Kamay Wharf Project – Sediment Investigation

Sampling and Analysis Quality Plan

18 January 2023

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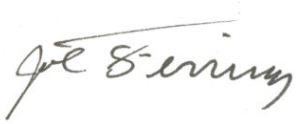

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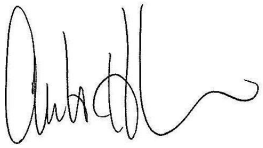

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CONTENTS

Acronyms and Abbreviations

Name	Description
ACM	Asbestos Containing Material
AHD	Australian Height Datum
AMG	Australian Map Grid
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure
ASS	Acid Sulfate Soils
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CLM	Contaminated Land Management Act 1997
CoPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DP	Deposited Plan
DPI	Department of Primary Industries
DSI	Detailed Site Investigation
EPL	Environment Protection License
ESA	Environmental Site Assessment
m	Metre
m AHD	Metres Above Australian Height Datum
m bgl	Metres Below Ground Level
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NSW EPA	New South Wales Environment Protection Authority
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PFAS	Per and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
POEO Act	Protection of the Environment Operations Act 1997
PSI	Preliminary Site Investigation
RAP	Remedial Action Plan
SAQP	Sampling and Analysis Quality Plan
TBT	Tributyltin
TRH	Total Recoverable Hydrocarbons
UXO	Unexploded Ordnance

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Arup Australia Pty Ltd (Arup) on behalf of Transport for New South Wales (TfNSW) to prepare this Sampling and Analysis Quality Plan (SAQP) for an assessment of potential contamination within sediments located at the proposed Kamay Wharf Project, located in Kurnell and La Perouse, NSW (the Site).

- The Project Area location is illustrated on **Figure 1a and Figure 1b** and the current layout is presented on **Figure 2a and Figure 2b**.

1.1 Background

ERM understands Transport for New South Wales (TfNSW) is seeking approval to reinstate the ferry wharves at La Perouse and Kurnell in Botany Bay (the project) under Division 5.2 of the Environmental Planning and Assessment Act 1979 (EP&A Act) as State Significant Infrastructure.

The project would allow for an alternative transport connection between La Perouse and Kurnell rather than by road. The primary purpose of this infrastructure would be to operate a public ferry service for visitors to the area and for the local community for cultural and recreational purposes. It would also provide supplementary temporary mooring for tourism-related commercial vessels and recreational boating.

The project provides opportunities for significant cultural and economic benefits to the local Aboriginal community by providing improved access to culturally significant sites.

It is also expected to deliver benefits and opportunities to wider communities on either side of Botany Bay such as investment opportunities in a ferry service and other new visitor/tourist experiences.

A concept design has been developed for the proposed redevelopment which includes the following key features:

- Two new wharves, one at La Perouse and one at Kurnell, that would include:
  - Berth for ferries (to accommodate vessels up to 40 m long);
  - Berth for recreational and commercial vessels (to accommodate vessels up to 20 m long);
  - Sheltered waiting areas and associated furniture;
  - Additional space within waiting areas to accommodate other users such as fishing and those using recreational vessels;
  - Signage and lighting;
- Landside paving, access ramps, seating and landscaping at the entrance to the wharves;
- Reconfiguration of existing car parking areas at La Perouse to increase the number of spaces (including provision of accessible parking and kiss-and-ride bays);
- Reconfiguration of footpaths around the new car parking area;
- Provision for bicycle racks at La Perouse; and
- Installation of utilities to service the wharves.

Previous investigations undertaken within the Site by ERM (summarised in Section 3) identified sediments during offshore drilling works to range from 1.2 m to 11.2 m in thickness within the Kurnell and La Perouse sites respectively. Key outcomes of this investigation are summarised in Section 3:

Following completion of previous investigation works within the Site, the Department of Climate Change, Energy, the Environment and Water (DCCEEW) requested in November 2022 that further sediment sampling be undertaken to meet the requirements of the Australian Government (2009) *National Assessment Guideline for Dredging*.

This SAQP has therefore been prepared to outline the Data Quality Objectives (DQOs) and requirements for the collection of sediment samples as required by DCCEEW.

1.2 Objectives

The objectives of this SAQP are to summarise the:

- DQOs for the proposed sediment investigation; and
- The methodology for the proposed works, including sampling, analytical and reporting requirements.

The objective of the sediment investigation is to refine the Conceptual Site Model (CSM) and to identify contamination risks in off-shore sediments that may require management to facilitate construction of the Kamay Wharf Project.

2. SITE IDENTIFICATION AND SETTING

The Kamay Wharf Project comprises two sites located in Kurnell and La Perouse, NSW. Site-specific information relating to site identification and site setting is presented within the following sections.

2.1 Site Identification

Site identification information is presented within the table below:

Table 2.1 – Site Identification Details

Site	Item	Description
Kurnell	**Legal Description**	■ Part Lot 71 DP 908; and ■ Part Lot 3 DP 1165618
	Local Government Area	■ Sutherland Shire Council
	Current Zoning	■ E1 – National Parks and Nature Reserves ■ E2 – Environmental Conservation ■ W1 – Natural Waterways ■ B1 – neighbourhood Centres
	Geographical Co-Ordinates	■ 34º00’22”S 151º33’00” E (approximate centre of the Site)
	Site Location and Site Layout	■ Figure 1a and Figure 2a
La Perouse	**Legal Description**	■ Lot 5113 DP 752015 ■ Lot 1 DP 934156 ■ Lot 1057 DP 752015 ■ Lot 285 DP752015 ■ Part Lot 2 DP 776343 ■ Part Lot 1 DP 776343 ■ Part Lot 5086 DP 752015 ■ Part Lot 1 DP 862586 ■ Lot 5257 DP 824002 ■ Lot 5253 DP 824002 ■ Lot 5254 DP 824002 ■ Lot 5256 DP 824002 ■ Lot 5255 DP 824002 ■ Lot 1081 DP 752015 ■ Lot 7045 DP 1026891 ■ Lot 7043 DP 1026891 ■ Lot 1 DP 915424 ■ Lot 3 DP 1165618
	Local Government Area	■ Randwick Council
	Current Zoning	■ E1 – National Parks and Nature Reserves ■ RE1 – Public Recreation ■ SP2 - Infrastructure
	Geographical Co-Ordinates	■ 33o59’19”S 151o13’59” E (approximate centre of the Site)
	Site Location and Site Layout	■ Figure 1b and Figure 2b

ERM notes that the site boundaries have been modified slightly since completion of the Preliminary Site Investigations (PSIs) (ERM, 2020a and 2020b) due to changes in planning approvals. The boundaries presented in this SAQP should be considered the site boundary for the purposes of project approvals and site auditing purposes.

