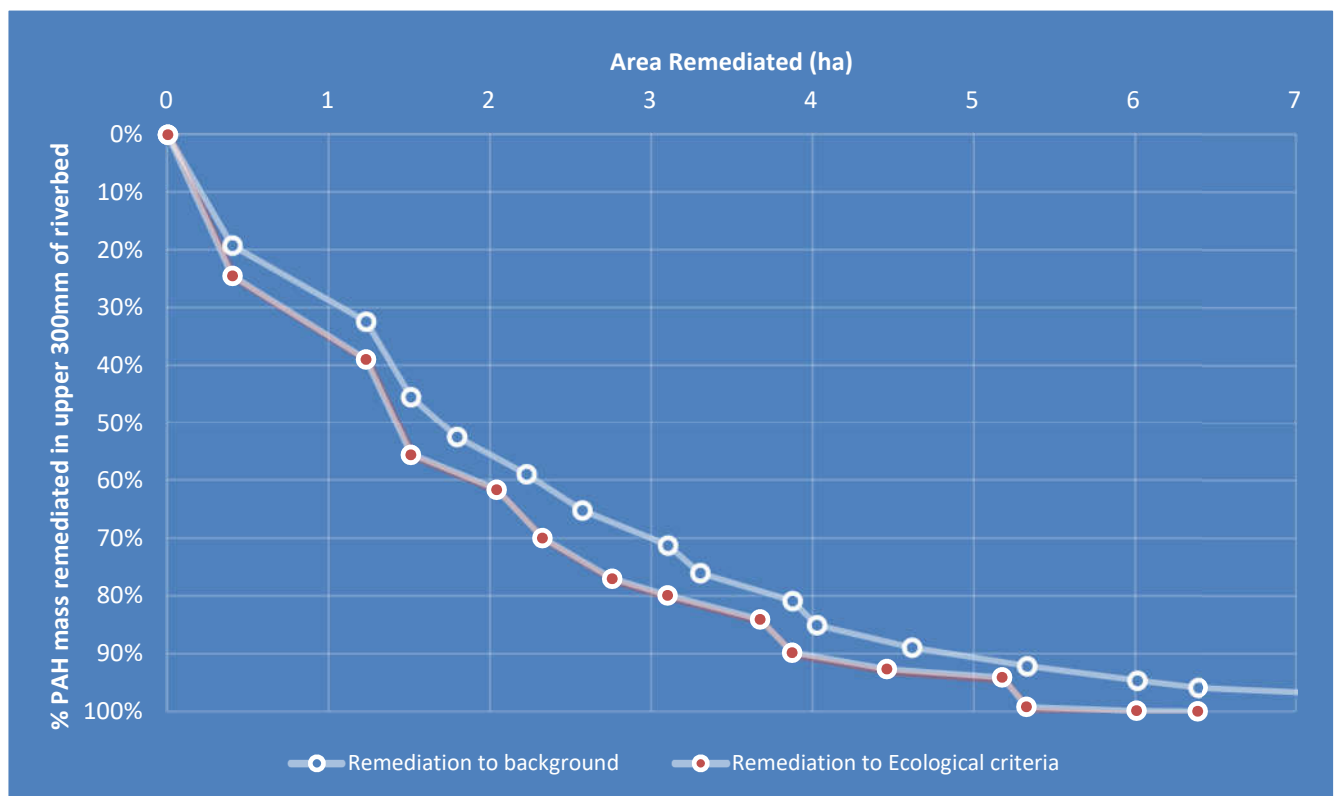
5.6 Additional ESD Analyses

5.6.1 Additional Analysis of Remediation Effectiveness

The Jacob study evaluated the application of the ESD criteria by comparing the reduction in PAH contamination in the shallow sediments to the average total PAH ecological criteria of 25 mg/kg dry weight (at 1% TOC). The sequence of cells remediated began with the two cells that make up the Remediation Area (cells 28 and 38). Subsequent cells were prioritised on the basis of highest to lowest mass of PAHs that would be remediated in a cell.

This report has further evaluated the application of the ESD criteria by comparing the reduction in PAH contamination in the shallow sediments to the background total PAH level of 10 mg/kg measured outside the Declared Area at baseline locations. The results obtained from both analyses are plotted in **Figure 5-15**. The results obtained for both analyses are summarised in **Tables 5-1** and **5-2**.

Figure 5-15: ESD Assessment for Cells Exceeding Average total PAH Ecological Criteria



The results obtained by the ESD analysis show that the Remediation Area proposed by the 2018 RAP (cells 28 & 38) would realise:

- A 39% reduction in the mass of PAH contamination that causes the shallow sediments to exceed the average total PAH criteria. This Remediation Area corresponds to 4.9% of the Declared Area.; and
- A 32% reduction in the mass of PAH contamination that causes the shallow sediments to exceed background PAH levels.

Table 5-1: ESD Assessment for Cells Exceeding Average Total PAH Ecological Criteria

Cell	Area (ha)	Average normalised total PAHs in upper 300mm (mg/kg)	Total PAHs exceeding Ecological Criteria ⁽²⁾ (mg/kg)	Total PAH mass in upper 300mm above ecological criteria ⁽¹⁾ (kg)	Mass remediated in cell (%)	Cumulative area remediated (ha)	Cumulative mass remediated (%)	Cumulative area remediated (%)
						0	0%	0.0%
28	0.401	251.71	226.7	16.4	24.5%	0.401	24.5%	6.3%
38	0.829	89.72	64.7	9.7	14.4%	1.230	38.9%	19.3%
39	0.278	245.85	220.9	11.1	16.6%	1.509	55.5%	23.6%
21	0.531	67.40	42.4	4.1	6.1%	2.040	61.5%	31.9%
8	0.285	134.60	109.6	5.6	8.4%	2.325	69.9%	36.4%
33	0.433	85.55	60.6	4.7	7.1%	2.758	77.0%	43.2%
41	0.345	101.01	31.371	1.9	2.9%	3.102	79.9%	48.5%
1	0.573	52.00	27.0	2.8	4.2%	3.675	84.1%	57.5%
27	0.199	132.06	107.1	3.8	5.7%	3.874	89.8%	60.6%
10	0.589	43.16	18.2	1.9	2.9%	4.463	92.7%	69.8%
19	0.714	32.50	7.5	1.0	1.4%	5.176	94.1%	81.0%
29	0.152	149.85	124.8	3.4	5.1%	5.328	99.2%	83.4%
24	0.683	28.58	3.6	0.4	0.7%	6.011	99.9%	94.1%
36	0.379	26.27	1.3	0.1	0.1%	6.390	100.0%	100.0%
Totals	6.390			66.9				
<u>Legend:</u>								
(1) Sediment dry unit weight = 600 kg/m ³								
(2) Average total PAH ecological criteria 25 mg/kg (normalised to 1%TOC)								
 Remediation Area proposed by 2018 RAP								

Table 5-2: ESD Assessment for Cells Exceeding Background PAH Level (Sheet 1 of 2)

Cell	Area (ha)	Average normalised total PAHs in upper 300mm	Total PAH mass in upper 300mm in cell above background level ⁽¹⁾ (kg)	Proportion of mass remediated across Declared Area (%)	Cumulative area remediated (ha)	Cumulative mass remediated (%)	Cumulative area remediated (%)
					0	0.0%	0.0%
28	0.401	251.71	97.017	19.3%	0.401	19.3%	1.6%
38	0.829	89.72	66.096	13.1%	1.230	32.4%	4.9%
39	0.278	245.85	65.670	13.0%	1.509	45.4%	6.0%
8	0.285	134.60	35.482	7.0%	1.794	52.5%	7.1%
33	0.433	85.55	32.690	6.5%	2.226	59.0%	8.8%
41	0.345	101.01	31.371	6.2%	2.571	65.2%	10.1%
21	0.531	67.40	30.492	6.1%	3.102	71.3%	12.2%
27	0.199	132.06	24.277	4.8%	3.301	76.1%	13.0%
1	0.573	52.00	24.058	4.8%	3.874	80.9%	15.3%
29	0.152	149.85	21.198	4.2%	4.026	85.1%	15.9%
10	0.589	43.16	19.526	3.9%	4.614	88.9%	18.2%
19	0.714	32.50	16.054	3.2%	5.328	92.1%	21.0%
24	0.683	28.58	12.693	2.5%	6.011	94.7%	23.7%
36	0.379	26.27	6.171	1.2%	6.390	95.9%	25.2%
26	0.664	16.38	4.239	0.842%	7.055	96.7%	27.8%
20	0.961	13.99	3.836	0.762%	8.016	97.5%	31.6%
25	0.421	19.08	3.825	0.760%	8.437	98.2%	33.3%
34	0.595	14.65	2.769	0.550%	9.032	98.8%	35.7%
7	0.313	20.61	3.325	0.660%	9.346	99.4%	36.9%
42	0.315	13.92	1.235	0.245%	9.661	99.7%	38.1%
31	0.418	12.23	0.935	0.186%	10.079	99.9%	39.8%
4	0.555	10.59	0.326	0.065%	10.634	99.9%	42.0%
18	0.581	10.48	0.277	0.055%	11.215	100.0%	44.3%
15	1.057	9.03	0.000	0.000%	12.273	100.0%	48.4%

Table 5-2 (cont'd): ESD Assessment for Cells Exceeding Background PAH Level (Sheet 2 of 2)

Cell	Area (ha)	Average normalised total PAHs in upper 300mm	Total PAH mass in upper 300mm in cell above background level ⁽¹⁾ (kg)	Proportion of mass remediated across Declared Area (%)	Cumulative area remediated (ha)	Cumulative mass remediated (%)	Cumulative area remediated (%)
37	0.909	8.49	0.000	0.000%	13.182	100.0%	52.0%
40	0.813	6.78	0.000	0.000%	13.995	100.0%	55.2%
2	0.572	5.86	0.000	0.000%	14.567	100.0%	57.5%
12	0.777	5.56	0.000	0.000%	15.344	100.0%	60.6%
3	0.599	4.35	0.000	0.000%	15.943	100.0%	62.9%
5	0.819	3.82	0.000	0.000%	16.762	100.0%	66.2%
6	0.694	3.94	0.000	0.000%	17.456	100.0%	68.9%
9	0.354	0.00	0.000	0.000%	17.810	100.0%	70.3%
11	1.028	3.13	0.000	0.000%	18.837	100.0%	74.4%
13	1.137	2.94	0.000	0.000%	19.975	100.0%	78.9%
14	0.768	3.08	0.000	0.000%	20.742	100.0%	81.9%
16	0.698	2.94	0.000	0.000%	21.441	100.0%	84.6%
17	0.617	3.55	0.000	0.000%	22.058	100.0%	87.1%
22	0.443	8.24	0.000	0.000%	22.501	100.0%	88.8%
23	0.403	9.03	0.000	0.000%	22.904	100.0%	90.4%
30	0.725	2.52	0.000	0.000%	23.630	100.0%	93.3%
32	0.545	5.68	0.000	0.000%	24.175	100.0%	95.4%
35	0.495	5.32	0.000	0.000%	24.670	100.0%	97.4%
43	0.662	6.20	0.000	0.000%	25.332	100.0%	100.0%
Totals	25.332		503.6	100.0%			
Notes:							
(1)	Adopted background total PAH concentration 10 mg/kg based on data provided in Section 5.3 and Table 5.2 of the 2018 RAP. Sediment dry unit weight = 600 kg/m ³						
	Remediation Area proposed by 2018 RAP						

The results provided by the analysis indicate that the Remediation Area proposed by the 2018 RAP would:

- Represent the part of the Declared Area that would achieve the most effective remediation per unit area in terms of benefits to the ecology, human health and aesthetic impacts. **Figure 5-15** shows the slope of the curve for cells 28 and 38 is steep, with the remediation of the shallow sediments in these two cells also addressing the human health and aesthetic criteria;
- Remediate 37.3% of PAH contamination that needed to be remediated to achieve the sediment ecological criteria across the Declared Area and 32.0% of PAH contamination within the Declared Area that exceeds background concentrations;
- Reduce the total PAH mass exceeding the ecological criteria from 62.5 kg to 39.2 kg, which corresponds to 32 % of a single 205 L drum of coal tar;
- Remediate the part of the Declared Area that was the most contaminated with gasworks wastes, this being cell 28 in the northern part of Kendall Bay;
- Represents 20.4 % of the total area of the 13 cells that exceed the ecological criteria; and
- Remediate all shallow sediments in tidal flats at the southern end of Kendall Bay, which is an area that has the greatest potential recreation use and is the area where mangroves have become established and continue to expand.

5.6.2 Influence of Cell 39

The ESD analysis also shows that remediation of cell 39 would realise a further 13% reduction in the mass of PAH contamination that causes the shallow sediments to exceed background PAH levels within the Declared Area. The likely reasons why the 2018 RAP did not include cell 39 in the Remediation Area are:

- Cell 39 did not include a sample location that exceeded the health criteria because practically the entire cell is permanently submerged, since the riverbed is practically all below the LAT;
- The CSIRO³⁸ advise that *'For the most part, because of the enormous costs involved, there is unlikely to be large scale sediment remediation, unless driven by human health risk assessments. Natural remediation of contaminated sediments may occur via the deposition, above the contaminated zone, of freshly deposited sediments able to support viable biological populations. This will occur through water column inputs and be managed through controls on inputs via water quality guidelines'*; and
- Cell 39 is located away from the beach and mangrove area and is likely to have a much lower utilisation by recreational users of Kendall Bay compared to the cell 38, 41 and 42 areas.

5.6.3 Fairmile Cove

The 2018 RAP considered none of the sediments in Fairmile Cove needed to be remediated. The reasons that are considered to support this conclusion include:

- The available data indicate there is a low risk of significant unknown sediment contamination in Fairmile Cove, based on the historical and available sediment data;
- Practically all sediments in Fairmile Cove are permanently submerged, as shown by the closeness of the LAT line to the seawall, and so do not pose a hazard to recreational use (health & aesthetics);
- Only a relatively small amount of the Cove contains contamination that exceeds the ecological Remediation Criteria; and
- The river is more exposed and actively used in Fairmile Cove compared to Kendall Bay, which would make any active remediation difficult and impractical. It is likely that speed restrictions would need to be placed on Rivercat ferries and other commercial boats in this area of the Parramatta River if active remediation was required. This would have an adverse impact to commuters and the amenity of the River. It is likely that the RMS would not approve of any such speed restrictions.

³⁸ Section 1.1, CSIRO (2013) *'Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines'*

5.7 Remedial Area Conclusions

The Jacobs study³⁹ concluded that the Remediation Area contemplated by the 2018 RAP is sufficient to justify the lifting of the Declaration if the 2018 RAP is implemented. The minor exceedance of the health and aesthetic criteria on the southern tidal flat north of SA3 to the LAT bathymetric line could be addressed by either:

- Allowing Monitored Natural Recovery (MNR) to remediate this area; or
- Assessing the extent of this exceedance as part of the remediation program; or
- Slightly moving the SA3 boundary to include this area.

This report considers the part of the Remediation Area in the southern part of Kendall Bay should be slightly modified by moving the north-western boundary of remediation sub-area SA3 to include the south-western corner of Cell 41, as shown in **Figure 5-14**. Such an approach would result in sample locations SS04, HH2_10, B8, B11 and SHA15 being included in the Remediation Area. Such a change would:

- Increase the southern Remediation Area by 2,230 m², consisting of a 1,930 m² area from the southern part of cell 41 and a 300 m² area from the southern part of cell 39;
- Address the health risk exceedance at location SS04 together with aesthetic impacts in this area;
- Provide additional health protection for recreational users of Kendall Bay by addressing uncertainties associated with a transition from a 'source area' exposure scenario at sample location SS04 to a 'beach area' exposure scenario at sample locations HH2_10, B8 and B11;
- Address most of the aesthetic impacts that are located outside the present Remediation Area;
- All sediments in cell 39 would be permanently submerged;
- Provide additional improvements to ecological conditions by reducing the level of total PAH contamination remaining at the southern end of Kendall Bay; and
- Further reduce the mass of PAH contamination that causes the shallow sediments to exceed background PAH levels within the Declared Area.

MNR processes should then be allowed to provide a cover of clean sediment over sediments adjacent to the southern Remediation Area.