2.2 Site Setting

Table 2.2 – Site Identification Details

Site Identifier	Item	Description
Kurnell	**Site area**	Approximately 28.5 ha (including land and water portions of the Site)
	Current land-use	The Site is currently comprised of undeveloped recreational land (beach, open grass parkland and vegetated bushland), open water (Botany Bay) and public roadways,
	Proposed Future Use	Re-instatement of public ferry wharves and associated infrastructure
	Surrounding Land use	The land uses surrounding the Site include: ■ **North:** Botany Bay; ■ **South:** Low density residential dwellings then the former Kurnell refinery (Caltex Kurnell Terminal); ■ **East:** Undeveloped recreational bushland then Botany Bay / Pacific Ocean; and ■ **West:** Low density residential dwellings (suburb of Kurnell) followed by undeveloped bushland / wetlands and then Botany Bay.
	Site Elevation	■ Between 0 – 4 m Australian Height Datum (AHD)
	Topography	■ Regional topography is generally flat with a slight slope to the north / north east. The portion of the Site located on land slopes to the north in the direction of Botany Bay.
	Hydrology	■ The portion of the Site located on land was observed to be comprised of a public road way in the south western portion, of the Site, a public beach within the northern portion of the Site and undeveloped recreational land in the eastern portion. ■ During periods of rainfall, it is anticipated that surface waters would either flow into stormwater infrastructure located within Captain Cook Drive, infiltrate the Site surface in unsealed portions of the Site or flow offsite to the adjacent Botany Bay.
	Geology, Soils and Acid Sulfate Soils	■ Geology mapping provided by NSW Planning and Environment – resources and energy indicates the Site is underlain by an unnamed Quaternary formation comprising coarse quartz sands, varying amounts of shell fragments and clean to muddy, shelly, mostly marine sand overlying the Triassic Hawksbury Sandstone Formation comprising medium to coarse-grained quartz sandstone with minor shale and laminite lenses. ■ Soils within the Site are described as deep podzols of dunes within swales and organic peats within swamp areas. ■ Mapping indicated that the western portion of the Site was comprised of class 1, class 3 and class 5 Acid Sulfate Soils (ASS). Mapping indicated that there was a high probability of ASS occurring within subtidal marine sediments.
	Hydrogeology	Information from NSW Department of Primary Industries' and the Bureau of Meteorology indicated the following: ■ A search of registered groundwater bores identified 11 bores within the 2 km search radius. Standing water levels were measured between 0 m below ground level (bgl) and 3.0 m bgl. Registered bores were utilised for a range of purposes including water supply, domestic, household, monitoring and water supply bores. ■ Drillers logs indicated that groundwater was identified within unconsolidated sand and clayey sand. ■ Groundwater flow direction will be influenced by tidal activity but was generally inferred to be flowing towards Botany Bay
La Perouse	**Site area**	Approximately 11.5 ha (including land and water portions of the Site)
	Current land-use	The Site is currently comprised of undeveloped recreational land (open grass parkland), open water (Frenchmans Bay) and public roadways (Anzac Parade).
	Proposed Future Use	■ Re-instatement of public ferry wharves and associated infrastructure.

Site Identifier	Item	Description
	Surrounding Land use	The land uses surrounding the Site include: ■ **North:** Frenchmans Bay, low density residential dwellings and recreational parkland; ■ **South:** Botany Bay; ■ **East:** Undeveloped recreational bushland then Botany Bay / Pacific Ocean; and ■ **West:** Botany Bay followed by industrial land comprising fuel / chemical storage located approximately 1.5 km to the west of the Site.
	Site Elevation	■ Between 0 – 15 m Australian Height Datum (AHD)
	Topography	■ Regional topography is generally flat with a slight slope to the south / south east in the direction of the Pacific Ocean. ■ The central portion of the Site is located at an elevation of approximately 15 m AHD and slopes to the south, east and west in the direction of Botany Bay.
	Hydrology	■ The portion of the Site located on land was observed to contain a centralised ring road (Anzac Parade). During periods of rainfall, it is anticipated that surface water would either flow into stormwater infrastructure located within Anzac Parade, infiltrate the site surface in unsealed portions of the Site or flow offsite to the adjacent Botany Bay.
	Geology, Soils and Acid Sulfate Soils	■ Geology mapping provided by NSW Planning and Environment – resources and energy indicates the Site is underlain by an unnamed Mesozoic formation comprising medium to coarse grained quartz and sandstone, very minor shale and laminite lenses and an unnamed Quaternary formation comprising coarse quartz sands and varying amounts of shell fragment. ■ Soils within the Site are described as shallow discontinuous earthy sands and yellow earths on crests and insides of benches. Shallow siliceous sands on leading edges, shallow to deep leached sands, grey sands and gleyed podzolic soils in poorly drained areas ad localised yellow podzolic soils associated with shale lenses. ■ Mapping indicated that the western portion of the Site was comprised of class 4 and class 5 ASS. Mapping indicated that there was a potential probability of ASS occurring within subtidal marine sediments.
	Hydrogeology	Information from NSW Department of Primary Industries and the Bureau of Meteorology indicated the following: ■ A search of registered groundwater bores identified 37 bores within the 2 km search radius. Standing water levels were measured between 0 m below ground level (bgl) to 143.0 m bgl. The majority of bores identified groundwater at depths of between 3 m and 8 m bgl. Registered bores were utilised for a range of purposes including water supply, domestic, household, monitoring and water supply bores. ERM< notes that the bore drilled to a depth of 143m is likely to be use for extraction of groundwater from deep aquifers. ■ ERM notes that the Site is located immediately adjacent to the NSW Office of Water Groundwater Extraction Exclusion Area (GEEA) - Area 2. Mapping indicates the exclusion zone extends from the northern boundary of the Site at the intersection of Anzac Parade and Endeavour Avenue. ■ Drillers logs indicated that groundwater was identified within unconsolidated sand, clays and sandstone bedrock. ■ Groundwater flow direction will be influenced by tidal activity but was generally inferred to be flowing towards Botany Bay

3. PREVIOUS INVESTIGATIONS

In developing this SAQP, ERM reviewed the following previous reports:

- Environmental Resources Management (2020) Kamay Wharf Project, Preliminary Site Investigation – Kurnell Site, 25th August 2020 (ERM 2020a).
- Environmental Resources Management (2020) Kamay Wharf Project, Preliminary Site Investigation – La Perouse Site, 25th August 2020 (ERM 2020b).
- Environmental Resources Management (2020) Kamay Wharf Project, Sampling and Analysis Quality Plan, 4th September 2020 (ERM 2020c).
- Environmental Resources Management (2021) Kamay Wharf Project, Targeted Site Investigation, 11th June 2021 (ERM 2021).

A summary of the above reports is presented within the following sections.

3.1 PSI – Kurnell (ERM 2020a)

ERM was engaged by Arup to undertake a PSI at the site identified as the Kamay Ferry Wharf Project located in Kurnell, NSW. The results of the PSI indicated the following:

- The Site is located in predominantly public open space comprising beach area, parkland and undeveloped bushland associated with Botany Bay National Park with the northern portion of the Site extending into Botany Bay.
- The Site is underlain by a quaternary formation comprising coarse quartz sands, varying amounts of shell fragments and clean to muddy, shelly, mostly marine sand overlying the Triassic Hawksbury Sandstone Formation comprising medium to coarse-grained quartz sandstone with minor shale and laminate lenses.
- Groundwater within the surrounding area was identified at depths between 0 m bgl to 3.0 m bgl, with registered bores utilised for a range of purposes including domestic use, household use, monitoring and water supply.
- Historical records indicate the Site has largely been vacant since the 1950s with minor construction works of a small jetty / pier in the 1970s. The surrounding area has comprised low density residential land use to the west, open space / bushland to the east and the Ampol (previously Caltex) Kurnell refinery/terminal to the south since the 1950s to present time.

Based on information reviewed as part of the PSI, ERM considered there to be a potential risk to human health / ecological receptors due to the following potentially complete pollutant linkages identified at the Site:

- Potential uncontrolled fill materials associated with construction of the existing roadways or levelling / site filling purposes;
- Potential per- and polyfluoroalkyl substances (PFAS) contamination associated with Botany Bay and the adjacent Ampol refinery which are identified as NSW EPA PFAS investigation sites;
- Potential ASS associated with sediments located within Botany Bay and adjacent areas;
- Historical onsite and surrounding land uses including (but not limited to) the adjacent Ampol Kurnell refinery/terminal which is currently regulated by the NSW EPA; and
- Potential impacted surface materials resulting from illegal dumping of waste materials.

ERM further noted that based on the proposed construction method, the potential release of contamination within subsurface soils and sediments would require consideration during the design of construction environmental controls.

It was the opinion of ERM that based on the results of the PSI, an intrusive investigation of soil, sediment, surface water and groundwater should be undertaken to more accurately assess the contamination status of the Site.

3.2 PSI – La Perouse (ERM 2020b)

ERM was engaged by Arup to undertake a PSI at the Site identified the Kamay Ferry Wharf Project located in la Perouse, NSW. The results of the PSI indicated the following:

- The Site is located in predominantly public open space comprising beach area, parkland and undeveloped bushland associated with Botany Bay National Park with the northern portion of the Site extending into Botany Bay.
- The Site is underlain by an unnamed Mesozoic formation comprising medium to coarse grained quartz and sandstone, very minor shale and laminite lenses and an unnamed Quaternary formation comprising coarse quartz sands and varying amounts of shell fragment.
- Groundwater within the surrounding area was identified at depths between 0 m bgl to 143.0 m bgl. The majority of bores identified groundwater at depths of between 3 m and 8 m bgl. Registered bores were utilised for a range of purposes including water supply, domestic, household, monitoring and water supply bores. The Site is located immediately adjacent to the NSW Office of Water Groundwater Extraction Exclusion Area (GEEA) - Area 2. Mapping indicates the exclusion zone extends from the northern boundary of the Site at the intersection of Anzac Parade and Endeavour Avenue.
- Historical records indicate the Site has largely been vacant since the 1930s with limited use of the Site for Defence purposes in the 1940s. Records from this time indicate the potential for Mortar Firing to have been undertaken in an easterly direction towards Congwong Bay. ERM notes that a small pier was observed in aerial photographs from the 1930's and may be associated with the adjacent historical sand mining in Frenchmans Bay. Following closure / demotion of Defence buildings, the Site has been used for recreational parkland and the La Perouse Museum.

Based on information reviewed as part of the PSI, ERM considered there to be a potential risk to human health / ecological receptors due to the following potentially complete pollutant linkages identified at the Site:

- Potential uncontrolled fill materials associated with construction of the existing roadways or levelling / site filling for construction of onsite building structures;
- Potential PFAS contamination associated with Botany Bay which is identified as NSW EPA PFAS investigation sites;
- Potential ASS associated with sediments located within Botany Bay and adjacent areas;
- Potential use of hazardous materials within onsite historical and current building structures;
- Historical onsite and surrounding land uses including (but not limited to) former Defence land uses, sand mining etc.; and
- Potential Unexploded Ordnance located within a former Mortar Firing area located to the East of the Site.

ERM further noted that based on the proposed construction method, the potential release of contamination within subsurface soils and sediment would require consideration during the design of construction environmental controls.

It was the opinion of ERM that based on the results of the PSI, an intrusive investigation of soil, sediment, surface water and groundwater should be undertaken to more accurately assess the contamination status of the Site.

3.3 SAQP – Targeted Site Investigation (ERM, 2020c)

ERM was engaged by Arup to prepare a SAQP for a Targeted Site Investigation to be undertaken within the Site identified as the Kamay Wharf Project, located in Kurnell and La Perouse, NSW. The objectives of this SAQP were to summarise the:

- DQOs for the proposed Targeted Site Investigation; and
- The methodology for the proposed works, including sampling, analytical and reporting requirements.

3.4 Targeted Site Investigation (ERM, 2021)

The ERM (2021) TSI was undertaken to refine the understanding of the Project Area and assist Arup / TfNSW in assessing potential constraints associated with site contamination that may require.

Based on field observations made during site investigation works, laboratory analysis of collected soil and sediment samples and with reference to the updated CSM, ERM concluded the following:

- Sediments were identified during offshore drilling works to range from 1.2 m to 11.2 m in thickness within the Kurnell and La Perouse sites respectively.
    - Laboratory analysis of collected samples returned concentrations of CoPCs less than the adopted screening criteria with the exception of nickel within one sample. It is considered that identified nickel concentrations were likely to be indicative of natural / background concentrations.
    - Laboratory analysis of sediment samples returned concentrations of monobutyltin (MBT) higher than LOR in all collected samples ranging from 0.75 mg/kg – 3.8 mg/kg. ERM noted that while there is no screening criteria for MBT, further consideration may be required to waste classification / disposal and dredging purposes.
    - ERM noted that as works were undertaken concurrently with geotechnical works, limited sample volumes were obtained resulting in a reduced analytical suite being analysed.
    - While concentrations of CoPCs within collected sediment samples were less than the adopted screening criteria, due to the limited number of samples collected and reduced sample volumes, additional information will be required for waste classification purposes.
- Fill materials within the onshore test pits located at Kurnell and La Perouse sites were identified to contain Asbestos Containing Materials (ACM) within several locations.
- Laboratory analysis of collected samples returned concentrations of all other CoPCs less than the adopted screening criteria. Concentrations of Total Recoverable Hydrocarbons (TRH) (within both the Kurnell and La Perouse sites) and PFAS (La Perouse only) were reported to exceed the laboratory LOR but were less than the screening criteria within several collected soil samples.
    - ERM noted that while these minor elevated concentrations were unlikely to be indicative of significant or widespread anthropogenic contamination or pose a risk to identified receptors, further consideration may be required prior to construction for waste classification purposes.
- While ERM noted that the completed sampling density during investigation works was insufficient to support waste classification of the Site, based on laboratory analysis of collected soil samples it was the opinion of ERM that fill materials within the Site may be classified as General Solid Waste (GSW) and General Solid Waste – Special Waste Asbestos (GSW-A).
    - Concentrations of benzo(a)pyrene were identified to exceed the Hazardous Solid Waste classification criteria in one location, however, based on field observations this isolated exceedance is considered likely to be associated with historical road infrastructure (bitumen) and not indicative of significant anthropogenic contamination.