³⁹ Section 6, Ref [81]

6. Adequacy of the 2018 RAP Remediation Strategy

6.1 Remedial Objectives

The 2018 RAP⁴⁰ advised that the preferred remediation strategy was designed from an assessment that linked location-specific conditions to contamination risks to remediation objectives. This process resulted in the definition of five southern sub-areas (SA1 – SA5) and the three northern sub-areas (NA1 – NA3) shown in **Figures 2-1 to 2-3**. Remediation objectives for each of these sub-areas were then established, from which a preferred remediation strategy for each sub-area was determined. This analysis resulted in a range of technologies being applied to the different sub-areas, which was designed to achieve an optimal remediation strategy.

The remediation objectives that the 2018 RAP assigned to each of the 8 sub-areas are summarised in **Table 6-1** in terms of the sediment remediation criteria previously summarised in **Table 4-1**. The table compares these remediation objectives to the exceedances of the sediment remediation criteria shown by the results obtained by the Jacobs GIS model summarised in **Section 5**.

Table 6-1: Remediation Criteria Needing to be Addressed by 2018 RAP Remediation Sub-Areas

2018 RAP Sub-Area	Human health ⁽¹⁾	Aesthetic ⁽²⁾	Ecological ⁽³⁾	ESD ⁽⁴⁾
Southern Remediation Area				
SA1	✓		✓	✓
SA2	✓	✓	✓	✓
SA3	✓			✓
SA4		✓		✓
SA5		✓		✓
Northern Remediation Area				
NA1	✓	✓	✓	✓
NA2	✓		✓	✓
NA3	✓		✓	✓

Legend

✓ 2018 RAP Remediation objective

Exceedance of sediment criteria shown by Jacobs GIS modelling results

Notes:

1. Refer Jacobs Figure 5-3
2. Refer Jacobs Figure 5-4
3. Refer Jacobs Figure 5-7
4. Refer Figure 5-8

⁴⁰ Executive summary & Section 8.6, Ref [80]

The data presented in **Table 6-1** indicate that most of the remedial objectives proposed by the 2018 RAP for the 8 sub-areas are appropriate. However, some additional objectives need to be allocated to some of the sub-areas, these being:

- Sub-area SA1: Aesthetic criteria;
- Sub-area SA3: Aesthetic and ecological criteria;
- Sub-area SA4: Ecological criteria; and
- Sub-area SA5: Ecological criteria.

This report has assessed the ability of the proposed remediation strategy to address these additional remediation objectives.

6.2 Remediation Strategy for Sub-Areas SA1, NA2 & NA3

The 2018 RAP proposes a common remediation strategy for sub-areas SA1, NA2 and NA3. The strategy the sub-area SA1 involves installing in-situ cement-stabilised columns down to a competent surface. No stabilised columns are considered necessary for sub-areas NA2 and NA3 because of the reported presence of a shallow stiff clay layer.

A 1.5 m thick stabilised raft of contaminated sediment would then be formed across all three sub-areas. The top 0.5 m of the solidified raft will then be excavated to 0.5 m below the LAT, with the excavated material to be barged to the Staging Site for processing and offsite disposal, as required. An activated carbon impregnated geotextile would then be placed across the base of the excavation. The excavation would then be backfilled with a permeable capping layer suitable for benthic re-colonisation. The backfill materials would involve a mix of cobble-sized rock and sand for the three sub-areas. It is proposed to enclose sub-area SA1 in a permanent continuous sheet pile wall to provide environmental control. Sheet piles are not currently proposed in sub-areas NA2 and NA3, however they may be included based on the results of the field trial.

Figure 6-1 provides a cross-section that shows the main design features of this remediation strategy for sub-area SA1, with cross-sections for sub-areas NA2 and NA3 provided in **Figure 6-2**.

This report considers the remediation strategy proposed for sub-areas SA1, NA2 and NA3 is capable of addressing exceedances of the remediation criteria because:

- Formation of a 0.3 m thick clean soil cap will minimise the risk of human contact with the underlying contaminated sediments and address aesthetic, ecological and ESD criteria;
- The potential for recontamination of the clean soil cap by the underlying contaminated sediments is minimised by the placement of an activated carbon layer at across the base of the excavation; and
- Future sediment deposition across the area will gradually increase the soil cap to more than 0.5 m.

6.3 Remediation Strategy for Sub-Areas SA2 & NA1

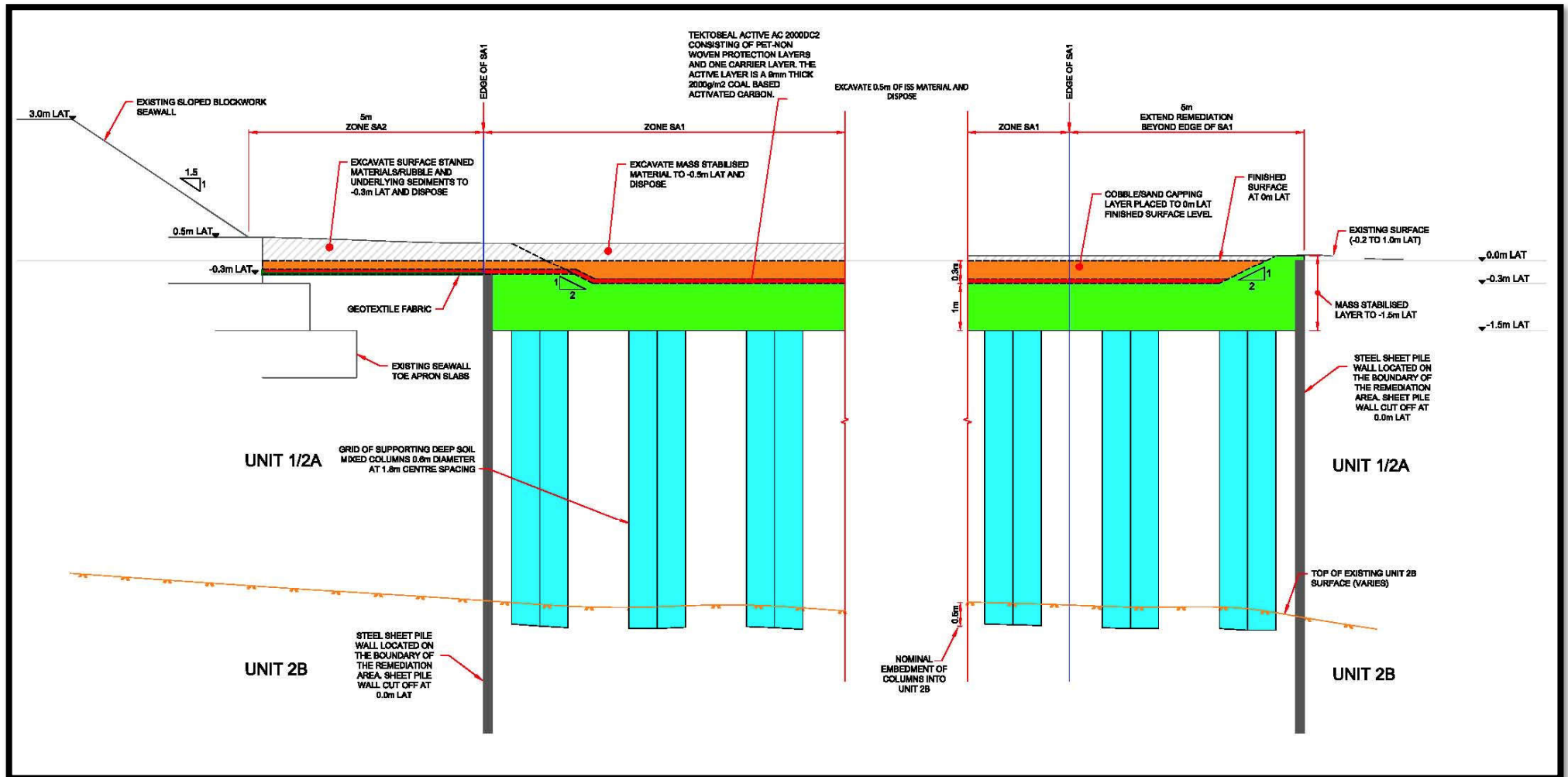
The 2018 RAP⁴¹ proposes a common remediation strategy for sub-areas SA2 and NA1. The strategy involves lowering the seabed to a depth of 0.3 m such that the final level is below the LAT. A geotextile fabric would then be laid followed by the placement of a 0.3 m thick capping layer for benthic recolonization. Geotechnical considerations, such as avoiding undermining founding material associated with the seawall, would also be considered when determining the depth of excavation adjacent to seawalls.

The RAP advises that this approach will prevent human access to the contaminated rubble along the base of the seawall at low tide and improve the marine ecosystem within the bay. Stained rock/rubble and rubbish will also be removed to restore site aesthetics and to provide habitat for intertidal fauna.

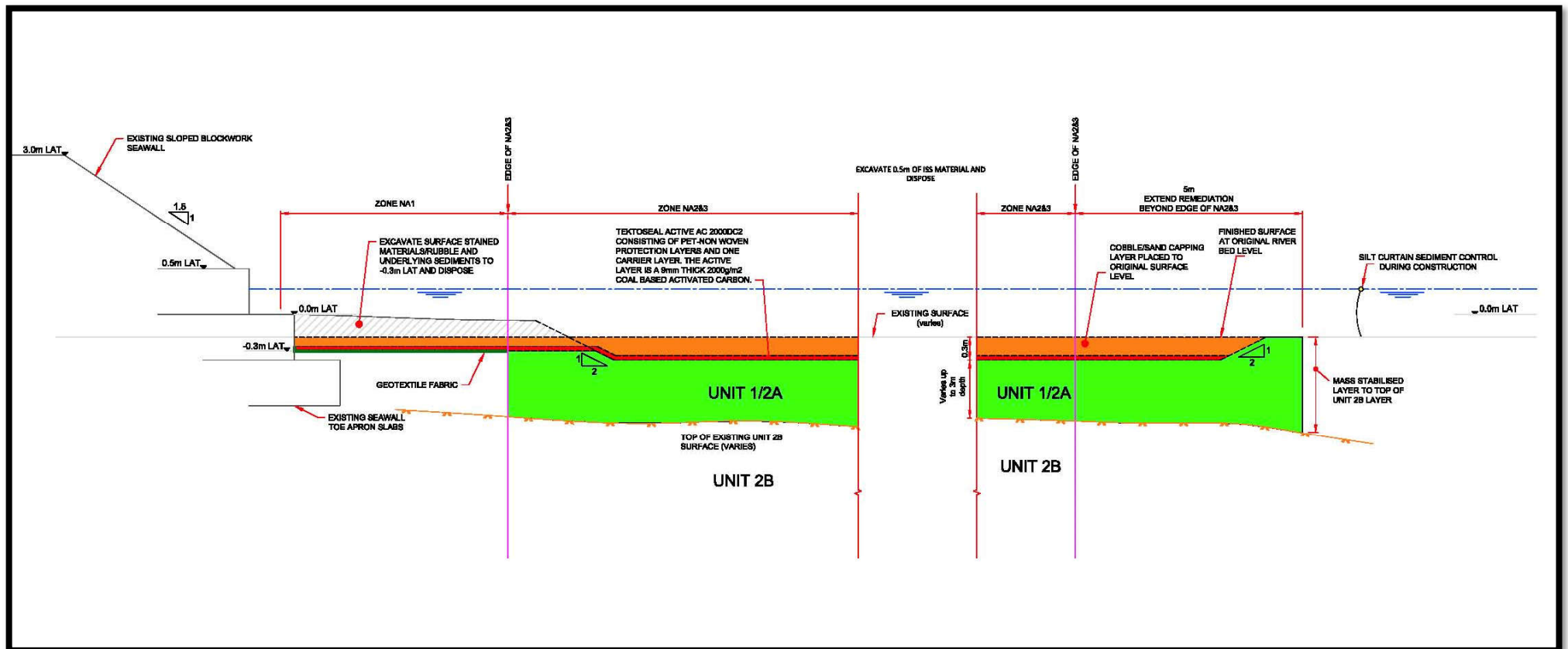
⁴¹ Executive summary, Sections 8.6.2 & 8.6.6, Ref [80]

Figure 6-1 Cross-Section of Proposed Remediation Strategy for Sub-Area SA1

(Source: Ref [82])



(Source: Ref [83])



This report considers the remediation strategy proposed for sub-areas SA2 and NA1 is capable of addressing exceedances of the remediation criteria because:

- Formation of a 0.3 m thick clean soil cap underlain by a geotextile fabric will minimise the risk of human contact with the underlying contaminated sediments and address aesthetic, ecological and ESD criteria;
- The removal of contaminated / stained rock / rubble along the base of the seawall at low tide will address exceedances of the remediation criteria posed by this material; and
- Future sediment deposition across the area will gradually increase the soil cap to more than 0.5 m.

6.4 Remediation Strategy for Sub-Area SA3

Sub-area SA3 covers the main mangrove area at the southern end of Kendall Bay. This report recommends that the northern boundary of sub-area SA3 be moved further north to include sample location SS04 for the reasons given in **Section 5**.

The 2018 RAP describes the remediation strategy for this sub-area as retaining the established mangroves by hand excavating visually contaminated material to a nominal depth of 0.2 m while minimising damage to the mangroves. North of the mangroves, sediments will be removed to a depth of 0.2 m and replaced with clean imported sand (VENM) compatible with the existing natural material. The excavated material will be removed to the Staging Site for offsite disposal or reuse within the capping layer at sub-areas SA1, NA2 or NA3 if suitable. The excavated material would then be replaced by clean sand.

Stormwater controls would also be provided to ensure stormwater discharge to Kendall Bay does not impact the remediated and managed parts of the Remediation Area. This will involve the redirection of stormwater flows away from the seawall by the installation of a series of spur walls along an alignment through the mangrove area. 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.

This report considers the remediation strategy proposed for sub-area SA3 is capable of addressing exceedances of the remediation criteria because:

- The proposed excavation depths and replacement with clean sand will minimise the risk of human contact with the underlying contaminated sediments and address aesthetic, ecological and ESD criteria;
- The mangrove root mat will restrict and minimise access to underlying contaminated sediments;
- The health of the existing mangroves should not be adversely impacted;
- The proposed stormwater control measures should reduce the risk of scouring of the clean soil cap and
- Future sediment deposition across the area will gradually increase the soil cap to more than 0.5 m.

6.5 Remediation Strategy for Sub-Area SA4

Sub-area SA4 covers the beach area at the southern end of Kendall Bay. The 2018 RAP describes the remediation strategy for this sub-area as involving the removal of coke and coal from the sand surface to a nominal depth of 0.2 m. The excavated material will be removed to the Staging Site for offsite disposal, or reuse within the capping layer at sub-areas SA1, NA2 or NA3 if suitable. The removed material would then be replaced with clean sand (VENM). The beach nourishment sand will be retained by a 30 m long extension of the existing sandstone seawall.

This report considers the remediation strategy proposed for sub-area SA4 is capable of addressing exceedances of the remediation criteria because:

- The proposed excavation depths and replacement with clean sand will address aesthetic, ecological and ESD criteria; and
- Extending the seawall should reduce the risk of beach erosion.

6.6 Remediation Strategy for Sub-Area SA5

Sub-area SA5 covers the shallow sediments at the southern end of Kendall Bay located in slightly deeper water adjacent to sub-area SA4. The 2018 RAP⁴² describes the remediation strategy for this sub-area as involving the shallow excavation of existing seabed material to 0.3 m depth. The excavated material will be removed to the Staging Site for offsite disposal, or reuse within capping layer at sub-areas SA1, NA2 or NA3 if suitable. The removed material would then be replaced with a 0.3 m layer of clean sand to match the existing riverbed level. Beneficial reuse of the excavated sediment would be achieved by blending it with sand used for capping other parts of the Remediation Area (eg SA1).

This report considers the remediation strategy proposed for sub-area SA5 is capable of addressing exceedances of the remediation criteria because:

- The proposed excavation depths and replacement with clean sand will address aesthetic, ecological and ESD criteria; and
- Future sediment deposition across the area will gradually increase the soil cap to more than 0.5 m. Studies estimate the average sedimentation rate in Sydney Harbour is 0.8 mm / year⁴³.

6.7 Design Life and Performance Criteria

The 2018 RAP⁴⁴ mentions that the NSW EPA requirements that the remediation outcome achieved at Kendall Bay is 'durable' and 'robust'. These requirements relate to performance criteria that ensure that remediation treatments are effective for an extended period of time and are resistant to the action of natural processes and anthropogenic influences.

The 2018 RAP⁴⁵ advises that this requirement will be met by:

- Conducting remediation and laboratory trials of the proposed cement stabilisation work;
- Having the capping layers designed by specialist marine engineers from Royal HaskoningDHV to withstand near-bed velocities generated by 100-year recurrence wind wave conditions as well as near-bed velocities from regular boat-generated waves;
- The preparation of detailed design and specifications for the proposed remediation work that will be included in a Remediation Works Plan (RWP) after endorsement by the Site Auditor;
- The remediation work being subject to review by a Site Auditor; and
- Preparation of a validation report that is to be reviewed and assessed by the Site Auditor.

This report considers these measures are reasonable provided:

- The Site Auditor is kept up-to-date as remediation progresses and undertakes regular inspection and auditing of the site work;
- Jemena provides regular up-dates to regulatory agencies and on an as-required basis;
- The RMS should consider placing appropriate operational controls on future boating activities that may occur in Kendall Bay; and
- The RMS should consider placing appropriate planning controls that require any development proposed for Kendall Bay to account for the contamination that will remain buried below the remediation areas to the satisfaction of the NSW EPA.

⁴² Executive summary & Section 8.6.5, Ref [80]

⁴³ Section 5.6.8, Irvine I (1980)

⁴⁴ Section 8.7, Ref [80]

⁴⁵ Sections 5.10, 8.6.7, 8.7, 9.3, 14.7 & 14.8, Ref [80]

7. Remediation Procedures

The 2018 RAP is considered to describe remediation procedures to a level of detail required by NSW EPA guidelines and which represent good practice for the strategy proposed. Additional requirements that should be included in the RWP include:

- a) The approved remediation strategy should be implemented unless a variation is approved in accordance with consent conditions prior to the work being undertaken;
- b) Comprehensive and robust odour control measures need to be designed and specified in the Remediation Works Environmental Work Plan (RWEMP). The goal should be to meet the requirement of no offensive odour measured at the nearest residential receptor. Control measures should be designed to address all reasonably foreseeable circumstances;
- c) Comprehensive and robust surface water control measures need to be designed and specified in the RWEMP. These measures should be designed to protect human health and the environment and to meet the water quality requirements approved by regulatory authorities. Control measures should be designed to address all reasonably foreseeable circumstances;
- d) The 2018 RAP⁴⁶ requires the RWEMP to provide appropriate control measures to protect the environment at the Remediation Areas, along the transport corridor in Kendall Bay and at the Staging Site, and that appropriate monitoring is implemented to identify any improvements or repair to control measures required. The RWEMP should also ensure that the environment is protected in accordance with regulatory requirements;
- e) The RWEMP should be reviewed and approved by the Site Auditor prior to the commencement of site work⁴⁷;
- f) The Site Auditor should be responsible for auditing the remediation work, which should include among other things making regular site inspections and review monthly reports prepared by Jemena and the remediation contractor;
- g) Operational requirements of the remediation work should be controlled and monitored by measuring parameters capable of being measured in real-time for which the minimum values have been determined from successful field trials. For example, the likely performance of cement stabilisation work should be controlled by measuring the amount of cement being used and the mixing time spent per unit length of column.
- h) All excavated and backfill material should be tracked from cradle-to-grave, with sufficient documentation generated that will allow the Site Auditor to independently verify compliance with this requirement;
- i) Excavation depths and thickness should be specified as minimums to ensure that the as-constructed remediation work meets design requirements and approvals;
- j) The methods of measurement and their accuracy should be specified;
- k) The documentation to be generated by the remediation and validation work should be specified;
- l) If an existing seawall shows signs of instability during remediation work, consideration should be given to placing gabion rock blankets at the toe of the wall over a geotextile blanket to address the remediation objectives;
- m) Heritage items that are discovered or disturbed during the remediation work should be located, documented, preserved and/or recovered in accordance with regulatory requirements;
- n) The validation program should be designed so that success of the remediation work can be measured by the time the remediation work has been completed. This will facilitate the completion of a site audit and the lifting of the Declaration. This should initially involve a review of the RAP's target performance criteria during the field trial, with any amendments to the validation program for the full-scale work to be

⁴⁶ Section 11, Ref [80]

⁴⁷ Section 11.3 of the 2018 RAP only requires Jemena to approve the RWEMP

reviewed and approved by the Site Auditor⁴⁸. Confirmation of target performance criteria and validation strategy should then be documented in the RWP and validation SAQP (VSAQP); and

- o) The need for ongoing environmental monitoring after the completion of the remediation work should be avoided since:
- The remediation criteria adopted by the 2018 RAP and expanded in this report provide a quantitative measure of the environmental benefits that will be realised by the Kendall Bay Remediation Project;
 - The results obtained by the Alison Hunt (2018) fieldwork indicate that the recolonization of benthic communities within the remediation areas is unlikely to provide a quantitative measure of remediation success; and
 - The purpose of the remediation work is to realise the lifting of the Declaration if the 2018 RAP is implemented.

It is recommended that the need for the monitoring outlined in Chapter 15 of the RAP should be reassessed in consultation with the Site Auditor, RMS and the NSW EPA.

⁴⁸ For example, there maybe a need for early indication of success of ISS remediation, which is likely to be facilitated by short duration UCS strength testing correlated to LEAF testing results, rather than LEAF testing stated in the RAP where full results are not received until 90 days after receipt of the sample in the laboratory.

8. Other Relevant Information

This report relates to contaminated sediments located within an area within Kendall Bay, Sydney, that was declared by the NSW EPA on 25 May 2004 ('the site'). The report has been prepared in accordance with an agreement between Jemena and IS&A. Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions.

This report has been prepared for Jemena Limited (the 'Client') for the purposes nominated in the report. It is acknowledged that the report may be used by the NSW EPA and the NSW EPA Site Auditor appointed by Jemena in reaching their conclusions about the Site. The scope of work performed in connection with the report may not be appropriate to satisfy the needs of any other person. Any other person's use of, or reliance on, the report, or the findings, conclusions, recommendations or any other material presented in them, is at that person's sole risk.

The assessment documented in this report is, limited by and relies on the data and results of investigations conducted by other consultants appointed by Jemena through the documents provided to us. IS&A has taken this information to represent a fair and reasonable characterisation of the status of the Site. Whilst all reasonable care has been taken, to the extent practical under normal assessment procedures, to assure adequacy of the information, IS&A cannot warrant that this is the case. If the information is subsequently determined to be false, inaccurate or incomplete, it is possible that IS&A's conclusions, as expressed in the report may change.

This report applies to the condition of the site at the time the investigations were undertaken. IS&A cannot be responsible for future activities that may result in changes to the site conditions. In the event that site conditions have since changed or are likely to change in the future, IS&A recommends that the Client engage an environmental consultant to assess the significance of the changes on the environmental conditions at the site.

It must also be recognised that sub-surface conditions, including groundwater levels and contaminant concentrations, can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

There are always some variations in sub-surface conditions across a site that cannot be fully defined by investigation. No investigation, in practice, can be thorough enough to preclude the presence of materials on the subject property that presently, or in the future, may be considered hazardous. Hence it is possible that the measurements and values obtained from the sampling and testing presented do not represent the extremes of conditions which exist within the site.

Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable at the time of this audit report and statement, may in the future become subject to different regulatory standards and require reassessment. It is not possible in this report to present all data that could be of interest to all readers of this report. Readers are therefore referred to the referenced documentation for further data.

Appendix A. List of References

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Appendix B. Database Derived for GIS Model

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Sample date	Hand cores/push tubes/vibrocores	Grab samples	Hand auger	Sediment logs available	Lab summary tables available	Location Coordinates		Bathymetry		Exposure Scenario ⁽⁷⁾
									Northing (m)	Easting (m)	RL sea floor (mAHD)	Bathymetry relative to LAT (m)	
1	0.57	ESD33	Feb-06	1			yes	yes					Submerged
2	0.57	ESD34	Feb-06	1			yes	yes					Submerged
3	0.60	ESD35	Feb-06	1			yes	yes					Submerged
4	0.55	ESD32	Feb-06	1			yes	yes					Submerged
5	0.82	ESD31	Feb-06	1			yes	yes					Submerged
6	0.69	ESD30	Feb-06	1			yes	yes					Submerged
7	0.31	HSD18	Jan-06	1			yes	yes	325006	6254125			Submerged
8	0.28	ESD29	Feb-06	1			yes	yes					Submerged
9	0.35	HSD17	Jan-06	1			yes	yes	325105	6254139			Submerged
10	0.59	ESD26	Feb-06	1			yes	yes					Submerged
		HSD16	Jan-06	1			yes	yes	325172	6254186			Submerged
11	1.03	ESD28	Feb-06	1			yes	yes					Submerged
12	0.78	ESD27	Feb-06	1			yes	yes					Submerged
13	1.14	ESD24	Feb-06	1			yes	yes					Submerged
14	0.77	ESD23	Feb-06	1			yes	yes					Submerged
15	1.06	ESD21	Feb-06	1			yes	yes					Submerged
		KBR4	Oct-17		1		yes	yes	6254233	325352			Submerged
		KBR5	Oct-17		1		yes	yes	6254233	325352			Submerged
16	0.70	ESD22	Feb-06	1			yes	yes					Submerged
17	0.62	ESD20	Feb-06	1			yes	yes					Submerged
18	0.58	ESD19	Feb-06	1			yes	yes					Submerged
19	0.71	ESD17	Feb-06	1			yes	yes					Submerged
		SG1	May-09		1		no	yes					Submerged
		SG2	May-09		1		no	yes					Submerged
20	0.96	ESD18	Feb-06	1			yes	yes					Submerged
		SG3	May-09		1		no	yes					Submerged
		KBR6	Oct-17		1		yes	yes	6254187	325408			Submerged
		KBR12	Oct-17		1		yes	yes	6254184	325425			Submerged
21	0.53	ESD12	Feb-06	1			yes	yes					Submerged
		HSD14	Jan-06	1			yes	yes	325345	6254048			Submerged
		HSD15	Jan-06	1			yes	yes	325330	6254089			Submerged
		PC1	Apr-09	1			yes	yes					Submerged
		PC2	Apr-09	1			yes	yes					Submerged
		SG4	May-09		1		no	yes					Submerged
22	0.443	ESD16	Feb-06	1			yes	yes					Submerged
		PC3	Apr-09	1			yes	yes					Submerged
		PC4	Apr-09	1			yes	yes					Submerged
23	0.40	ESD15	Feb-06	1			yes	yes					Submerged
		KBR11	Oct-17		1		yes	yes	6254103	325477			Submerged
24	0.68	PC5	Apr-09	1			yes	yes					Submerged
		PC6	Apr-09	1			yes	yes					Submerged
		PC9	Apr-09	1			yes	yes					Submerged
		PC10	Apr-09	1			yes	yes					Submerged
		SG6	May-09		1		no	yes					Submerged
		SW2	May-09		1		yes	yes					Submerged
		MB26	Jan-16		1		yes	no	6254026	325414	-3.53	-2.68	Submerged
		705	Feb-16	1			yes	no	6253965	325395	-2.01	-1.16	Submerged
		707	Feb-16	1			yes	no	6253980	325435	-3.37	-2.51	Submerged
		708	Feb-16	1			yes	no	6254011	325414	-3.45	-2.60	Submerged
		709	Feb-16	1			yes	no	6253998	325406	-3.26	-2.40	Submerged
		710	Feb-16	1			yes	no	6253987	325388	-2.37	-1.52	Submerged
		801	Mar-16	1			yes	no	6253998	325384	-2.51	-1.65	Submerged
25	0.42	802	Mar-16	1			yes	no	6254020	325412	-3.48	-2.62	Submerged
		ESD13	Feb-06	1			yes	yes					Submerged
		PC7	Apr-09	1			yes	yes					Submerged
		SG5	May-09		1		no	yes					Submerged
		SG7	May-09		1		no	yes					Submerged
26	0.66	803	Mar-16	1			yes	no	6254034	325443	-3.83	-2.98	Submerged
		ESD14	Feb-06	1			yes	yes					Submerged
		PC8	Apr-09	1			yes	yes					Submerged
		PC29	May-09	1			yes	yes					Submerged
27	0.20	PC11	Apr-09	1			yes	yes					Submerged
		PC12	Apr-09	1			yes	yes					Submerged
		804	Mar-16	1			yes	no	6254003	325456	-3.65	-2.79	Submerged
		ESD09	Feb-06	1			yes	yes					Submerged
		B9	Oct-07	1			yes	no					Submerged
		B10	Oct-07	1			yes	no					Submerged
		PC14	May-09	1			yes	yes					Submerged
		PC19	May-09	1			yes	yes					Submerged
		SG8	May-09		1		no	yes					Submerged
		SHB21	Dec-19	1	1		yes	yes	6253914	325423	-1.53	-0.68	Submerged
		SHB22	Dec-10	1	1		yes	yes	6253910	325420	-1.21	-0.36	Submerged
		SHB23	Dec-10	1	1		yes	yes	6253894	325430	-1.42	-0.56	Submerged
		SHB24	Dec-10	1	1		yes	yes	6253880	325433	-1.67	-0.81	Submerged
		SHB25	Dec-10	1	1		yes	yes	6253875	325441	-2.54	-1.69	Submerged

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Sample date	Hand cores/push tubes/ vibrocores	Grab samples	Hand auger	Sediment logs available	Lab summary tables available	Location Coordinates		Bathymetry		Exposure Scenario ⁽⁷⁾
									Northing (m)	Easting (m)	RL sea floor (mAHD)	Bathymetry relative to LAT (m)	
28	0.401	SS11	Jul-13	1			yes	yes	6253903	325442	-1.88	-1.02	Submerged
		SS12	Jul-13	1			yes	yes	6253925	325437	-3.36	-2.51	Submerged
		SS13	Jul-13	1			yes	yes	6253906	325413	-0.43	0.42	Submerged
		410	Jul-15		1		yes	no	6253945	325424	-2.52	-1.6642	Submerged
		550	Oct-15	1			yes	no	6253923	325432	-2.86	-2.01	Submerged
		555	Oct-15	1			yes	no	6253909	325433	-2.03	-1.18	Submerged
		557	Oct-15	1			yes	no	6253877	325445	-3.14	-2.29	Submerged
		561	Oct-15	1			yes	no	6253892	325440	-2.35	-1.49	Submerged
		MB1	Jan-16		1		yes	no	6253896	325437	-1.83	-0.98	Submerged
		MB2	Jan-16		1		yes	no	6253892	325444	-3.00	-2.15	Submerged
		MB3	Jan-16		1		yes	no	6253939	325428	-2.38	-1.53	Submerged
		701	Feb-16	1			yes	no	6253946	325418	-2.28	-1.42	Submerged
		702	Feb-16	1			yes	no	6253920	325420	-1.50	-0.65	Submerged
		704	Feb-16	1			yes	no	6253957	325440	-3.25	-2.39	Submerged
		706	Feb-16	1			yes	no	6253965	325426	-3.07	-2.21	Submerged
		720	Feb-16	1			yes	no	6253920	325420	-1.50	-0.65	Submerged
		731	??		1		no	no					Submerged
		733	??		1		no	no					Submerged
		734	??		1		no	no					Submerged
		735	??		1		no	no					Submerged
		812	Mar-16	1			yes	no	6253893	325439	-2.10	-1.25	Submerged
		903	Apr-16	1			yes	no	6253905	325416	-0.65	0.21	Source
29	0.15	PC15	May-09	1			yes	yes					Submerged
		PC20	May-09	1			yes	yes					Submerged
		560	Oct-15	1			yes	no	6253910	325464	-1.98	-1.13	Submerged
		703	Feb-16	1			yes	no	6253941	325453	-3.52	-2.66	Submerged
		712	Feb-16	1			yes	no	6253896	325472	-4.66	-3.81	Submerged
30	0.73	ESD10	Feb-06	1			yes	yes					Submerged
		SG9	May-09		1		no	yes					Submerged
		SG10	May-09		1		no	yes					Submerged
		551	Oct-15	1			yes	no	6253940	325469	-4.15	-3.29	Submerged
		MB4	Jan-16		1		yes	no	6253996	325475	-3.80	-2.95	Submerged
31	0.42	PC16	Apr-09	1			yes	yes					Submerged
		PC17	May-09	1			yes	yes					Submerged
		PC21	May-09	1			yes	yes					Submerged
		PC22	May-09	1			yes	yes					Submerged
		411	Jul-15		1		yes	no	6253919	325475	-2.31	-1.4596	Submerged
		554	Oct-15	1			yes	no	6253904	325489	-5.09	-4.23	Submerged
		562	Oct-15	1			yes	no	6253929	325498	-2.83	-1.98	Submerged
		MB5	Jan-16		1		yes	no	6253899	325505	-5.34	-4.49	Submerged
		MB6	Jan-16		1		yes	no	6253921	325474	-2.66	-1.81	Submerged
32	0.55	805	Mar-16	1			yes	no	6253920	325488	-2.05	-1.19	Submerged
		806	Mar-16	1			yes	no	6253896	325502	-5.18	-4.32	Submerged
		ESD11	Feb-06	1			yes	yes					Submerged
33	0.43	408	Jul-15		1		yes	no	6253938	325609	-5.40	-4.55	Submerged
		KBR9	Oct-17		1		yes	yes	6253970	325594			Submerged
		ESD07	Feb-06	1			yes	yes					Submerged
34	0.60	PC25	May-09	1			yes	yes					Submerged
		SG11	May-09		1		no	yes					Submerged
		SG16	May-09		1		no	yes					Submerged
		SW1	May-09		1		yes	yes					Submerged
		711	Feb-16	1			yes	no	6253863	325444	-1.66	-0.80	Submerged
		ESD06	Feb-06	1			yes	yes					Submerged
35	0.49	PC23	May-09	1			yes	yes					Submerged
		PC24	May-09	1			yes	yes					Submerged
		PC26	May-09	1			yes	yes					Submerged
		PC27	May-09	1			yes	yes					Submerged
		SG12	May-09		1		no	yes					Submerged
36	0.38	KBR8	Oct-17		1		yes	yes	6253911	325594			Submerged
		ESD04	Feb-06	1			yes	yes					Submerged
37	0.91	MB7	Jan-16		1		yes	no	6253766	325517	-2.05	-1.19	Submerged
		ESD05	Feb-06	1			yes	yes					Submerged
		SG13	May-09		1		no	yes					Submerged
		MB8	Jan-16		1		yes	no	6253790	325618	-2.34	-1.48	Submerged
		MB10	Jan-16		1		yes	no	6253836	325649	-2.87	-2.02	Submerged
		KBR7	Oct-17		1		yes	yes	6253831	325625			Submerged
		HH2_02	Jul-06	1			yes	yes					Mangrove
		HH2_03	Jul-06	1			yes	yes					Mangrove
		HH2_04	Jul-06	1			yes	yes					Source
		HH2_05	Jul-06	1			yes	yes					Source
		HH2_06	Jul-06	1			yes	yes					Submerged
		HH3_1	Jun-07	1			yes	yes					Beach
		HH3_2	Jun-07	1			yes	yes					Beach
		HH3_3	Jun-07	1			yes	yes					Beach