- ERM noted that prior to construction, further assessment of the Site is required to facilitate waste classification requirements.

- The assessment of Unexploded Ordnance (UXO) was not undertaken as part of this Targeted Site Investigation, however, this may require further consideration should construction activities be required within areas mapped to contain potential UXO.

Based on the results of this TSI, ERM recommended the following additional works to be undertaken prior to the commencement of construction works for the ferry wharves.

- Where groundwater is to be encountered or extracted during future development works, an assessment of groundwater should be completed to further inform the management of potential groundwater issues during construction and subsequent operation of the Site.
- Additional sampling and analysis of soils, sediments and (where necessary) groundwater should be undertaken to aid in the assessment of potential offsite disposal requirements.
- A Construction Environmental Management Plan (CEMP) detailing the require processes / procedures for the excavation, handling, storage and transport of sediments will be required.
- Prior to the commencement of construction works, an Asbestos Management Plan (AMP) and / or Site Management Plan (SMP) will be required to outline the required processes / procedures to be adopted for the remediation and / or management of asbestos within the Site. The AMP should also be developed in consideration of occupational safety / hygiene requirements during remediation and / or subsequent site operations.

4. CONCEPTUAL SITE MODEL

4.1 Conceptual Site Model – Kurnell (Sediments)

Based on the results of the Targeted Site Investigation detailed in Section 3.4, ERM developed the below Conceptual Site Model (CSM) for the Kurnell site. It is noted that the below CSM relates to sediments only.

Table 9.1 – Conceptual Site Model – Kurnell (Sediments)

Potential Sources	COPCs	Pathways	Potential Receptors	Risk of Potentially Complete Pollutant Linkage	Comment
Historical onsite and surrounding land uses	■ Total recoverable hydrocarbons (TRH) in the C6-C40 fractions; ■ Benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN); ■ Heavy metals and metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, Zn); ■ Polycyclic aromatic hydrocarbons (PAHs); ■ Organochlorine and organophosphorus (OC and OP) pesticides; ■ Organotins: tributyltin (TBT), dibutyltin (DBT) and monobutyltin (MBT); ■ Per- and polyfluoro alkyl substances (PFAS)	■ Dermal contact and / or incidental ingestion with contaminated sediments	■ Current and future site users (recreational and commercial); and ■ Workers carrying out development, installation or maintenance works within the Project Area.	■ Low	■ Concentrations of CoPCs in sediment were less than the adopted assessment criteria within all collected sediment samples. ■ ERM notes that, while the risk to potential receptors is likely to be low, further consideration of concentrations of CoPCs in sediments (TRH, PFAS etc.) may be required for waste classification purposes during construction works. ■ Sediment samples returned concentrations of monobutyltin (MBT) higher than the laboratory LOR. While there is no screening criteria for MTB, further consideration may be required for waste classification / disposal requirements.
		■ Transport of contamination through surface water.	■ Adjacent sensitive receptors; ■ Current and future site users (recreational and commercial); and ■ Workers carrying out development, installation or maintenance works within the Project Area.	■ Low	
		■ Transport of contamination to underlying groundwater aquifers	■ Adjacent sensitive receptors; and	■ Low	

Potential Sources	COPCs	Pathways	Potential Receptors	Risk of Potentially Complete Pollutant Linkage	Comment
			■ Future potential on-site users of groundwater.		
		■ Transport of contaminants through mechanical transport (during excavation of sediments, etc.)	■ Workers carrying out development, installation or maintenance works within the Project Area.	■ Moderate - High	

4.2 Conceptual Site Model – La Perouse (Sediments)

Based on the results of the Targeted Site Investigation detailed in Section 3.4, ERM developed the below CSM for the La Perouse site. It is noted that the below CSM relates to sediments only.

Table 9.2 – Conceptual Site Model La Perouse

Potential Sources	COPCs	Pathways	Potential Receptors	Risk of Potentially Complete Pollutant Linkage	Comment
Historical onsite and surrounding land uses	■ TRH in the C6-C40 fractions; ■ BTEXN; ■ Heavy metals and metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, Zn); ■ PAHs; ■ OC and OP pesticides; ■ Organotins: TBT, DBT and MBT; and ■ PFAS	Dermal contact and / or incidental ingestion with contaminated surface waters / soils.	■ Current and future site users (recreational and commercial); and ■ Workers carrying out development, installation or maintenance works within the Project Area.	Low	■ Concentrations of CoPCs were less than the adopted assessment criteria within all collected sediment samples. ■ ERM notes that, while the risk to potential receptors is likely to be low, further consideration of concentrations of CoPCs in sediments may be required for waste classification purposes during construction works. ■ Sediment samples returned concentrations of MBT higher than LOR. ERM notes that, while there is no screening criteria for MTB, further consideration may be required for waste classification / disposal requirements.
		Transport of contamination through surface water.	■ Adjacent sensitive receptors; ■ Current and future site users; and ■ Workers carrying out development, installation or maintenance works within the Project Area.	Low	
		Transport of contamination to underlying groundwater aquifers	■ Adjacent sensitive receptors; and ■ Future potential on-site users of groundwater.	Low	
		Transport of contaminants through mechanical transport (during excavation of sediments etc)	■ Workers carrying out development, installation or maintenance works within the Project Area.	High	
Unexploded Ordnance	■ UXO	Disturbance during future construction works	■ Workers / site users ■ Ecological receptors	Low - Moderate	■ ERM notes that UXO mapping indicated the area to the east of the Project Area (outside

Potential Sources	COPCs	Pathways	Potential Receptors	Risk of Potentially Complete Pollutant Linkage	Comment
					the Project Area boundary) was utilised for Mortar firing. ■ ERM notes that an assessment of UXO was not undertaken as part of this Targeted Site Investigation, however, may require further consideration should construction activities be required within areas mapped to contain potential UXO.

5. DATA QUALITY OBJECTIVES

Based on the results of previous investigations summarised in Section 3.0, and with reference to the CSM outlined in Sections 4.1 and 4.2, ERM has developed the following DQOs for this investigation.

The DQOs for this SAQP have been developed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013 (ASC NEPM) and the Australian Standard *AS4482 Guide to the Sampling and Investigation of Potentially Contaminated Soil*.

- ERM notes that AS4482 has now been withdrawn, however as no guidance has been developed to replace this standard, it is considered appropriate for use as a reference document for the purposes of this assessment.

5.1 Step 1 – State the Problem

Following completion of previous investigation works within the Site, the DCCEEW requested further sediment sampling be undertaken to meet the requirements of the Australian Government (2009) *National Assessment Guideline for Dredging*.

The sediment investigation is, therefore, being undertaken to refine the CSM (relating to sediments only) and to identify contamination risks in offshore sediments that may require management prior to or during construction works to enable construction of the Kamay Wharf Project.

5.2 Step 2 – Identify the Decisions

The decisions required to meet the investigation objectives are discussed below:

- Are there (or will the proposed development create) any potential unacceptable risks to human health and / or ecological receptors from contaminants within offshore sediments?
- Is there sufficient information on the distribution and characteristics of contaminated sediments to evaluate risk of harm to human health and/or the environment?
- Is management or remediation of contaminated sediments, if identified, required?
- Is there sufficient information on the distribution and characteristics of contaminated sediments across the Site to develop a Remediation Action Plan or Site Management Plan to (where necessary) remediate and / or manage contaminated sediments?

5.3 Step 3 – Identify Information Inputs

The inputs to make the above decisions include:

- Information relating to the history and environmental setting of the Site and surrounding area obtained during preparation of the PSIs (ERM, 2020a and 2020b) and the TSI (ERM ,2021);
- Field observations made during intrusive investigation works;
- Laboratory analytical data reported for collected sediment samples;
- Field measurements collected during sediment investigation works;
- Screening-level assessment criteria sourced from guidelines made by the Australian Government and made / endorsed by the NSW EPA detailed within Section 7.0; and
- Confirmation of acceptable data quality by assessment of data quality assurance / quality control by comparison against Data Quality Indicators (DQI).

5.4 Step 4 – Define the Study Boundaries

The boundaries of the investigation are identified as follows:

- **Spatial boundaries** – the investigation is limited to the site boundaries as illustrated within Figure 1a and Figure 1b and the maximum depth of investigation at each location is 1 m below the sea floor as detailed within Section 6.0 of this SAQP.
- **Temporal boundaries** – the temporal boundary is limited to the data collected during these investigation works. As such, seasonality will not be assessed at this stage of the investigation.
- **Constraints within the study boundaries** – the following are potential limitations that require consideration as part of the development of the sampling strategy:
  - Restrictions associated with sediment sample collection under water;
  - Access restrictions associated with weather / tides, etc. that have the potential to impact anchor locations, etc;
  - Restrictions associated with recreational and commercial boats and members of the general public utilising the surrounding waters; and
  - Possible presence of underground utilities within the sea floor.

Proposed sample locations have been selected taking into consideration the above factors.

5.5 Step 5 – Develop the Decision Rules

The decision rules adopted for this investigation are included in the table below:

Decision Required to be Made	Decision Rule
Are the data sufficient to address the objectives of the investigation?	■ Do the collected data indicate the potential for significant and widespread contamination within offshore sediments that requires management / remediation to enable construction works ■ Do field observations (including visual, olfactory, presence of anthropogenic materials in fill) indicate potential significant contamination at the investigation locations? ■ Do analytical data exceed adopted screening-level assessment criteria? ■ Have any additional areas of potential environmental concern been identified within investigations works?
Are the data generated by sampling and analysis of an acceptable quality?	■ Have the data collected been subjected to an assessment of quality assurance/quality control and found to be suitable for use in this assessment?
Does the Site contain sediment impacted by contamination resulting from historical land uses?	■ Collected sediment samples are to be analysed for CoPCs associated with current and historical land uses practices and results compared to relevant Australian Government dredging guidelines and NSW EPA made / endorsed regulatory guideline criteria.
Is there evidence of significant widespread contamination?	■ Collected sediment samples are to be analysed for CoPCs associated with current and historical land uses practices and results compared to relevant Australian Government dredging guidelines and NSW EPA made / endorsed regulatory guideline criteria.
Is additional information required to determine the potential liabilities/constraints associated with the proposed development?	■ If it is determined that additional information is required to further reduce the uncertainties associated with the distribution and characterisation of sediment contamination, then appropriate recommendations for further assessment and/or investigation (including for assessment of potential risks) will be provided.
Is there sufficient information to develop a remedial / site management strategy	■ Do the results of the investigation provide sufficient information of the nature, distribution and potential risks to identified receptors of contamination within sediments? If no, additional investigation may be required,

5.6 Step 6 – Specify Limits of Decision Errors

This step establishes the decision maker's tolerable limits on decision errors, which provide performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits for this project have been adopted in accordance with the appropriate guidance from the HEPA (2017) NEMP and the ASC NEPM appropriate data quality indicators (DQIs) used to assess data quality assurance / quality control (QA / QC) and standard ERM procedures for field sampling and sample handling.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined DQIs for precision, accuracy, representativeness, comparability and completeness.

The pre-determined DQIs established for the project are discussed below in relation to precision, accuracy, representativeness, comparability, completeness and sensitivity:

- **Precision** – measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples;
- **Accuracy** – measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this project is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards;
- **Representativeness** – expresses the degree with which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the Site, and by using an adequate number of sample locations to characterise the Site to the required accuracy;
- **Comparability** – expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in sampling techniques, analytical techniques and reporting methods;
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study; and
- **Sensitivity** – expresses the appropriateness of the chosen laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted assessment criteria.

If any of the data quality indicators (DQIs) are not met, further assessment will be necessary to decide whether the non-conformance will significantly affect the usefulness of the data. Corrective actions may include requesting further information from samplers and/or analytical laboratories, downgrading of the quality of the data or alternatively, re-collection of the data. DQIs are provided in the table below.

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Blind duplicates (intra laboratory)	■ 1/20 samples (or 1/10 for PFAS)	■ <30% RPD where result is >10 times LOR
Blind duplicates (inter laboratory)	■ 1/20 samples (or 1/10 for PFAS)	■ <30% RPD where result is >10 times LOR
Accuracy		
Surrogate spikes	■ All organic samples	■ 70-130%
Laboratory control samples	■ 1 per lab batch	■ 70-130%

Data Quality Objectives	Frequency	Data Quality Indicator
Matrix spikes	■ 1 per lab batch	■ 70-130% ■ Lower recoveries may be acceptable for OCPs, OPPs, PCBs and phenols and will be assessed according to USEPA protocols.
Representativeness		
Sampling appropriate for media and analytes	■ NA	■ NA
Samples extracted and analysed within holding times.	■ NA	■ organics (14 days), inorganics (6 months)
Rinsate blank	■ 1 per day where non-dedicated equipment is used. ■ Samples are to be analysed for all CoPCs other than asbestos.	■ Laboratory results are reported <LOR
Trip spike	■ 1 per lab batch (BTEX only)	■ 70-130%
Method blank / field blank	■ 1 per lab batch	■ Laboratory results are reported <LOR
Comparability		
ERM standard operating procedures for sample collection & handling	■ All samples	■ All samples
National Association of Testing Authorities (NATA) accredited analytical methods used for all analyses	■ All samples	■ All samples
Consistent field conditions, sampling staff and laboratory analysis	■ All samples	■ All samples
Completeness		
Sample description and Chain of Custodies completed and appropriate	■ All samples	■ All samples
Appropriate documentation	■ All samples	■ All samples
Satisfactory frequency and result for QC samples	■ All QA / QC samples	■ -
Data from critical samples is considered valid	■ NA	■ Critical samples valid
Sensitivity		
Limits of reporting appropriate and consistent	■ All samples	■ All samples

5.7 Step 7 – Optimise the Design for Obtaining Data

Historic uses of the Site and surrounding area indicate the potential for contamination to be present within sediments that may have the potential to pose a risk to identified sensitive human health / ecological receptors. The potentially contaminating sources and activities undertaken at the Site are detailed above and within the PSI reports (ERM, 2020a) and ERM, 2020b).