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Sample date	Hand cores/push tubes/ vibrocores	Grab samples	Hand auger	Sediment logs available	Lab summary tables available	Location Coordinates		Bathymetry		Exposure Scenario ⁽⁷⁾
									Northing (m)	Easting (m)	RL sea floor (mAHD)	Bathymetry relative to LAT (m)	
38	0.829	HH3_5	Jun-07	1			yes	yes					Beach
		HSD04	Jan-06	1			yes	yes					Beach
		HSD05	Jan-06	1			yes	yes					Mangrove
		HSD06	Jan-06	1			yes	yes					Mangrove
		HSD09	Jan-06	1			yes	yes					Mangrove
		HSD10	Jan-06	1			yes	yes					Source
		HSD11	Jan-06	1			yes	yes					Source
		HSD12	Jan-06	1			yes	yes					Submerged
		HSD13	Jan-06	1			yes	yes					Submerged
		B1	Oct-07	1			yes	no					Submerged
		B2	Oct-07	1			yes	no					Submerged
		B3	Oct-07	1			yes	no					Submerged
		B4	Oct-07	1			yes	no					Submerged
		B5	Oct-07	1			yes	no					Submerged
		B6	Oct-07	1			yes	no					Submerged
		B7	Oct-07	1			yes	no					Mangrove
		SHA01	Dec-10	1	1		yes	yes	6253733	325470	-1.06	-0.21	Source
		SHA02	Dec-10	1	1		yes	yes	6253739	325475	-1.42	-0.57	Submerged
		SHA03	Dec-10	1	1		yes	yes	6253676	325488	-0.89	-0.04	Submerged
		SHA04	Dec-10	1	1		yes	yes	6253655	325498	-0.73	0.12	Submerged
		SHA05	Dec-10	1	1		yes	yes	6253659	325522	-0.88	-0.03	Submerged
		SHA07	Dec-10	1	1		yes	yes	6253642	325500	-0.70	0.16	Submerged
		SHA08	Dec-10	1	1		yes	yes	6253650	325533	-0.89	-0.04	Beach
		SHA11	Dec-10	1	1		yes	yes	6253637	325523	-0.75	0.11	Source
		SHA13	Dec-10	1	1		yes	yes	6253625	325509	-0.59	0.26	Source
		SHA14	Dec-10	1	1		yes	yes	6253626	325535	-0.74	0.11	Source
		SHA17	Dec-10	1	1		yes	yes	6253635	325616	-0.61	0.24	Beach
		SHA18	Dec-10	1	1		yes	yes	6253616	325549	-0.31	0.54	Mangrove
		SHA19	Dec-10	1	1		yes	yes	6253613	325575	-0.16	0.69	Mangrove
		SHA20	Dec-10	1	1		yes	yes	6253619	325595	-0.37	0.48	Beach
		SHA27	Dec-10	1	1		yes	yes	6253638	325506	-0.74	0.11	Submerged
		SS01	Jul-13			1	yes	yes	6253601	325594	0.92	1.77	Mangrove
		SS02	Jul-13			1	yes	yes	6253594	325566	0.59	1.44	Mangrove
		SS03	Jul-13			1	yes	yes	6253591	325528	0.00	0.86	Mangrove
		SS05	Jul-13	1			yes	yes	6253619	325522	-0.58	0.28	Source
		SS06	Jul-13	1			yes	yes	6253632	325595	-0.62	0.23	Beach
		SS09	Jul-13	1			yes	yes	6253682	325485	-0.91	-0.05	Submerged
		SS10	Jul-13	1			yes	yes	6253715	325481	-1.37	-0.52	Submerged
		SS14	Jul-13			1	yes	yes	6253603	325518	0.52	1.37	Mangrove
		SS15	Jul-13			1	yes	yes	6253600	325530	0.31	1.16	Mangrove
		SS16	Jul-13			1	yes	yes	6253587	325547	0.96	1.81	Mangrove
		SS17	Jul-13			1	yes	yes	6253598	325549	0.25	1.10	Mangrove
		SS18	Jul-13			1	yes	yes	6253585	325564	1.18	2.03	Mangrove
		SS19	Jul-13			1	yes	yes	6253590	325578	1.35	2.21	Mangrove
		SS20	Jul-13			1	yes	yes	6253591	325592	1.44	2.29	Mangrove
		SS21	Jul-13			1	yes	yes	6253598	325608	1.36	2.22	Mangrove
		SS22	Jul-13			1	yes	yes	6253606	325605	0.86	1.72	Mangrove
		SS23	Jul-13			1	yes	yes	6253614	325617	0.44	1.29	Beach
		SS24	Jul-13	1			yes	yes	6253639	325615	-0.65	0.21	Beach
		SS25	Jul-13			1	yes	yes	6253611	325576	-0.17	0.69	Mangrove
		2	Apr-15	1			yes	no	6253624	325623	-0.36	0.49	Beach
		3	Apr-15	1			yes	no	6253619	325635	0.73	1.59	Beach
		4	Apr-15	1			yes	no	6253615	325609	0.05	0.91	Beach
		5	Apr-15	1			yes	no	6253609	325626	1.46	2.31	Beach
		6	Apr-15	1			yes	no	6253623	325601	-0.50	0.36	Beach
		8	Apr-15	1			yes	no	6253622	325575	-0.39	0.46	Beach
		9	Apr-15	1			yes	no	6253618	325546	-0.48	0.38	Source
		11	Apr-15	1			yes	no	6253608	325611	0.89	1.75	Beach
		12	Apr-15	1			yes	no	6253604	325589	0.37	1.23	Beach
		13	Apr-15	1			yes	no	6253604	325567	0.14	0.99	Mangrove
		14	Apr-15	1			yes	no	6253606	325541	0.09	0.95	Mangrove
		15	Apr-15	1			yes	no	6253626	325507	-0.51	0.34	Source
		16	Apr-15	1			yes	no	6253609	325519	0.11	0.97	Source
		17	Apr-15	1			yes	no	6253595	325538	0.45	1.30	Mangrove
		19	Apr-15	1			yes	no	6253587	325584	1.48	2.34	Mangrove
		20	Apr-15	1			yes	no	6253599	325617	1.47	2.33	Mangrove
		23	Apr-15	1			yes	no	6253612	325514	-0.23	0.62	Source
		24	Apr-15	1			yes	no	6253621	325506	-0.29	0.56	Source
		25	Apr-15	1			yes	no	6253633	325499	-0.50	0.36	Source
		26	Apr-15	1			yes	no	6253618	325528	-0.51	0.34	Source
		100	??		1		no	no					Beach
		101	??		1		no	no					Beach
		102	??		1		no	no					Beach
		103	??		1		no	no					Mangrove
		104	??		1		no	no					Mangrove

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Sample date	Hand cores/push tubes/ vibrocores	Grab samples	Hand auger	Sediment logs available	Lab summary tables available	Location Coordinates		Bathymetry		Exposure Scenario ⁽⁷⁾
									Northing (m)	Easting (m)	RL sea floor (mAHD)	Bathymetry relative to LAT (m)	
		105	May-15	1			yes	no	6253593	325550	0.46	1.32	Mangrove
		106	May-15	1			yes	no	6253592	325565	0.69	1.55	Mangrove
		107	May-15	1			yes	no	6253595	325578	0.94	1.79	Mangrove
		109	??		1		no	no					Submerged
		110	??		1		no	no					Submerged
		201	Jul-15	1			yes	no	6253631	325507	-0.65	0.20	Source
		202	Jul-15	1			yes	no	6253643	325528	-0.93	-0.07	Source
		402	Jul-15		1		yes	no	6253627	325505	-0.54	0.31	Source
		403	Jul-15		1		yes	no	6253631	325502	-0.51	0.35	Source
		405	Jul-15		1		yes	no	6253714	325481	-1.39	-0.53	Submerged
		406	Jul-15		1		yes	no	6253671	325494	-0.95	-0.10	Source
		407	Jul-15		1		yes	no	6253631	325510	-0.67	0.19	Source
		501	Sep-15	1			yes	no	6253654	325494	-0.77	0.08	Source
		502	Sep-15	1			yes	no	6253646	325496	-0.63	0.22	Source
		503	Sep-15	1			yes	no					Submerged
		504	Sep-15	1			yes	no	6253622	325505	-0.62	0.24	Source
		505	Sep-15	1			yes	no	6253608	325513	-0.41	0.45	Source
		506	Sep-15	1			yes	no	6253673	325508	0.16	1.02	Submerged
		507	Sep-15	1			yes	no	6253658	325516	-1.18	-0.33	Submerged
		510	Sep-15	1			yes	no	6253649	325521	-1.47	-0.62	Source
		513	Oct-15	1			yes	no					Submerged
		514	Sep-15	1			yes	no	6253637	325527	-0.72	0.13	Source
		517	Oct-15	1			yes	no	6253625	325537	-0.71	0.14	Source
		521	Oct-15	1			yes	no	6253615	325541	-0.51	0.35	Mangrove
		523	Sep-15	1			yes	no	6253683	325485	-0.93	-0.07	Source
		524	Sep-15	1			yes	no	6253701	325480	-1.10	-0.25	Source
		525	Oct-15	1			yes	no	6253661	325492	-0.76	0.10	Source
		526	Oct-15	1			yes	no	6253669	325489	-0.73	0.12	Source
		527	Oct-15	1			yes	no	6253678	325505	-1.01	-0.16	Submerged
		533	Oct-15	1			yes	no	6253651	325495	-0.65	0.20	Source
		540	Oct-15	1			yes	no	6253667	325501	-0.91	-0.06	Submerged
		MB14	Jan-16		1		yes	no	6253646	325518	-0.92	-0.07	Submerged
		MB15	Jan-16		1		yes	no	6253641	325500	-0.69	0.16	Source
		MB16	Jan-16		1		yes	no	6253627	325506	-0.56	0.29	Source
		MB20	Jan-16		1		yes	no	6253639	325506	-0.73	0.12	Source
		717	Feb-16	1			yes	no	6253674	325501	-0.93	-0.07	Submerged
		736	??		1		no	no					Source
		737	??		1		no	no					Source
		738	??		1		no	no					Source
		739	??		1		no	no					Source
		740	??		1		no	no					Source
39	0.28	ESD01	Feb-06	1			yes	yes					Submerged
		HH2_07	Jul-06	1			yes	yes					Submerged
		HSD08	Jan-06	1			yes	yes					Submerged
		SHA12	Dec-10	1	1		yes	yes	6253641	325550	-0.81	0.04	Submerged
		SHA26	Dec-10	1	1		yes	yes	6253667	325540	-1.06	-0.20	Submerged
		SS08	Jul-13	1			yes	yes	6253684	325527	-1.26	-0.40	Submerged
		203	Jul-15	1			yes	no	6253657	325550	-0.98	-0.12	Submerged
		508	Sep-15	1			yes	no	6253684	325535	-0.92	-0.06	Submerged
		511	Sep-15	1			yes	no	6253671	325543	-0.82	0.03	Submerged
		515	Sep-15	1			yes	no	6253662	325548	-1.11	-0.25	Submerged
		522	Sep-15	1			yes	no	6253694	325531	-1.44	-0.58	Submerged
		530	Oct-15	1			yes	no	6253688	325502	-1.20	-0.35	Submerged
		713	Feb-16	1			yes	no	6253667	325537	-1.12	-0.27	Submerged
		714	Feb-16	1			yes	no	6253680	325530	-1.14	-0.29	Submerged
		715	Feb-16	1			yes	no	6253672	325549	-1.19	-0.33	Submerged
		718	Feb-16	1			yes	no	6253690	325493	-1.31	-0.45	Submerged
		809	Mar-16	1			yes	no	6253690	325544	-1.47	-0.61	Submerged
		810	Mar-16	1			yes	no	6253686	325512	-1.32	-0.47	Submerged
40	0.81	ESD03	Feb-06	1			yes	yes					Submerged
		SG14	May-09		1		no	yes					Submerged
		MB21	Jan-16		1		yes	no	6253760	325533	-2.06	-1.20	Submerged
		509	Sep-15	1			yes	no	6253699	325561	-1.20	-0.34	Submerged
		528	Oct-15	1			yes	no	6253704	325524	-1.53	-0.68	Submerged
		529	Oct-15	1			yes	no	6253713	325547	-1.76	-0.90	Submerged
		808	Mar-16	1			yes	no	6253711	325569	-1.55	-0.70	Submerged
		HH2_01	Jul-06	1			yes	yes					Beach
		HH2_08	Jul-06	1			yes	yes					Submerged
		HH2_09	Jul-06	1			yes	yes					Submerged
		HH2_10	Jul-06	1			yes	yes					Beach
		HSD07	Jan-06	1			yes	yes					Submerged
		B8	Oct-07	1			yes	no					Beach
		B11	Oct-07	1			yes	no					Beach
		SHA06	Dec-10	1	1		yes	yes	6253662	325557	-1.15	-0.30	Submerged
		SHA09	Dec-10	1	1		yes	yes	6253650	325572	-0.90	-0.04	Submerged