Based on the nature of identified potential contamination and the information required to inform potential design / construction procedures for the management of offshore sediments, a targeted assessment of sediments will be undertaken within the Site along the proposed offshore construction alignment.

Proposed sampling locations are presented on **Figure 3a and 3b**.

6. INVESTIGATION METHODOLOGY

6.1 Fieldwork Methodology

The following table summarises the scope of works and methodology to be adopted for the investigation and to meet the requirements detailed within the response from DCCEEW to undertake an assessment for sediments in consideration of the Australian Government (2009) National Assessment Guideline for Dredging.

Proposed sampling locations are illustrated on **Figure 3a** and **Figure 3b**.

Task	Proposed Scope
1 – Project Preliminaries	Prior to the commencement of investigation works, ERM will complete the following: ■ Preparation of a site-specific Health and Safety Plan (HASP) and associated Safe Work Method Statements (SWMS). ERM notes that all project safety / underground service clearance and project permitting will be undertaken by Arup and their nominated commercial diving contractor (McLennan's Diving Services).
2 – Service Location	■ ERM notes that where service locating is required, Arup and McLennan's will undertake appropriate clearance works prior to the commencement of intrusive sampling
3 – Equipment Calibration	All equipment used in the field will be operated under the appropriate technical procedures and calibrated prior to use in accordance with the manufacturer's specifications. ■ The photoionisation detector (PID) will be calibrated to an isobutylene standard at the beginning of each working day in accordance with manufacturer requirements and ERM's SOPs. ■ Water quality meters will be calibrated by the equipment hire company prior to use and relevant calibration certificates retained by ERM. ■ Water quality meters will also be calibrated at the beginning of each day (where used over multiple days) in accordance with the manufacturer specifications. ■ All of the relevant calibration records will be provided as an annex in the investigation reports.
4 - Sediment	■ To enable sample collection, McLennan's Diving Services will undertake vibra-coring sediment sample at 6 locations within the Kurnell site and 6 locations within the La Perouse site. ■ Total sample numbers are based on guidance provided within the 2009 Dredging Guidelines. Sample locations are considered to be representative of overall sediment conditions within the project area and likely be indicative of locations with the highest potential for disturbance during construction and subsequent site operation. It is noted that where sample locations do not contain sufficient sediment for sampling, alterative locations may be required for sampling. ■ ERM notes that based on the identified CoPCs, the collection of samples via vibra-coring is considered appropriate for the required sample collection and analysis. ■ Sediment cores will be drilled to a depth of 1.0 m below the sea floor (unless refusal is encountered). Upon completion of coring the sediment core tube will be sealed and returned to the surface. ■ All locations will be GPS recorded for incorporation into subsequent reporting. ■ Sediment cores will be stored within a chilled esky until all sampling works are completed within each site and then transported to the shore for field screening and sample collection by a suitably qualified environmental scientist. ■ 3 sediment samples per core (36 primary samples in total) and elutriate samples (6 primary samples in total) will be collected from sediment cores from depths of 0.0, 0.5 and 1.0 m and placed in laboratory-supplied containers for subsequent laboratory analysis. ■ A 500 mg sample (duplicate split taken from 0-0.5 m) will be collected at 3 locations from each site (6 in total) and submitted to the laboratory for elutriate analysis. Samples will be chosen for elutriate analysis where field observations indicate potential for contamination (odours/staining, etc.), at depths likely to be affected by

Task	Proposed Scope
	potential future operational disturbances etc and to provide spatial coverage of the investigation area. A 20 L drum of seawater will also be collected from each site for elutriate testing. ■ Elutriate testing will be carried out using the USEPA's standard seawater elutriate test (USEPA, 1991; Simpson et al., 2005). ■ Sediments will be logged by an appropriately trained and experienced scientist/engineer to record the following information: sediment type, colour, grain size, sorting, angularity, inclusions, moisture condition, structure, visual signs of contamination and odour. ■ Sediments will be field screened with a calibrated photoionisation detector (PID) for the presence of ionisable volatile organic compounds. ■ Additional samples will be collected from each sediment core, transported to the laboratory and placed on hold in case further delineation of the vertical extent of contamination may be required. ■ All collected samples will be placed within laboratory-supplied containers, stored in a chilled esky and transported to a NATA accredited laboratory analysis under chain of custody conditions for the required analysis.
5 - Equipment Decontamination	All sampling equipment will be decontaminated between sampling locations where designated disposable materials are not used. All non-dedicated equipment will be decontaminated as follows: ■ all loose sediment will be removed with a wire brush; ■ equipment will be washed in potable (tap) water and brush scrubbed using tap water and a non-phosphate / PFAS free detergent (Decon 90 / Liquinox respectively) and deionised water; ■ rinsed with water; and ■ air dried. Rinsate samples are to be collected as per the requirements of this SAQP to confirm the appropriateness of equipment decontamination.
6 - Waste Materials	Waste materials generated from sampling works will be collected and stored in appropriately labelled dedicated drums or an intermediate bulk container (IBC) within a designated area for subsequent appropriate offsite disposal. Waste tracking records will be maintained and included within the final investigation report.

6.2 Field Quality Assurance and Quality Control

The field quality assurance procedures to be adopted and the field quality control samples to be collected during the investigation are presented in table below.

The field QA / QC plan to be adopted for the investigation has been designed to achieve pre-determined DQIs that will demonstrate the precision, accuracy, representativeness, completeness, comparability and sensitivity of the dataset and that the dataset is of acceptable quality to meet the objectives of the investigation.

Data Type	Comments and Acceptable Control Limits
Field personnel	■ Field personnel; appropriately trained in the collection of environmental samples and inducted into all site-specific client requirements.
Field data collection	■ Site conditions and sample locations properly described. ■ Information to be recorded in field notes. Field notes are appropriately completed and summarised in the report on the investigation.
Sample handling (storage and transport)	■ Sediment will be collected into the sample containers supplied by the selected analytical laboratories and appropriate for the required analysis. ■ All containers will be filled so that minimal headspace is present within the jar. ■ The filled jars will be stored on ice in a chilled, insulated container until received by the analysing laboratory to retard potential sample degradation.