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Sample date	Hand cores/ push tubes/ vibrocores	Grab samples	Hand auger	Sediment logs available	Lab summary tables available	Location Coordinates		Bathymetry		Exposure Scenario ⁽⁷⁾
									Northing (m)	Easting (m)	RL sea floor (mAHD)	Bathymetry relative to LAT (m)	
41	0.34	SHA10	Dec-10	1	1		yes	yes	6253650	325604	-0.97	-0.12	Submerged
		SHA15	Dec-10	1	1		yes	yes	6253632	325564	-0.58	0.28	Beach
		SHA16	Dec-10	1	1		yes	yes	6253628	325589	-0.54	0.31	Beach
		SS04	Jul-13	1			yes	yes	6253626	325563	-0.53	0.32	Source
		SS07	Jul-13	1			yes	yes	6253650	325566	-0.90	-0.04	Submerged
		SS26	Jul-13	1			yes	yes	6253639	325577	-0.74	0.11	Beach
		108	??		1		no	no					Submerged
		204	Jul-15	1			yes	no	6253673	325583	-1.27	-0.41	Submerged
		512	Sep-15	1			yes	no	6253688	325564	-1.12	-0.27	Submerged
		516	Sep-15	1			yes	no	6253678	325568	-1.17	-0.31	Submerged
		518	Oct-15	1			yes	no	6253645	325559	-0.84	0.02	Submerged
		519	Oct-15	1			yes	no	6253658	325583	-1.18	-0.33	Submerged
		520	Oct-15	1			yes	no	6253675	325593	-1.35	-0.49	Submerged
		716	Feb-16	1			yes	no	6253679	325572	-1.08	-0.22	Submerged
		807	Mar-16	1			yes	no	6253649	325583	-0.97	-0.12	Submerged
		901	Apr-16	1			yes	no	6253667	325586	-1.22	-0.37	Submerged
		904	Apr-16	1			yes	no	6253653	325576	-1.11	-0.25	Submerged
42	0.32	ESD02	Feb-06	1			yes	yes					Submerged
		HH3_4	Jun-07	1			yes	yes					Beach
		HSD02	Jan-06	1			yes	yes					Beach
		HSD03	Jan-06	1			yes	yes					Submerged
		1	Apr-15	1			yes	no	6253642	325655	0.12	0.97	Submerged
		205	Jul-15	1			yes	no	6253690	325604	-1.48	-0.62	Submerged
		811	Mar-16	1			yes	no	6253672	325613	-1.29	-0.43	Submerged
		902	Apr-16	1			yes	no	6253676	325612	-1.30	-0.44	Submerged
43	0.66	SG15	May-09		1		no	yes					Submerged
		HSD01	Jan-06	1			yes	yes					Submerged
		MB9	Jan-16		1		yes	no	6253712	325615	-1.66	-0.80	Submerged
Total	25.33												

Legend:

	Data digitised from available figures
	Sample not laboratory tested for PAHs or TPH
	TOC measurement not available - used average value of 2.8%
	Data not available from investigation reports

Notes:

- (1) TPH = C6 - C36 fractions
- (2) Detection limit varies between 2 and 10mg/kg. Half the detection limit was used in calculations.
- (3) Detection limit 100 mg/kg. Half the detection limit was used in calculations.
- (4) Maximum and minimum TOC used to normalise results was 10% and 0.2%, respectively (refer Section 1.2 of 2013 sediment guidelines). Where TOC was not measured, the average of the URS (2006) values was used (TOC = 2.8%)
- (5) Objectionable aesthetic impacts defined as an oily gasworks appearance, moderate-strong PAH odour, sheen.
- (6) Bathymetric levels based on 0m AHD = +0.855m LAT
- (7) Exposure scenarios comprise source (sediments adjacent to contaminant source area), beach, mangrove, and submerged (seafloor below LAT)
- (8) BaP TEQ Health criteria for shallow sediments are: Sediments adjacent to source areas on tidal flat = 1 mg/kg; Beach area on tidal flat = 60 mg/kg; Mangrove area on tidal flat = 120 mg/kg; Submerged area = not relevant

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 50mm (mg/kg)			Highest BaP (TEQ) in upper 500mm			Highest normalised total PAHs in upper 300mm			
			Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Lab result (mg/kg)	Sample Depth (m)	Exceedance of Health Criteria ⁽⁸⁾	Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Sample Depth (m)
1	0.57	ESD33	78.00	1.50	52.00	15.52	0.02-0.10	no	78.00	1.50	52.00	0.0-0.02
2	0.57	ESD34	17.00	2.90	5.86	3.01	0.0-0.02	no	17.00	2.90	5.86	0.0-0.02
3	0.60	ESD35	10.00	2.30	4.35	1.52	0.0-0.02	no	10.00	2.30	4.35	0.0-0.02
4	0.55	ESD32	37.00	3.70	10.00	18.74	0.30-0.40	no	36.00	3.40	10.59	0.10-0.20
5	0.82	ESD31	13.00	3.40	3.82	1.93	0.0-0.02	no	13.00	3.40	3.82	0.0-0.02
6	0.69	ESD30	13.00	3.30	3.94	1.99	0.02-0.10	no	13.00	3.30	3.94	0.02-0.10
7	0.31	HSD18	57.70	2.80	20.61	11.08	0.10-0.20	no	57.70	2.80	20.61	0.10-0.20
8	0.28	ESD29	265.00	2.50	106.00	77.07	0.10-0.20	no	673.00	5.00	134.60	0.10-0.20
9	0.35	HSD17	0.00	2.80	0.00	0.00	0.0-0.10	no	0.00	2.80	0.00	0.0-0.10
10	0.59	ESD26	78.00	1.00	78.00	10.51	0.35-0.50	no	78.00	1.00	78.00	0.0-0.02
		HSD16	23.30	2.80	8.32	2.45	0.0-0.10	no	23.30	2.80	8.32	0.0-0.10
11	1.03	ESD28	10.00	3.20	3.13	1.53	0.02-0.10	no	10.00	3.20	3.13	0.0-0.02
12	0.78	ESD27	10.00	1.80	5.56	1.41	0.02-0.10	no	10.00	1.80	5.56	0.02-0.10
13	1.14	ESD24	5.00	1.70	2.94	0.78	0.02-0.10	no	5.00	1.70	2.94	0.02-0.10
14	0.77	ESD23	8.00	2.60	3.08	1.21	0.0-0.02	no	8.00	2.60	3.08	0.0-0.02
15	1.06	ESD21	55.00	2.90	18.97	10.08	0.0-0.02	no	55.00	2.90	18.97	0.0-0.02
		KBR4	42	9.0	4.67	7.90	0.0-0.10	no	42	9.0	4.67	0.0-0.10
		KBR5	20	5.8	3.45	4.20	0.0-0.10	no	20	5.8	3.45	0.0-0.10
16	0.70	ESD22	10.00	3.40	2.94	1.54	0.0-0.02	no	10.00	3.40	2.94	0.0-0.02
17	0.62	ESD20	11.00	3.10	3.55	1.83	0.0-0.02	no	11.00	3.10	3.55	0.0-0.02
18	0.58	ESD19	22.00	2.10	10.48	3.66	0.02-0.06	no	22.00	2.10	10.48	0.02-0.06
19	0.71	ESD17	52.00	1.60	32.50	7.75	0.0-0.02	no	52.00	1.60	32.50	0.0-0.02
		SG1	129.00	46.90	12.90							
		SG2	26.00	2.95	8.81							
20	0.96	ESD18	14.00	1.40	10.00	2.20	0.02-0.10	no	14.00	1.40	10.00	0.02-0.10
		SG3	39.00	4.61	8.46							
		KBR6	16	4.7	3.40	3.70	0.0-0.10	no	16	4.7	3.40	0.0-0.10
		KBR12	20	0.7	28.57	4.40	0.0-0.10	no	20	0.7	28.57	0.0-0.10
21	0.53	ESD12	1442.00	5.10	282.75	103.98	0.02-0.10	no	1442.00	5.10	282.75	0.02-0.10
		HSD14	0.50	2.80	0.18	1.01	0.0-0.10	no	6.00	2.80	2.14	0.0-0.10
		HSD15	6.00	2.80	2.14	1.01	0.0-0.10	no	6.00	2.80	2.14	0.0-0.10
		PC1	186.00	7.26	25.62	35.02	0.02-0.10	no	110.00	3.13	35.14	0.20-0.40
		PC2	31.00	2.83	10.95	7.13	0.25-0.40	no	40.00	2.70	14.81	0.25-0.40
		SG4	379.00	46.30	37.90							
22	0.443	ESD16	37.00	2.90	12.76	7.11	0.02-0.10	no	29.00	2.20	13.18	0.25-0.45
		PC3	25.00	4.50	5.56	4.32	0.02-0.10	no	24.00	4.02	5.97	0.1-0.25
		PC4	23.00	4.13	5.57	3.88	0.02-0.10	no	23.00	4.13	5.57	0.02-0.10
23	0.40	ESD15	23.00	3.00	7.67	4.92	0.20-0.30	no	28.00	2.90	9.66	0.20-0.30
		KBR11	16	2.8	5.71	3.40	0.0-0.10	no	16	2.8	5.71	0.0-0.10
24	0.68	PC5	481.00	3.06	157.19	42.33	0.02-0.10	no	481.00	3.06	157.19	0.02-0.10
		PC6	40.00	5.28	7.58	11.42	0.25-0.40	no	59.00	5.19	11.37	0.25-0.40
		PC9	330.00	15.30	33.00	54.30	0.0-0.02	no	292.00	7.57	38.57	0.30-0.40
		PC10	90.00	2.80	32.14	24.12	0.20-0.35	no	137.00	5.90	23.22	0.20-0.35
		SG6	106.00	47.00	10.60							
		SW2	31.00	2.80	11.07							
		MB26				14.00	0.0-0.125	no	57.00	7.50	7.60	0.0-0.125
		705										
		707				18.00	0.30-0.60	no	2.90	6.80	0.43	0.0-0.30
		708				35.00	0.30-0.60	no	2.00	7.90	0.25	0.0-0.30
		709				67.00	0.30-0.60	no	190.00	5.80	32.76	0.0-0.30
		710				58.00	0.30-0.60	no	170.00	44.00	17.00	0.0-0.30
25	0.42	801				88.00	0.30-0.60	no	110.00	38.00	11.00	0.0-0.30
		802				38.00	0.30-0.60	no	81.00	5.40	15.00	0.0-0.30
25	0.42	ESD13	34.00	2.80	12.14	12.03	0.30-0.40	no	34.00	2.80	12.14	0.0-0.02
		PC7	43.00	2.80	15.36	14.49	0.25-0.45	no	79.00	3.43	23.03	0.25-0.45
		SG5	32.00	5.64	5.67							
		SG7	58.00	5.77	10.05							
26	0.66	803				15.00	0.0-0.30	no	75.00	3.40	22.06	0.0-0.30
		ESD14	20.00	2.80	7.14	3.62	0.0-0.02	no	20.00	2.80	7.14	0.02-0.10
		PC8	26.00	4.29	6.06	7.59	0.25-0.40	no	41.00	5.08	8.07	0.25-0.40
		PC29	95.00	2.80	33.93	17.86	0.02-0.10	no	95.00	2.80	33.93	0.02-0.10
27	0.20	PC11	85.00	2.80	30.36	36.26	0.25-0.50	no	383.00	2.80	136.79	0.25-0.50
		PC12	64.00	4.99	12.83	58.87	0.25-0.40	no	729.00	3.11	234.41	0.25-0.40
		804				40.00	0.30-0.60	no	130.00	5.20	25.00	0.0-0.30
		ESD09	682.00	3.80	179.47	236.73	0.30-0.50	no	682.00	3.80	179.47	0.0-0.02
		B9										
		B10										
		PC14	4034.00	49.10	403.40	147.50	0.02-0.10	no	3388.00	2.80	1210.00	0.30-0.50
		PC19	658.00	2.80	235.00	82.72	0.02-0.10	no	658.00	2.80	235.00	0.02-0.10
		SG8	2025.00	27.80	202.50							
		SHB21	420.60	3.30	127.45							
		SHB22										
		SHB23	208.60	1.30	160.46							
SHB24	381.10	6.20	61.47									
SHB25												

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 50mm (mg/kg)			Highest BaP (TEQ) in upper 500mm			Highest normalised total PAHs in upper 300mm			
			Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Lab result (mg/kg)	Sample Depth (m)	Exceedance of Health Criteria ⁽⁸⁾	Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Sample Depth (m)
28	0.401	SS11										
		SS12										
		SS13										
		410				150.00	0.0-0.15	no	620.00	2.80	221.43	0.0-0.30
		550										
		555										
		557				2.90	0.10-0.40	no	15.00	2.80	5.36	0.10-0.40
		561				65.00	0.20-0.40	no	1300.00	2.80	464.29	0.20-0.40
		MB1				58.00	0.0-0.125	no	830.00	26.00	83.00	0.0-0.125
		MB2				30.00	0.0-0.125	no	150.00	1.50	100.00	0.0-0.125
		MB3				65.00	0.0-0.125	no	370.00	42.00	37.00	0.0-0.125
		701				310.00	0.30-0.60	no	3100.00	15.00	310.00	0.0-0.30
		702				160.00	0.30-0.60	no	1400.00	15.00	140.00	0.0-0.30
		704				81.00	0.30-0.60	no	730.00	9.40	77.66	0.0-0.30
		706				56.00	0.30-0.60	no	120.00	9.60	12.50	0.0-0.30
		720										
		731				88.00	0.0-0.125	no	480.00	13.00	48.00	0.0-0.125
		733				750.00	0.0-0.125	no	13000.00	40.00	1300.00	0.0-0.125
		734				130.00	0.0-0.125	no	850.00	32.00	85.00	0.0-0.125
		735				5.40	0.0-0.125	no	28.00	3.10	9.03	0.0-0.125
		812				57.00	0.0-0.30	no	500.00	1.90	263.16	0.0-0.30
		903				20.00	0.30-0.60	yes	3.20	2.10	1.52	0.0-0.30
29	0.15	PC15	1570.00	2.80	560.71	124.79	0.30-0.50	no	1570.00	2.80	560.71	0.02-0.10
		PC20	44.00	2.80	15.71	6.43	0.30-0.50	no	44.00	2.80	15.71	0.02-0.10
		560				25.00	0.40-0.70	no				
		703				64.00	0.30-0.60	no	70.00	4.90	14.29	0.0-0.30
		712				5.00	0.0-0.30	no	26.00	3.00	8.67	0.0-0.30
30	0.73	ESD10	12.00	2.80	4.29	19.00	0.40-0.50	no	12.00	2.80	4.29	0.02-0.10
		SG9	48.00	3.96	12.12							
		SG10	15.00	3.12	4.81							
		551										
		MB4				0.60	0.0-0.125	no	3.40	4.50	0.76	0.0-0.125
31	0.42	PC16	21.00	2.80	7.50	5.48	0.30-0.60	no	21.00	2.80	7.50	0.02-0.10
		PC17	38.00	2.80	13.57	7.22	0.0-0.02	no	38.00	2.80	13.57	0.0-0.02
		PC21	101.00	2.80	36.07	12.55	0.0-0.02	no	101.00	2.80	36.07	0.0-0.02
		PC22	29.00	2.80	10.36	4.51	0.02-0.10	no	29.00	2.80	10.36	0.02-0.10
		411				8.20	0.0-0.30	no	38.00	2.80	13.57	0.0-0.30
		554										
		562										
		MB5				3.30	0.0-0.125	no	18.00	3.70	4.86	0.0-0.125
		MB6				10.00	0.0-0.125	no	47.00	5.10	9.22	0.0-0.125
		805				23.00	0.30-0.60	no	59.00	11.00	5.90	0.0-0.30
32	0.55	ESD11	11.00	3.10	3.55	2.98	0.20-0.40	no	17.00	3.10	5.48	0.20-0.40
		408				2.50	0.0-0.15	no	13.00	2.80	4.64	0.0-0.30
		KBR9	18	2.6	6.92	4.60	0.0-0.10	no	18.00	2.60	6.92	0.0-0.10
33	0.43	ESD07	41.00	2.40	17.08	19.03	0.30-0.40	no	104.00	1.90	54.74	0.15-0.25
		PC25	32.00	2.80	11.43	55.96	0.15-0.25	no	516.00	2.80	184.29	0.15-0.25
		SG11	49.00	5.12	9.57							
		SG16	103.00	5.81	17.73							
		SW1	230.00	2.80	82.14							
		711				12.00	0.0-0.30	no	67.00	3.80	17.63	0.0-0.30
34	0.60	ESD06	26.00	2.90	8.97	13.26	0.30-0.40	no	26.00	2.90	8.97	0.02-0.10
		PC23	31.00	2.80	11.07	5.82	0.0-0.02	no	31.00	2.80	11.07	0.0-0.02
		PC24	29.00	2.80	10.36	5.71	0.0-0.02	no	29.00	2.80	10.36	0.0-0.02
		PC26	37.00	2.80	13.21	6.52	0.0-0.02	no	37.00	2.80	13.21	0.0-0.02
		PC27	35.00	3.46	10.12	15.92	0.20-0.35	no	83.00	2.80	29.64	0.20-0.35
		SG12	22.00	3.12	7.05							
35	0.49	ESD08	23.00	2.60	8.85	17.90	0.30-0.35	no	23.00	2.60	8.85	0.02-0.10
		KBR8	5.2	2.9	1.79	1.60	0.0-0.10	no	5.20	2.90	1.79	0.0-0.10
36	0.38	ESD04	56.00	2.10	26.67	26.38	0.20-0.40	no	144.00	3.10	46.45	0.20-0.40
		MB7				10.00	0.0-0.125	no	45.00	7.40	6.08	0.0-0.125
37	0.91	ESD05	71.00	3.30	21.52	12.97	0.0-0.02	no	71.00	3.30	21.52	0.0-0.02
		SG13	82.00	4.51	18.18							
		MB8				7.70	0.0-0.125	no	34.00	6.20	5.48	0.0-0.125
		MB10				4.50	0.0-0.125	no	21.00	5.90	3.56	0.0-0.125
		KBR7	9.2	2.7	3.41	1.80	0.0-0.10	no	9.20	2.70	3.41	0.0-0.10
		HH2_02	214.51	2.80	76.61	58.62	0.0-0.02	no	441.89	2.80	157.82	0.10-0.20
		HH2_03	206.51	2.80	73.75	112.58	0.0-0.02	no	206.51	2.80	73.75	0.10-0.20
		HH2_04	287.57	2.80	102.70	121.05	0.10-0.20	yes	1168.94	2.80	417.48	0.10-0.20
		HH2_05	1489.56	2.80	531.99	156.14	0.10-0.20	yes	1489.56	2.80	531.99	0.0-0.1
		HH2_06	499.78	2.80	178.49	119.51	0.10-0.20	no	1794.1	2.80	640.75	0.10-0.20
		HH3_1	0.70	2.80	0.25							
		HH3_2	18.90	2.80	6.75	5.82	0.10-0.20	no	33.00	2.80	11.79	0.10-0.20
		HH3_3	14.70	2.80	5.25	59.95	0.10-0.20	no	443.10	2.80	158.25	0.10-0.20