Data Type	Comments and Acceptable Control Limits
	■ Sample numbers, dates, preservation and analytical requirements will be recorded on Chain of Custody documentation, which will also be delivered to the analytical laboratory. ■ All samples are required to be documented as received by the laboratory chilled and intact.
Calibration of Field Equipment	■ The PID will be calibrated at the commencement of each day of sampling, and if necessary, during the day in accordance with the procedure provided by the supplier. ■ Supplier calibration records will be obtained for all equipment sourced for the investigation. ■ Calibration records will be kept for inclusion in the report on the investigation.
Decontamination Procedures	Decontamination of non-dedicated sampling equipment will be undertaken in accordance with ERMs standard procedures and will generally involve: ■ Using clean, disposable nitrile gloves for each sample collection event; and ■ Rinsing all non-disposable equipment with deionised water; then a detergent such as Decon 90; then again with deionised water after each sample collection event. When sampling for PFAS, decontamination of non-dedicated sampling equipment will involve: ■ Rinsing all non-disposable equipment with deionised water; then a detergent such as Liquinox; then again with deionised water after each sample collection event.
Field Duplicates (intra-laboratory and inter-laboratory)	■ Intra-laboratory duplicates will be collected and analysed at a rate of 1 in every 10 primary samples, with a minimum of 1 sample. ■ Inter-laboratory duplicates will be collected and analysed at a rate of 1 in every 10 primary samples, with a minimum of 1 sample. The duplicate samples will be obtained from locations suspected of being contaminated and analysed for the key CoPCs as collected primary samples. ■ Duplicate / Triplicate samples will be collected (i.e. splitting technique) as per the requires of the ASC NEPM and relevant sections of the Australian Government (2009) Dredging Guidelines.
Rinsate Blanks	■ Rinsate blank samples will be collected at a rate of one per day where non-dedicated equipment is used.
Method Blank/Field Blank	■ Laboratory prepared trip blanks will be used and analysed at a rate of one per batch for sediment investigation.
Trip Spikes	■ Laboratory prepared trip spikes will be used and analysed at a rate of one per batch for the sediment investigation

6.3 Sample Nomenclature

Sample nomenclature will be as outlined in the below table:

Sample Media	Sample Location Type	Site	Location	Sample Convention (Example Field Identification)
Sediment	Sediment	Kurnell / La Perouse	SED01	■ K_SED01_Depth ■ LP_SED01_Depth
Elutriate	Sediment	Kurnell / La Perouse	EL_01	■ K_EL01_Depth ■ LP_ EL01_Depth
Field Duplicate	Sediment	Kurnell / La Perouse	All	■ D01_date
Rinsate	Sediment	Kurnell / La Perouse	All	■ R01_date

6.4 Laboratory Methods

All samples collected during this investigation will be submitted to nominated primary and secondary laboratories that use NATA certified methods for all required analysis with LORs which are appropriate for the adopted screening criteria.

6.5 Anticipated Analytical Schedule

The below **table** outlines the analytical requirements. It is noted that laboratory analysis may be modified where observed site-specific conditions indicate a variation in expected CoPCs.

Sample media	Analytical Analysis	Anticipated Primary Sample Numbers
Sediments	■ TRH in the C_6-C_{40} fractions; ■ BTEXN; ■ Heavy metals and metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, Zn)); ■ PAHs; ■ OC and OP pesticides; ■ Organotins: TBT, DBT and MBT; ■ Total Organic Carbon / Grain Size Analysis; and ■ PFAS (30 analytes) – standard limit of reporting	■ 36
Elutriate	■ TRH, BTEXN, Heavy metals and metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, Zn), PAHs, OC and OP pesticides, TBT, DBT, MBT, PFAS	■ 6

The adopted analytical schedule is in general accordance with the requirements detailed within the Australian Government (2009) National Assessment Guidelines for Dredging, however ERM notes that PFAS analysis has been added to the analytical suite due to identified potential sources within the area.

6.6 Laboratory QAQC

The laboratory quality assurance procedures to be adopted and the internal laboratory quality control samples to be analysed and the corresponding acceptable control limits are presented in the table below.

Item	Comments and Acceptable Control Limits
Sample Analysis	All sample analyses to be conducted using NATA certified laboratories which will implement a quality control plan in accordance with the ASC NEPM.
Holding Times	All samples are to be submitted to the laboratory within the required laboratory holding times. Maximum acceptable sample holding times include: ■ Sediments: 7 days for pH and some chlorinated hydrocarbon such as vinyl chloride, 14 days for organic analyses, 6 months for inorganic analyses and indefinite for asbestos.
Laboratory Detection Limits	■ All laboratory detection limits (limits of reporting)? to be less than the adopted assessment criteria.
Laboratory Blanks	■ Laboratory blanks to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch.
Laboratory Duplicates	■ Laboratory duplicates to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch.
Laboratory Control Samples (LCS)	■ LCSs to be analysed at a rate of 1 in 20, with a minimum of one analysed per analytical batch.

Item	Comments and Acceptable Control Limits
Surrogates	■ Surrogate compound concentrations will be required to be spiked at similar concentration to sample results, at a rate of 1 in 20.
Matrix spikes	■ Matrix spikes matrix spike duplicate prepared by dividing a field sample into two aliquots, then spiking each with identical concentrations of the analytes at a rate of 1 in 20.

7. ASSESSMENT CRITERIA

Laboratory data reported for individual sediment / elutriate samples, along with the maximum, minimum, mean, standard deviation and 95% Upper Confidence Limit (UCL) of the mean concentration (if required) will be compared to the relevant assessment criteria detailed within ***Table 3 and Table 4*** of the Australian Government (2009) *National Assessment Guidelines for Dredging* and the Recommended toxicant default guideline values for sediment quality, including both the Default Guideline Values and the Guideline Value-High criteria, and the toxicant default guidelines values for marine water presented in the *Australian and New Zealand Guidelines for Freshwater and Marine Water Quality*.

PFAS results will be screened against the PFOS marine sediment criterion (95% species protection level) presented in *Chronic effects and thresholds for estuarine and marine benthic organism exposure to perfluorooctane sulfonic acid (PFOS)-contaminated sediments: Influence of organic carbon and exposure routes* (Simpson et al., 2021). Published screening criteria for other PFAS COPCs in sediment were not available at the time of writing.