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 50mm (mg/kg)			Highest BaP (TEQ) in upper 500mm			Highest normalised total PAHs in upper 300mm			
			Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Lab result (mg/kg)	Sample Depth (m)	Exceedance of Health Criteria ⁽⁸⁾	Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Sample Depth (m)
38	0.829	HH3_5	16.40	2.80	5.86	12.26	0.10-0.20	no	73.00	2.80	26.07	0.10-0.20
		HSD04	nd	2.80	0.00	1.34	0.1-0.2	no	7.3	2.80	2.61	0.10-0.20
		HSD05	1.9	2.80	0.68	6.85	0.1-0.2	no	41.8	2.80	14.93	0.10-0.20
		HSD06	114.3	2.80	40.82	34.94	0.1-0.2	no	225.1	2.80	80.39	0.10-0.20
		HSD09	122.3	2.80	43.68	18.99	0.0-0.1	no	122.3	2.80	43.68	0.0-0.1
		HSD10	68.9	2.80	24.61	7.68	0.0-0.1	yes	68.9	2.80	24.61	0.0-0.1
		HSD11	188.7	2.80	67.39	12.19	0.0-0.1	yes	188.7	2.80	67.39	0.0-0.1
		HSD12	240.4	2.80	85.86	25.01	0.0-0.1	no	240.4	2.80	85.86	0.0-0.1
		HSD13	114.9	2.80	41.04	20.91	0.0-0.1	no	114.9	2.80	41.04	0.0-0.1
		B1										
		B2										
		B3										
		B4										
		B5										
		B6										
		B7										
		SHA01	46.30	2.30	20.13	11.47	0.0-0.20	yes				
		SHA02				53.68	0.50-0.60	no				
		SHA03										
		SHA04										
		SHA05	144.20	4.30	33.53							
		SHA07										
		SHA08										
		SHA11	1662.60	5.00	332.52							
		SHA13	70.00	2.70	25.93							
		SHA14	880.90	4.80	183.52							
		SHA17	6.70	1.40	4.79							
		SHA18	128.80	3.40	37.88							
		SHA19	199.70	1.70	117.47							
		SHA20				53.73	0.20-0.40	no	282	14.00	28.20	0.20-0.40
		SHA27										
		SS01	0.28	0.12	1.40	2.00	0.50-0.60	no	11.00	0.30	36.67	0.50-0.60
		SS02	160.00	1.80	88.89	40.00	0.50-0.60	no	160.00	1.80	88.89	0.0-0.10
		SS03	36.00	2.20	16.36	95.00	0.50-0.60	no	720.00	5.10	141.18	0.50-0.60
		SS05										
		SS06	1.80	1.80	1.00	0.00	0.0-0.10	no	1.90	1.10	1.73	0.50-0.60
		SS09										
		SS10										
		SS14	130.00	3.20	40.63	19.00	0.0-0.10	no	130.00	3.20	40.63	0.0-0.10
		SS15	70.00	1.50	46.67	19.00	0.50-0.60	no	130.00	2.00	65.00	0.50-0.60
		SS16	25.00	0.86	29.07	23.00	0.50-0.60	no	200.00	1.10	181.82	0.50-0.60
		SS17	120.00	1.30	92.31	22.00	0.0-0.10	no	120.00	1.30	92.31	0.0-0.10
		SS18	40.00	0.74	54.05	66.00	0.50-0.60	no	440.00	5.70	77.19	0.50-0.60
		SS19	0.35	0.12	1.75	44.00	0.50-0.60	no	280.00	2.90	96.55	0.50-0.60
		SS20	nd	nd	0.00	0.00	0.0-0.10	no	1.70	nd	8.50	0.50-0.60
		SS21	0.06	0.16	0.30	1.00	0.50-0.60	no	7.40	0.180	37.00	0.50-0.60
		SS22	nd	0.12	0.00	2.00	0.50-0.60	no	11.00	0.560	19.64	0.50-0.60
		SS23	6.10	0.16	30.50	2.00	0.50-0.60	no	9.50	0.220	43.18	0.50-0.60
		SS24	41.00	2.90	14.14	8.00	0.0-0.10	no	41.00	2.900	14.14	0.0-0.10
		SS25	83.00	0.68	122.06	15.00	0.0-0.10	no	83.00	0.680	122.06	0.0-0.10
		2										
		3										
		4				16.18	0.0-0.30	no	70.00	3.40	20.59	0.0-0.30
		5				0.58	0.0-0.30	no	3.00	0.16	18.75	0.0-0.30
		6				8.87	0.0-0.30	no	37.00	4.30	8.60	0.0-0.30
		8				21.71	0.21-0.40	no	130.00	13.00	10.00	0.21-0.40
		9				45.84	0.0-0.30	yes	320.00	24.00	32.00	0.0-0.30
		11				23.00	0.29-0.49	no	12.00	0.24	50.00	0.0-0.29
		12				24.33	0.29-0.50	no	120.00	8.20	14.63	0.29-0.50
		13				25.50	0.0-0.30	no	34.00	0.72	47.22	0.40-0.70
		14										
		15										
		16				15.00	0.26-0.55	yes	157.60	2.80	56.29	0.26-0.55
		17										
		19										
		20				0.04	0.0-0.30	no	0.24	2.80	0.09	0.0-0.30
		23										
		24										
		25				78.00	0.30-0.60	yes				
		26										
		100				5.80	0.0-0.30	no	37.00	2.30	16.09	0.0-0.30
		101				1.40	0.0-0.30	no	7.90	0.31	25.48	0.0-0.30
		102				12.00	0.0-0.30	no	63.00	15.00	6.30	0.0-0.30
		103				18.00	0.0-0.30	no	93.00	22.00	9.30	0.0-0.30
		104				13.00	0.0-0.30	no	67.00	17.00	6.70	0.0-0.30

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 50mm (mg/kg)			Highest BaP (TEQ) in upper 500mm			Highest normalised total PAHs in upper 300mm			
			Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Lab result (mg/kg)	Sample Depth (m)	Exceedance of Health Criteria ⁽⁸⁾	Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Sample Depth (m)
		105				77.00	0.0-0.30	no	610.00	18.00	61.00	0.0-0.30
		106				26.00	0.0-0.30	no	190.00	17.00	19.00	0.0-0.30
		107				17.00	0.0-0.30	no	97.00	25.00	9.70	0.0-0.30
		109				120.00	0.0-0.125	no	630.00	34.00	63.00	0.0-0.125
		110				40.00	0.0-0.125	no	170.00	14.00	17.00	0.0-0.125
		201										
		202										
		402				9.80	0.0-0.30	yes	110.00	2.80	39.29	0.0-0.30
		403				210.00	0.0-0.30	yes	1900.00	2.80	678.57	0.0-0.30
		405				29.00	0.0-0.30	no	140.00	2.80	50.00	0.0-0.30
		406				85.00	0.0-0.15	yes	610.00	2.80	217.86	0.0-0.30
		407				27.00	0.0-0.30	yes	160.00	2.80	57.14	0.0-0.30
		501										
		502										
		503										
		504										
		505										
		506										
		507				160.00	0.40-0.70	no				
		510										
		513										
		514										
		517				62.00	0.0-0.30	yes	530.00	2.80	189.29	0.0-0.30
		521										
		523										
		524				2.00	0.30-0.60	yes				
		525				0.07	0.20-0.44	no	0.74	2.80	0.26	0.20-0.44
		526										
		527										
		533				24.00	0.40-0.70	yes				
		540				170.00	0.0-0.20	no	1700.00	2.80	607.14	0.0-0.20
		MB14				170.00	0.0-0.125	no	1400.00	25.00	140.00	0.0-0.125
		MB15				30.00	0.0-0.125	yes	290.00	20.00	29.00	0.0-0.125
		MB16				6.10	0.0-0.125	yes	59.00	27.00	5.90	0.0-0.125
		MB20				140.00	0.0-0.125	yes	1300.00	45.00	130.00	0.0-0.125
		717				70.00	0.0-0.30	no	930.00	12.00	93.00	0.0-0.30
		736				53.00	0.0-0.125	yes	390.00	20.00	39.00	0.0-0.125
		737				62.00	0.0-0.125	yes	430.00	26.00	43.00	0.0-0.125
		738				41.00	0.0-0.125	yes	240.00	22.00	24.00	0.0-0.125
		739				56.00	0.0-0.125	yes	370.00	27.00	37.00	0.0-0.125
		740				47.00	0.0-0.125	yes	250.00	15.00	25.00	0.0-0.125
39	0.28	ESD01	816.00	3.80	214.74	149.59	0.02-0.10	no	816.00	3.80	214.74	0.0-0.02
		HH2_07	215.35	2.80	76.91	157.36	0.35-0.50	no	849.2	2.80	303.29	0.1-0.2
		HSD08	1114.6	2.80	398.07	128.33	0.0-0.1	no	1114.6	2.80	398.07	0.0-0.1
		SHA12										
		SHA26										
		SS08										
		203										
		508										
		511				150.00	0.10-0.40	no	3600.00	3.40	1058.82	0.10-0.40
		515				12.00	0.125-0.40	no	190.00	3.60	52.78	0.125-0.40
		522										
		530				0.30	0.40-0.70	no				
		713				180.00	0.30-0.60	no	610.00	21.00	61.00	0.0-0.30
		714				41.00	0.0-0.30	no	380.00	16.00	38.00	0.0-0.30
		715				130.00	0.0-0.30	no	1900.00	9.10	208.79	0.0-0.30
		718										
40	0.81	809				66.00	0.0-0.30	no	520.00	22.00	52.00	0.0-0.30
		810				130.00	0.30-0.60	no	710.00	13.00	71.00	0.0-0.30
		ESD03	61.00	3.10	19.68	39.97	0.40-0.50	no	61.00	3.10	19.68	0.20-0.30
		SG14	107.00	6.88	15.55							
		MB21				1.00	0.0-0.125	no	4.60	7.20	0.64	0.0-0.125
		509										
		528										
		529				11.00	0.40-0.70	no				
		808				54.00	0.30-0.60	no	0.12	20.00	0.01	0.0-0.30
		HH2_01	171.31	2.80	61.18	25.29	0.40-0.50	no	171.31	2.80	61.18	0.0-0.1
		HH2_08	201.6	2.80	72.00	74.05	0.40-0.50	no	201.6	2.80	72.00	0.1-0.2
		HH2_09	379.88	2.80	135.67	144.90	0.1-0.2	no	1849.4	2.80	660.50	0.1-0.2
		HH2_10	75.33	2.80	26.90	24.30	0.1-0.2	no	168.87	2.80	60.31	0.1-0.2
		HSD07	97.7	2.80	34.89	112.34	0.1-0.2	no	1215.1	2.80	433.96	0.1-0.2
		B8										
		B11										
		SHA06										
		SHA09	95.40	4.60	20.74	17.60	0.1-0.2	no	95.40	4.30	22.19	0.0-0.10

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 50mm (mg/kg)			Highest BaP (TEQ) in upper 500mm			Highest normalised total PAHs in upper 300mm			
			Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Lab result (mg/kg)	Sample Depth (m)	Exceedance of Health Criteria ⁽⁸⁾	Lab result (mg/kg)	TOC ⁽⁴⁾ (%)	Normalised to 1% TOC (mg/kg)	Sample Depth (m)
41	0.34	SHA10										
		SHA15	106.30	2.80	37.96	22.77	0.1-0.2	no	106.30	2.80	37.96	0.0-0.10
		SHA16	48.50	1.70	28.53	9.70	0.1-0.2	no	48.50	1.70	28.53	0.0-0.10
		SS04	320.00	37.00	32.00	55.00	0.0-0.10	yes	200.00	7.50	26.67	0.50-0.60
		SS07										
		SS26	2.60	0.83	3.13	0.00	0.0-0.10	no	2.60	0.830	3.13	0.0-0.10
		108				23.00	0.0-0.125	no	100.00	14.00	10.00	0.0-0.125
		204										
		512										
		516				87.00	0.30-0.60	no				
		518										
		519				5.00	0.40-0.70	no				
		520				2.80	0.4-0.7	no				
		716				62.00	0.0-0.30	no	340.00	23.00	34.00	0.0-0.30
		807				23.00	0.0-0.30	no	170.00	11.00	17.00	0.0-0.30
		901				16.00	0.0-0.30	no	92.00	8.60	10.70	0.0-0.30
		904				57.00	0.0-0.30	no	370.00	12.00	37.00	0.0-0.30
42	0.32	ESD02	14.00	0.60	23.33	2.66	0.0-0.2	no	14.00	0.60	23.33	0.0-0.02
		HH3_4	16.80	2.80	6.00	2.91	0.0-0.10	no	16.80	2.80	6.00	0.0-0.10
		HSD02	15.70	2.80	5.61	4.05	0.10-0.20	no	22.30	2.80	7.96	0.10-0.20
		HSD03	44.90	2.80	16.04	20.93	0.10-0.20	no	103.00	2.80	36.79	0.10-0.20
		1										
		205										
		811				1.00	0.0-0.30	no	10.00	3.00	3.33	0.0-0.30
		902				11.00	0.0-0.30	no	53.00	8.70	6.09	0.0-0.30
43	0.66	SG15	52.00	6.43	8.09							
		HSD01	24.10	2.80	8.61	4.66	0.0-0.10	no	24.10	2.80	8.61	0.0-0.10
		MB9				8.10	0.0-0.125	no	38.00	14.00	3.80	0.0-0.125
Total	25.33											

Legend:

	Data digitised from available figures
	Sample not laboratory tested for PAHs or TPH
	TOC measurement not available - used average value of 2.8%
	Data not available from investigation reports

Notes:

- (1) TPH = C6 - C36 fractions
- (2) Detection limit varies between 2 and 10mg/kg. Half the detection limit was used in calculations.
- (3) Detection limit 100 mg/kg. Half the detection limit was used in calculations.
- (4) Maximum and minimum TOC used to normalise results was 10% and 0.2%, respectively (refer Section 1.2 of 2013 sediment guidelines). Where TOC was not measured, the average of the URS (2006) values was used (TOC = 2.8%)
- (5) Objectionable aesthetic impacts defined as an oily gasworks appearance, moderate-strong PAH odour, sheen.
- (6) Bathymetric levels based on 0m AHD = +0.855m LAT
- (7) Exposure scenarios comprise source (sediments adjacent to contaminant source area), beach, mangrove, and submerged (seafloor below LAT)
- (8) BaP TEQ Health criteria for shallow sediments are: Sediments adjacent to source areas on tidal flat = 1 mg/kg; Beach area on tidal flat = 60 mg/kg; Mangrove area on tidal flat = 120 mg/kg; Submerged area = not relevant