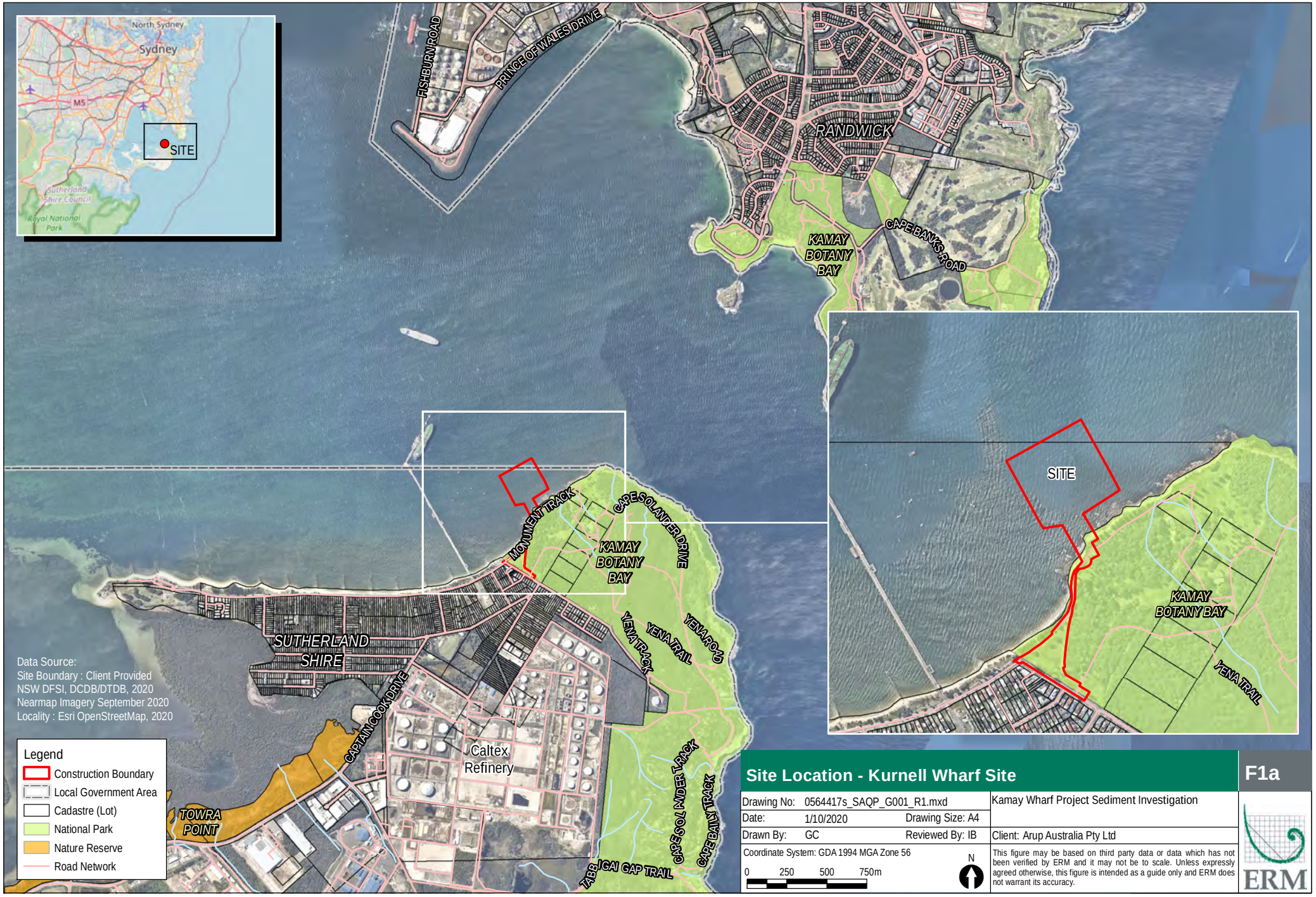
Due to the potential for offsite disposal of sediments during subsequent construction works, analytical results will also be compared against the NSW EPA (2014) Waste Classification Guidelines Part 1: Classifying Waste.

8. REPORTING

On completion of investigative works, ERM will summarise the findings of the investigation in a report consistent with guidelines and reporting requirements made or approved by NSW EPA. The following items will be included as a minimum:

- Executive Summary;
- Introduction, background and objectives, DQOs, scope of works and methodology (including a summary of any deviations from the agreed SAQP);
- Environmental setting;
- A summary of previous investigation results;
- Analytical results;
- Data quality assurance assessment;
- Physical and chemical characteristics controlling contaminant fate and transport;
- Tier 1 / qualitative risk assessment using published guidelines and site-specific data;
- Updated CSM;
- Tables, figures and appendices of supporting documentation from field investigations; and
- Conclusions.

APPENDIX A FIGURES


North Sydney
Sydney
M5
SITE
Sutherland Shire Council
Royal National Park
FISHBURN ROAD
PRINCE OF WALES DRIVE
RANDWICK
KAMAY BOTANY BAY
CAPE BANKS ROAD
MONUMENT TRACK
CAPE SOLANDER DRIVE
KAMAY BOTANY BAY
YENA TRACK
YENA TRAIL
YENA ROAD
SUTHERLAND SHIRE
CAPTAIN COOK DRIVE
Caltex Refinery
TOWRA POINT
CAPE SOLANDER TRACK
CAPE BAILY TRACK
TABBIGAI GAP TRAIL
SITE
KAMAY BOTANY BAY
YENA TRAIL
Data Source:
Site Boundary : Client Provided
NSW DFSI, DCDB/DTDB, 2020
Nearmap Imagery September 2020
Locality : Esri OpenStreetMap, 2020
Legend
Construction Boundary
Local Government Area
Cadastre (Lot)
National Park
Nature Reserve
Road Network
Site Location - Kurnell Wharf Site
F1a
Drawing No: 0564417s_SAQP_G001_R1.mxd
Date: 1/10/2020
Drawing Size: A4
Drawn By: GC
Reviewed By: IB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500 750m
N
Kamay Wharf Project Sediment Investigation
Client: Arup Australia Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Site Location - La Perouse Wharf Site

F1b

Drawing No:	0564417s_SAQP_G002_R0.mxd		Kamay Wharf Project Sediment Investigation
Date:	1/10/2020	Drawing Size: A4	
Drawn By:	GC	Reviewed By: IB	Client: Arup Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 250 500 750m

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Site Layout - Kurnell Wharf Site

F2a

Drawing No:	0564417s_SAQP_G003_R1.mxd		Kamay Wharf Project Sediment Investigation
Date:	1/10/2020	Drawing Size: A3	
Drawn By:	GC	Reviewed By: IB	Client: Arup Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

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Site Layout - La Perouse Wharf Site

F2b

Drawing No: 0564417s_SAQP_G004_R0.mxd	Kamay Wharf Project Sediment Investigation
Date: 1/10/2020 Drawing Size: A3	
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Proposed Sampling Locations - Kurnell Wharf Site

F3a

Drawing No:	0564417s_SAQP_G007_R0.mxd		Kamay Wharf Project Sediment Investigation
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Drawn By:	GC	Reviewed By: IB	Client: Arup Australia Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50 75m

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KAMAY
BOTANY BAY
Legend
Construction Boundary
Cadastre (Lot)
National Park
Ferry Design (Concept)
Proposed Sediment Core Location
Data Source:
Site Layout : Client Provided
NSW DFSI, DCDB/DTDB, 2020
Nearmap Imagery September 2020
Proposed Sampling Locations - La Perouse Wharf Site
F3b
Drawing No: 0564417s_SAQP_G008_R0.mxd
Kamay Wharf Project Sediment Investigation
Date: 1/10/2020
Drawing Size: A3
Drawn By: GC
Reviewed By: IB
Client: Arup Australia Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 25 50 75m
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