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised TPH ⁽¹⁾ in upper 300mm					Objectionable aesthetic impacts in upper 400mm ⁽⁵⁾ (refer logs)
			C6-C9 Lab result ⁽²⁾ (mg/kg)	C10-C36 Lab result ⁽³⁾ (mg/kg)	TOC ⁽⁴⁾ (%)	TPH normalised to 1% TOC (mg/kg)	Sample Depth (m)	
1	0.57	ESD33	nd	2350.00	1.50	1567.33	0.02-0.10	yes
2	0.57	ESD34	nd	650.00	3.20	203.44	0.02-0.10	no
3	0.60	ESD35	nd	120.00	2.30	52.61	0.00-0.02	no
4	0.55	ESD32	nd	2220.00	3.40	653.24	0.10-0.20	no
5	0.82	ESD31	nd	60.00	3.50	17.43	0.02-0.10	no
6	0.69	ESD30	nd	60.00	3.30	18.48	0.02-0.10	no
7	0.31	HSD18	nd	1340.00	2.80	478.93	0.10-0.20	yes
8	0.28	ESD29	10.00	18660.00	5.00	3732.20	0.10-0.20	yes
9	0.35	HSD17	nd	nd	2.80	0.00	0.0-0.10	no
10	0.59	ESD26	nd	1360.00	1.00	1361.00	0.0-0.02	no
		HSD16	nd	nd	2.80	0.00	0.0-0.10	no
11	1.03	ESD28	nd	nd	3.20	0.00	0.0-0.02	no
12	0.78	ESD27	nd	nd	1.80	0.00	0.02-0.10	no
13	1.14	ESD24	nd	nd	1.70	0.00	0.02-0.10	no
14	0.77	ESD23	nd	420.00	2.60	161.92	0.0-0.02	no
15	1.06	ESD21	nd	1240.00	2.50	496.40	0.02-0.10	no
		KBR4	nd	385	7.9	50.32	0.0-0.10	no
		KBR5	nd	125	4.5	30.56	0.0-0.10	no
16	0.70	ESD22	nd	390.00	3.40	115.00	0.0-0.02	no
17	0.62	ESD20	nd	560.00	3.50	160.29	0.02-0.10	no
18	0.58	ESD19	nd	460.00	2.10	219.52	0.02-0.06	no
19	0.71	ESD17	nd	370.00	1.60	231.88	0.0-0.02	no
		SG1						
		SG2						
20	0.96	ESD18	nd	210.00	1.20	175.83	0.25-0.40	no
		SG3						
		KBR6	nd	355	4.7	81.67	0.0-0.10	yes
		KBR12	nd	385	0.7	88.33	0.0-0.10	no
21	0.53	ESD12	nd	23800.00	5.10	4666.86	0.02-0.10	yes
		HSD14	nd	nd	2.80	0.00	0.0-0.10	no
		HSD15	nd	nd	2.80	0.00	0.0-0.10	no
		PC1	nd	1905.00	3.13	610.22	0.2-0.4	no
		PC2	nd	805.00	2.70	300.00	0.25-0.40	no
		SG4						
22	0.443	ESD16	nd	620.00	2.90	214.14	0.02-0.10	no
		PC3	nd	1165.00	4.02	291.04	0.1-0.25	yes
		PC4	nd	995.00	4.13	242.13	0.02-0.1	yes
23	0.40	ESD15	nd	370.00	3.00	123.67	0.0-0.02	no
		KBR11	nd	295	2.8	68.33	0.0-0.10	no
24	0.68	PC5	nd	3530.00	3.06	1155.23	0.02-0.10	yes
		PC6	nd	1175.00	5.19	227.36	0.25-0.40	no
		PC9	nd	4060.00	12.80	406.50	0.02-0.10	yes
		PC10	nd	4010.00	5.90	680.51	0.20-0.35	yes
		SG6						
		SW2						
		MB26	nd	1960.00	7.50	263.00	0.0-0.125	
		705						
		707	nd	nd	6.80	0.00	0.0-0.30	yes
		708	nd	nd	7.90	0.00	0.0-0.30	yes
		709	nd	2672.00	5.80	462.84	0.0-0.30	yes
		710	nd	2416.00	44.00	242.85	0.0-0.30	yes
		801		2407.00	38.00	241.95	0.0-0.30	yes
		802		2364.00	5.40	440.09	0.0-0.30	yes
25	0.42	ESD13	nd	1170.00	3.10	377.74	0.02-0.10	no
		PC7	nd	2100.00	3.43	613.70	0.25-0.45	no
		SG5						
		SG7						
		803	nd	1160.00	3.40	344.85	0.0-0.30	yes
26	0.66	ESD14	nd	280.00	2.80	100.36	0.02-0.10	no
		PC8	nd	945.00	5.08	187.01	0.25-0.40	yes
		PC29	nd	1205.00	2.80	432.14	0.02-0.10	no
27	0.20	PC11	nd	4620.00	2.80	1651.79	0.25-0.50	yes
		PC12	nd	15020.00	3.11	4831.19	0.25-0.40	no
		804		3193.00	5.20	616.44	0.0-0.30	yes
		ESD09	7.00	22060.00	4.20	5254.05	0.02-0.10	yes
		B9						yes
		B10						yes
		PC14	51.00	43400.00	49.10	4345.10	0.02-0.10	yes
		PC19	nd	10730.00	2.80	3833.93	0.02-0.10	yes
		SG8						
		SHB21						yes
		SHB22						yes
		SHB23						yes
		SHB24						yes
		SHB25						no

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised TPH ⁽¹⁾ in upper 300mm					Objectionable aesthetic impacts in upper 400mm ⁽⁵⁾ (refer logs)
			C6-C9 Lab result ⁽²⁾ (mg/kg)	C10-C36 Lab result ⁽³⁾ (mg/kg)	TOC ⁽⁴⁾ (%)	TPH normalised to 1% TOC (mg/kg)	Sample Depth (m)	
28	0.401	SS11						yes
		SS12						no
		SS13						yes
		410	nd	14380.00	2.80	5140.18	0.0-0.30	yes
		550						yes
		555						yes
		557	nd	110.00	2.80	43.75	0.10-0.40	no
		561	nd	9900.00	2.80	3540.18	0.20-0.40	yes
		MB1	nd	6130.00	26.00	614.25	0.0-0.30	yes
		MB2	nd	2178.00	1.50	1460.33	0.0-0.125	
		MB3	nd	7750.00	42.00	72.55	0.0-0.125	yes
		701	97	39300.00	15.00	3939.70	0.0-0.30	yes
		702	nd	16100.00	15.00	1611.25	0.0-0.30	yes
		704	nd	11610.00	9.40	1236.44	0.0-0.30	yes
		706	nd	4070.00	9.60	425.26	0.0-0.30	yes
		720						no
		731	nd	8100.00	13.00	811.25	0.0-0.125	
		733	160	96000.00	40.00	9616.00	0.0-0.125	
		734	nd	13690.00	32.00	1370.25	0.0-0.125	
		735	nd	840.00	3.10	275.00	0.0-0.125	
		812	nd	8510.00	1.90	4485.53	0.0-0.30	yes
		903	nd	nd	2.10	0.00	0.0-0.30	no
29	0.15	PC15	66.00	28570.00	2.80	10227.14	0.02-0.10	yes
		PC20	nd	1155.00	2.80	414.29	0.02-0.10	no
		560						yes
		703	nd	1480.00	4.90	304.59	0.0-0.30	no
		712	nd	540.00	3.00	184.17	0.0-0.30	no
30	0.73	ESD10	nd	430.00	2.60	165.77	0.20-0.30	yes
		SG9						
		SG10						
		551						
31	0.42	MB4	nd	nd	4.50	0.00	0.0-0.125	
		PC16	nd	625.00	2.80	225.00	0.02-0.10	yes
		PC17	nd	1245.00	2.80	446.43	0.02-0.10	no
		PC21	nd	1635.00	2.80	585.71	0.0-0.02	yes
		PC22	nd	945.00	2.80	339.29	0.02-0.10	no
		411	nd	610.00	2.80	222.32	0.0-0.30	
		554						
		562	nd					yes
		MB5	nd	nd	3.70	0.00	0.0-0.125	
		MB6	nd	1410.00	5.10	278.92	0.0-0.125	
32	0.55	805	nd	1650.00	11.00	166.25	0.0-0.30	yes
		806		900.00	3.20	285.16	0.0-0.30	no
		ESD11	nd	220.00	3.10	71.29	0.20-0.40	no
		408	nd	430.00	2.80	158.04	0.0-0.30	
33	0.43	KBR9	nd	365	2.6	83.89	0.0-0.10	no
		ESD07	nd	2090.00	1.90	1100.53	0.15-0.25	yes
		PC25	nd	8460.00	2.80	3023.21	0.15-0.25	yes
		SG11						
		SG16						
		SW1						
34	0.60	711	nd	730.00	3.80	195.39	0.0-0.30	yes
		ESD06	nd	720.00	2.90	248.62	0.02-0.10	no
		PC23	nd	985.00	2.80	353.57	0.20-0.50	no
		PC24	nd	995.00	2.74	364.96	0.25-0.40	no
		PC26	nd	925.00	2.80	332.14	0.02-0.10	no
		PC27	nd	1405.00	2.80	503.57	0.20-0.35	yes
35	0.49	SG12						
		ESD08	4.00	690.00	2.80	247.86	0.20-0.30	yes
36	0.38	KBR8	nd	124	2.9	30.33	0.0-0.10	yes
		ESD04	nd	3320.00	2.10	1581.43	0.02-0.10	yes
		MB7	nd	1010.00	7.40	138.18	0.0-0.125	
37	0.91	ESD05	nd	650.00	3.30	197.27	0.0-0.02	no
		SG13						
		MB8	nd	1090.00	6.20	177.82	0.0-0.125	
		MB10	nd	460.00	5.90	80.08	0.0-0.125	
		KBR7	nd	235	2.7	55.00	0.0-0.10	no
		HH2_02	nd	8360	2.80	2986.07	0.10-0.20	no
		HH2_03	47	10150	2.80	3625.36	0.10-0.20	no
		HH2_04	71	14810	2.80	5289.64	0.10-0.20	yes
		HH2_05	28	14750	2.80	5268.21	0.10-0.20	yes
		HH2_06	16	16590	2.80	5925.36	0.10-0.20	yes
		HH3_1	nd	nd	2.80	0.00	0.0-0.10	no
		HH3_2	nd	660.00	2.80	236.07	0.10-0.20	no
		HH3_3	nd	10320.00	2.80	3686.07	0.10-0.20	no

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised TPH ⁽¹⁾ in upper 300mm					Objectionable aesthetic impacts in upper 400mm ⁽⁵⁾ (refer logs)
			C6-C9 Lab result ⁽²⁾ (mg/kg)	C10-C36 Lab result ⁽³⁾ (mg/kg)	TOC ⁽⁴⁾ (%)	TPH normalised to 1% TOC (mg/kg)	Sample Depth (m)	
38	0.829	HH3_5	nd	1520.00	2.80	543.21	0.10-0.20	no
		HSD04	nd	nd	2.80	0.00	0.0-0.20	no
		HSD05	nd	nd	2.80	0.00	0.0-0.20	no
		HSD06	nd	4910	2.80	1758.04	0.1-0.20	yes
		HSD09	nd	2360	2.80	847.32	0.0-0.10	no
		HSD10	nd	420	2.80	154.46	0.0-0.10	no
		HSD11	nd	3010	2.80	1079.46	0.0-0.10	yes
		HSD12	nd	3350	2.80	1200.89	0.0-0.10	yes
		HSD13	nd	2720	2.80	975.89	0.1-0.2	yes
		B1						no
		B2						no
		B3						no
		B4						yes
		B5						yes
		B6						yes
		B7						no
		SHA01	nd	1150.00	2.30	505.43	0.0-0.20	no
		SHA02	nd	5220.00	2.80	1868.75	0.50-0.60	no
		SHA03						yes
		SHA04						yes
		SHA05						yes
		SHA07						yes
		SHA08						yes
		SHA11						yes
		SHA13						yes
		SHA14						no
		SHA17						no
		SHA18						yes
		SHA19						yes
		SHA20	nd	3240	14.00	324.00	0.2-0.4	yes
		SHA27						yes
		SS01	nd	nd	0.12	0.00	0.0-0.10	no
		SS02	nd	2440.00	1.80	1362.50	0.0-0.10	yes
		SS03	nd	12070.00	5.10	2369.12	0.50-0.60	yes
		SS05						yes
		SS06	nd	nd	1.80	0.00	0.0-0.10	yes
		SS09						yes
		SS10						yes
		SS14	nd	2482.00	3.20	779.53	0.0-0.10	no
		SS15	nd	1900.00	2.00	956.25	0.50-0.60	yes
		SS16	nd	1320.00	1.10	1211.36	0.50-0.60	no
		SS17	nd	1780.00	1.30	1378.85	0.0-0.10	no
		SS18	nd	5920.00	5.70	1040.79	0.50-0.60	yes
		SS19	nd	4478.00	2.90	1548.45	0.50-0.60	no
		SS20	nd	nd	nd	0.00	0.0-0.10	no
		SS21	nd	nd	0.16	0.00	0.0-0.10	no
		SS22	nd	nd	0.12	0.00	0.0-0.10	no
		SS23	nd	nd	0.16	0.00	0.0-0.10	no
		SS24	nd	580.00	2.90	204.31	0.0-0.10	no
		SS25	nd	990.00	0.68	1474.26	0.0-0.10	yes
		2						no
		3						no
		4	nd	860.00	3.40	256.62	0.0-0.30	no
		5	nd	nd	nd	0.00	0.0-0.30	no
		6	nd	620.00	1.30	486.54	0.40-0.70	no
		8	nd	1780.00	13.00	179.25	0.21-0.40	yes
		9	nd	6010.00	14.00	602.25	0.0-0.30	yes
		11	nd	2070.00	4.70	443.09	0.29-0.49	yes
		12	nd	1810.00	8.20	222.26	0.29-0.50	yes
		13	nd	610.00	0.72	864.58	0.40-0.70	yes
		14						no
		15						yes
		16	nd	3430.00	2.80	1229.46	0.26-0.55	yes
		17						yes
		19	nd					no
		20	nd	nd	2.80	0.00	0.0-0.30	no
		23						yes
		24						yes
		25						yes
		26						yes
		100	nd	270.00	2.30	122.83	0.0-0.30	
		101	nd	nd	0.31	0.00	0.0-0.30	
		102	nd	720.00	15.00	73.25	0.0-0.30	
		103	nd	1280.00	22.00	129.25	0.0-0.30	
		104	nd	1030.00	17.00	104.25	0.0-0.30	

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised TPH ⁽¹⁾ in upper 300mm					Objectionable aesthetic impacts in upper 400mm ⁽⁵⁾ (refer logs)
			C6-C9 Lab result ⁽²⁾ (mg/kg)	C10-C36 Lab result ⁽³⁾ (mg/kg)	TOC ⁽⁴⁾ (%)	TPH normalised to 1% TOC (mg/kg)	Sample Depth (m)	
		105		7710.00	18.00	772.25	0.0-0.30	no
		106		2471.00	17.00	248.35	0.0-0.30	no
		107		1250.00	25.00	126.25	0.0-0.30	no
		109	nd	11100.00	34.00	1111.25	0.0-0.125	
		110	nd	3381.00	14.00	339.35	0.0-0.125	
		201						
		202						yes
		402	nd	1410.00	2.80	508.04	0.0-0.30	yes
		403	nd	29700.00	2.80	10611.61	0.0-0.30	yes
		405	nd	2753.00	2.80	987.68	0.0-0.30	yes
		406	nd	8090.00	2.80	2893.75	0.0-0.30	yes
		407	nd	2374.00	2.80	852.32	0.0-0.30	
		501						yes
		502						no
		503						yes
		504						
		505						
		506						yes
		507						yes
		510						
		513						yes
		514						
		517		6120.00	2.80	2190.18	0.0-0.30	yes
		521						
		523	nd				0.25	yes
		524	nd				0.45	no
		525		nd	2.80	0.00	0.20-0.44	yes
		526						no
		527						yes
		533						yes
		540	nd	18220.00	2.80	6511.61	0.0-0.20	yes
		MB14	nd	18560.00	25.00	1857.25	0.0-0.125	yes
		MB15	nd	3340.00	20.00	335.25	0.0-0.125	yes
		MB16	nd	570.00	27.00	58.25	0.0-0.125	yes
		MB20	nd	7330.00	45.00	734.25	0.0-0.125	yes
		717	nd	9430.00	12.00	944.25	0.0-0.30	yes
		736	nd	7000.00	20.00	701.25	0.0-0.125	
		737	nd	6970.00	26.00	698.25	0.0-0.125	
		738	nd	3740.00	22.00	375.25	0.0-0.125	
		739	nd	4850.00	27.00	486.25	0.0-0.125	
		740	nd	3720.00	15.00	373.25	0.0-0.125	
39	0.28	ESD01	nd	21740.00	5.00	4348.20	0.10-0.20	yes
		HH2_07	38	9460	2.80	3383.04	0.10-0.20	yes
		HSD08	nd	14740	2.80	5268.75	0.0-0.10	yes
		SHA12						yes
		SHA26						yes
		SS08						yes
		203						
		508						yes
		511	nd	25900.00	3.40	7621.32	0.10-0.40	yes
		515	nd	1620.00	4.80	340.10	0.125-0.40	yes
		522						yes
		530						no
		713	nd	480.00	21.00	49.25	0.0-0.30	yes
		714	nd	3740.00	16.00	375.25	0.0-0.30	yes
		715	nd	15600.00	9.10	1715.66	0.0-0.30	yes
		718						yes
40	0.81	809	nd	10230.00	22.00	1024.25	0.0-0.30	yes
		810	nd	8900.00	13.00	891.25	0.0-0.30	yes
		ESD03	nd	2290.00	4.40	520.68	0.20-0.30	yes
		SG14						
		MB21	nd	nd	7.20	0.00	0.0-0.125	
		509						yes
		528						yes
		529						yes
		808	nd	nd	20.00	0.00	0.0-0.30	yes
		HH2_01	nd	1580	2.80	564.29	0.0-0.1	no
		HH2_08	nd	6630	2.80	2367.86	0.1-0.2	yes
		HH2_09	7	15810	2.80	5646.43	0.1-0.2	yes
		HH2_10	nd	2670	2.80	953.57	0.1-0.2	yes
		HSD07	9.00	13240	2.80	4728.57	0.1-0.2	yes
		B8						yes
		B11						yes
		SHA06						yes
		SHA09	nd	1510	4.60	330.98	0.0-0.10	yes

SUMMARY OF GIS DATA FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised TPH ⁽¹⁾ in upper 300mm					Objectionable aesthetic impacts in upper 400mm ⁽⁶⁾ (refer logs)
			C6-C9 Lab result ⁽²⁾ (mg/kg)	C10-C36 Lab result ⁽³⁾ (mg/kg)	TOC ⁽⁴⁾ (%)	TPH normalised to 1% TOC (mg/kg)	Sample Depth (m)	
41	0.34	SHA10						yes
		SHA15	nd	2230	2.80	800.89	0.0-0.10	yes
		SHA16	nd	930	1.70	554.41	0.0-0.10	yes
		SS04	nd	7020.00	7.50	937.67	0.50-0.60	yes
		SS07						yes
		SS26	nd	nd	0.83	0.00	0.0-0.10	no
		108	nd	1710.00	14.00	172.25	0.0-0.125	
		204						
		512						yes
		516						yes
		518						yes
		519						yes
		520						yes
		716	nd	5060.00	23.00	507.25	0.0-0.30	yes
		807	nd	3880.00	11.00	389.25	0.0-0.30	yes
		901	nd	1530.00	8.00	192.81	0.0-0.30	yes
		904	nd	7210.00	12.00	722.25	0.0-0.30	yes
42	0.32	ESD02	nd	120.00	1.40	86.43	0.20-0.30	no
		HH3_4	nd	590.00	2.80	211.07	0.0-0.10	no
		HSD02	nd	320.00	2.80	114.64	0.0-0.10	no
		HSD03	nd	1990.00	2.80	711.07	0.10-0.20	no
		1						no
		205						
		811	nd	nd	3.00	0.00	0.0-0.30	no
		902	nd	860.00	8.70	100.29	0.0-0.30	no
43	0.66	SG15						
		HSD01	nd	700.00	2.80	250.36	0.0-0.10	no
		MB9	nd	770.00	14.00	78.25	0.0-0.125	
Total	25.33							

Legend:

	Data digitised from available figures
	Sample not laboratory tested for PAHs or TPH
	TOC measurement not available - used average value of 2.8%
	Data not available from investigation reports

Notes:

- (1) TPH = C6 - C36 fractions
- (2) Detection limit varies between 2 and 10mg/kg. Half the detection limit was used in calculations.
- (3) Detection limit 100 mg/kg. Half the detection limit was used in calculations.
- (4) Maximum and minimum TOC used to normalise results was 10% and 0.2%, respectively (refer Section 1.2 of 2013 sediment guidelines). Where TOC was not measured, the average of the URS (2006) values was used (TOC = 2.8%)
- (5) Objectionable aesthetic impacts defined as an oily gasworks appearance, moderate-strong PAH odour, sheen.
- (6) Bathymetric levels based on 0m AHD = +0.855m LAT
- (7) Exposure scenarios comprise source (sediments adjacent to contaminant source area), beach, mangrove, and submerged (seafloor below LAT)
- (8) BaP TEQ Health criteria for shallow sediments are: Sediments adjacent to source areas on tidal flat = 1 mg/kg; Beach area on tidal flat = 60 mg/kg; Mangrove area on tidal flat = 120 mg/kg; Submerged area = not relevant

Appendix C. Database Derived for Ecological Model

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
1	0.57	ESD33	52.00	1567.33	52.00	1567.33	52.00	1567.33
2	0.57	ESD34	5.86	203.44	5.86	203.44	5.86	203.44
3	0.60	ESD35	4.35	52.61	4.35	52.61	4.35	52.61
4	0.55	ESD32	10.59	653.24	10.59	653.24	10.59	653.24
5	0.82	ESD31	3.82	17.43	3.82	17.43	3.82	17.43
6	0.69	ESD30	3.94	18.48	3.94	18.48	3.94	18.48
7	0.31	HSD18	20.61	478.93	20.61	478.93	20.61	478.93
8	0.28	ESD29	134.60	3732.20	134.60	3732.20	134.60	3732.20
9	0.35	HSD17	0.00	0.00	0.00	0.00	0.00	0.00
10	0.59	ESD26	78.00	1361.00	43.16	680.50	78.00	1361.00
		HSD16	8.32	0.00				
11	1.03	ESD28	3.13	0.00	3.13	0.00	3.13	0.00
12	0.78	ESD27	5.56	0.00	5.56	0.00	5.56	0.00
13	1.14	ESD24	2.94	0.00	2.94	0.00	2.94	0.00
14	0.77	ESD23	3.08	161.92	3.08	161.92	3.08	161.92
15	1.06	ESD21	18.97	496.40	9.03	192.42	18.97	496.40
		KBR4	4.67	50.32				
		KBR5	3.45	30.56				
16	0.70	ESD22	2.94	115.00	2.94	115.00	2.94	115.00
17	0.62	ESD20	3.55	160.29	3.55	160.29	3.55	160.29
18	0.58	ESD19	10.48	219.52	10.48	219.52	10.48	219.52
19	0.71	ESD17	32.50	231.88	32.50	231.88	32.50	231.88
		SG1						
		SG2						
20	0.96	ESD18	10.00	175.83	13.99	115.28	28.57	175.83
		SG3						
		KBR6	3.40	81.67				
		KBR12	28.57	88.33				
21	0.53	ESD12	282.75	4666.86	67.40	1115.42	282.75	4666.86
		HSD14	2.14	0.00				
		HSD15	2.14	0.00				
		PC1	35.14	610.22				
		PC2	14.81	300.00				
		SG4						
22	0.443	ESD16	13.18	214.14	8.24	249.10	13.18	291.04
		PC3	5.97	291.04				
		PC4	5.57	242.13				
23	0.40	ESD15	9.66	123.67	9.03	96.00	9.66	123.67
		KBR11	5.71	68.33				
24	0.68	PC5	157.19	1155.23	28.58	374.58	157.19	1155.23
		PC6	11.37	227.36				
		PC9	38.57	406.50				
		PC10	23.22	680.51				
		SG6						
		SW2						
		MB26	7.60	263.00				
		705						
		707	0.43	0.00				
		708	0.25	0.00				
		709	32.76	462.84				
		710	17.00	242.85				
		801	11.00	241.95				
		802	15.00	440.09				
25	0.42	ESD13	12.14	377.74	19.08	445.43	23.03	613.70
		PC7	23.03	613.70				
		SG5						
		SG7						
		803	22.06	344.85				
26	0.66	ESD14	7.14	100.36	16.38	239.84	33.93	432.14
		PC8	8.07	187.01				
		PC29	33.93	432.14				

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
27	0.20	PC11	136.79	1651.79	132.06	2366.47	234.41	4831.19
		PC12	234.41	4831.19				
		804	25.00	616.44				
28	0.401	ESD09	179.47	5254.05	251.71	2530.26	1300.00	9616.00
		B9						
		B10						
		PC14	1210.00	4345.10				
		PC19	235.00	3833.93				
		SG8						
		SHB21						
		SHB22						
		SHB23						
		SHB24						
		SHB25						
		SS11						
		SS12						
		SS13						
		410	221.43	5140.18				
		550						
		555						
		557	5.36	43.75				
		561	464.29	3540.18				
		MB1	83.00	614.25				
		MB2	100.00	1460.33				
		MB3	37.00	72.55				
		701	310.00	3939.70				
		702	140.00	1611.25				
		704	77.66	1236.44				
		706	12.50	425.26				
		720						
		731	48.00	811.25				
		733	1300.00	9616.00				
		734	85.00	1370.25				
		735	9.03	275.00				
		812	263.16	4485.53				
		903	1.52	0.00				
29	0.15	PC15	560.71	10227.14	149.85	2782.55	560.71	10227.14
		PC20	15.71	414.29				
		560						
		703	14.29	304.59				
		712	8.67	184.17				
30	0.73	ESD10	4.29	165.77	2.52	82.88	4.29	165.77
		SG9						
		SG10						
		551						
		MB4	0.76	0.00				
31	0.42	PC16	7.50	225.00	12.23	283.23	36.07	585.71
		PC17	13.57	446.43				
		PC21	36.07	585.71				
		PC22	10.36	339.29				
		411	13.57	222.32				
		554						
		562						
		MB5	4.86	0.00				
		MB6	9.22	278.92				
		805	5.90	166.25				
32	0.55	806	9.06	285.16	5.68	104.40	6.92	158.04
		ESD11	5.48	71.29				
		408	4.64	158.04				
		KBR9	6.92	83.89				
		ESD07	54.74	1100.53				

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
33	0.43	PC25	184.29	3023.21	85.55	1439.71	184.29	3023.21
		SG11						
		SG16						
		SW1						
		711	17.63	195.39				
34	0.60	ESD06	8.97	248.62	14.65	360.57	29.64	503.57
		PC23	11.07	353.57				
		PC24	10.36	364.96				
		PC26	13.21	332.14				
		PC27	29.64	503.57				
		SG12						
35	0.49	ESD08	8.85	247.86	5.32	139.10	8.85	247.86
		KBR8	1.79	30.33				
36	0.38	ESD04	46.45	1581.43	26.27	859.80	46.45	1581.43
		MB7	6.08	138.18				
37	0.91	ESD05	21.52	197.27	8.49	127.55	21.52	197.27
		SG13						
		MB8	5.48	177.82				
		MB10	3.56	80.08				
		KBR7	3.41	55.00				
		HH2_02	157.82	2986.07				
		HH2_03	73.75	3625.36				
		HH2_04	417.48	5289.64				
		HH2_05	531.99	5268.21				
		HH2_06	640.75	5925.36				
		HH3_1		0.00				
		HH3_2	11.79	236.07				
		HH3_3	158.25	3686.07				
		HH3_5	26.07	543.21				
		HSD04	2.61	0.00				
		HSD05	14.93	0.00				
		HSD06	80.39	1758.04				
		HSD09	43.68	847.32				
		HSD10	24.61	154.46				
		HSD11	67.39	1079.46				
		HSD12	85.86	1200.89				
		HSD13	41.04	975.89				
		B1						
		B2						
		B3						
		B4						
		B5						
		B6						
		B7						
		SHA01		505.43				
		SHA02		1868.75				
		SHA03						
		SHA04						
		SHA05						
		SHA07						
		SHA08						
		SHA11						
		SHA13						
		SHA14						
		SHA17						
		SHA18						
		SHA19						
		SHA20	28.20	324.00				
		SHA27						
		SS01	36.67	0.00				
		SS02	88.89	1362.50				

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
38	0.829	SS03	141.18	2369.12	89.72	1176.07	678.57	10611.61
		SS05						
		SS06	1.73	0.00				
		SS09						
		SS10						
		SS14	40.63	779.53				
		SS15	65.00	956.25				
		SS16	181.82	1211.36				
		SS17	92.31	1378.85				
		SS18	77.19	1040.79				
		SS19	96.55	1548.45				
		SS20	8.50	0.00				
		SS21	37.00	0.00				
		SS22	19.64	0.00				
		SS23	43.18	0.00				
		SS24	14.14	204.31				
		SS25	122.06	1474.26				
		2						
		3						
		4	20.59	256.62				
		5	18.75	0.00				
		6	8.60	486.54				
		8	10.00	179.25				
		9	32.00	602.25				
		11	50.00	443.09				
		12	14.63	222.26				
		13	47.22	864.58				
		14						
		15						
		16	56.29	1229.46				
		17						
		19						
		20	0.09	0.00				
		23						
		24						
		25						
		26						
		100	16.09	122.83				
		101	25.48	0.00				
		102	6.30	73.25				
		103	9.30	129.25				
		104	6.70	104.25				
		105	61.00	772.25				
		106	19.00	248.35				
		107	9.70	126.25				
		109	63.00	1111.25				
		110	17.00	339.35				
		201						
		202						
		402	39.29	508.04				
		403	678.57	10611.61				
		405	50.00	987.68				
		406	217.86	2893.75				
		407	57.14	852.32				
		501						
		502						
		503						
		504						
		505						
		506						
		507						

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
		510						
		513						
		514						
		517	189.29	2190.18				
		521						
		523						
		524						
		525	0.26	0.00				
		526						
		527						
		533						
		540	607.14	6511.61				
		MB14	140.00	1857.25				
		MB15	29.00	335.25				
		MB16	5.90	58.25				
		MB20	130.00	734.25				
		717	93.00	944.25				
		736	39.00	701.25				
		737	43.00	698.25				
		738	24.00	375.25				
		739	37.00	486.25				
		740	25.00	373.25				
39	0.28	ESD01	214.74	4348.20	245.85	2501.71	1058.82	7621.32
		HH2_07	303.29	3383.04				
		HSD08	398.07	5268.75				
		SHA12						
		SHA26						
		SS08						
		203						
		508						
		511	1058.82	7621.32				
		515	52.78	340.10				
		522						
		530						
		713	61.00	49.25				
		714	38.00	375.25				
		715	208.79	1715.66				
		718						
		809	52.00	1024.25				
		810	71.00	891.25				
40	0.81	ESD03	19.68	520.68	6.78	173.56	19.68	520.68
		SG14						
		MB21	0.64	0.00				
		509						
		528						
		529						
		808	0.01	0.00				
41	0.34	HH2_01	61.18	564.29	101.01	1257.90	660.50	5646.43
		HH2_08	72.00	2367.86				
		HH2_09	660.50	5646.43				
		HH2_10	60.31	953.57				
		HSD07	433.96	4728.57				
		B8						
		B11						
		SHA06						
		SHA09	22.19	330.98				
		SHA10						
		SHA15	37.96	800.89				
		SHA16	28.53	554.41				
		SS04	26.67	937.67				
		SS07						

ECOLOGICAL MODEL FOR DECLARED AREA - KENDALL BAY REMEDIATION PROJECT

Cell	Area (ha)	Location IDs	Highest normalised total PAHs in upper 300mm	Highest normalised TPH in upper 300mm	Average normalised total PAHs in upper 300mm	Average normalised TPH in upper 300mm	Maximum normalised total PAHs in upper 300mm	Maximum normalised TPH in upper 300mm
		SS26	3.13	0.00				
		108	10.00	172.25				
		204						
		512						
		516						
		518						
		519						
		520						
		716	34.00	507.25				
		807	17.00	389.25				
		901	10.70	192.81				
		904	37.00	722.25				
42	0.32	ESD02	23.33	86.43	13.92	203.92	36.79	711.07
		HH3_4	6.00	211.07				
		HSD02	7.96	114.64				
		HSD03	36.79	711.07				
		1						
		205						
		811	3.33	0.00				
43	0.66	SG15			6.20	164.30	8.61	250.36
		HSD01	8.61	250.36				
		MB9	3.80	78.25				
Total	25.33							

Legend

	Concentration > 2 x criteria
	Criteria < Concentration ≤ 2 x criteria
	Concentration ≤ criteria