Sydney Environmental Group

Remedial Action Plan

277 The Grand Parade, Ramsgate NSW

Bronxx Pty Ltd

Report No: 2781-RAP-01-211024.v1f

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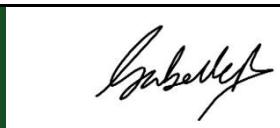
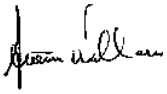
Author Signature		**Reviewer Signature**	
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EXECUTIVE SUMMARY

Sydney Environmental Group (SE) were engaged by Bronxx Pty Ltd (the client), to prepare a Remedial Action Plan (RAP) for the property located at 277 The Grand Parade, Ramsgate NSW (refer **Figure 1** with the 'site' boundaries outlined in **Figure 2**).

SE has the following project appreciation:

- The entirety of the site covers an area of approximately 4500 m^2;
- The site is proposed for redevelopment, comprising demolition of existing structures prior to construction of a multistorey mixed use building underlain by two (2) basement levels;
- A Stage 1 Preliminary Site Investigation (PSI) with limited sampling was undertaken by JK Environments in June 2022 (JKE 2022) which identified several data gaps requiring further assessment following demolition works;
- A Remedial Action Plan (RAP) is required to outline the objectives of the supplementary contamination assessment proposed to be undertaken following demolition works and to outline a preliminary remedial plan for potential Areas of Environmental Concern (AEC) which may be uncovered following the supplementary assessment; and
- This report has been prepared to satisfy Clause 7 (2) and (3) of SEPP *'Resilience and Hazards'* and local council planning policies.

The objectives of this RAP are to:

- Undertake an additional Detailed Site investigation (DSI) to address data gaps identified in the previous contamination assessment undertaken for the site following the completion of demolition works;
- Prepare a preliminary Remedial Action Plan (RAP) to address the potential contamination that may be encountered following the DSI and to provide a preliminary strategy to mitigate the potential unacceptable human health and environmental risks from residual soil and groundwater by exploring available remediation options that will effectively and efficiently provide this outcome; and
- Achieve an acceptable outcome that is technically, logistically and financially feasible.

The scope of the RAP has been established on the basis of findings from the previous contamination investigation, with the RAP aimed at providing:

- Provision to undertake as supplementary detailed site investigation to address data gaps identified in previous contamination assessment;
- An appropriate draft remedial strategy (to be informed by the yet to be completed supplementary detailed site investigation) to render the site suitable for the proposed high-density residential and commercial land-use;
- Appropriate requirements for the validation and verification of the successful implementation of the remediation strategy and the remediation acceptance criteria to be adopted;
- Appropriate environmental safeguards required to conduct the remediation works in an environmentally acceptable manner; and
- OH&S procedures required to conduct the remediation works in a manner that will not pose a threat to the health of site workers or users.

The available site data was assessed within the objectives of this investigation and in the context of the proposed development works. That assessment identified areas of environmental concern (AECs) and contaminants of concern which have the potential to be present on site. The AECs identified are presented in attached **Figure 3** and associated contaminants of concern are presented in **Table 5.1.1** overleaf.

Table 5.1.1 AECs and Contaminants of Concern

ID	Area of Environmental Concern	Source	Contaminants of Concern	Affected mediums	Exposure risk
AEC01	Fill Materials Across the Site Footprint	Importation of impacted materials, Use of Pesticides	Metals, PAH, TRH/BTEX, OCP, PCB, Asbestos	Soil	Human Health, Ecological and Aesthetic
AEC02	On-Site Structures	Hazardous Building Materials	Asbestos, Lead, SMF, PCB	Building Materials	Human Health and Aesthetic
AEC03	Off-Site Land Use Activities (Service Station)	Leaks and Spills from Underground Storage Tanks	Metals, PAH, TRH/BTEX, Phenols	Groundwater	Human Health and Ecological
AEC04	Asbestos Impacted Soil Materials associated with 'BH2' (JKE 2022)	Uncontrolled Demolition and Filling	Asbestos	Soil	Human Health and Aesthetic
AEC05	Nickel and Asbestos Impacted Soil Materials associated with 'BH6' (JKE 2022)	Uncontrolled Demolition and Filling	Nickel, Asbestos	Soil	Human Health, Ecological and Aesthetic
AEC06	Nickel Impacted Soil Materials associated with 'BH1' and 'BH4' (JKE 2022)	Uncontrolled Filling	Nickel	Soil	Ecological
AEC07	Heavy Metal Impacted Groundwater as identified within JKE 2022	Off-Site Land Use Activities	Arsenic, Copper, Zinc	Groundwater	Human Health

The remedial goal for this site is to remediate potential contamination (where identified) to a level that does not present an unacceptable human health exposure and environmental risks, based on the proposed land use setting. SE notes that the client, would prefer that the remedial works be undertaken in a manner that does not result in the need for:

- Notation on a planning certificate for the site;
- A covenant registered on the title to the land; or
- A long-term environmental management plan (EMP).

The extent of contamination within the site is presented within **Table 9.2.1** overleaf.

Table 9.2.1 Approximate Remedial Extents

ID	Area of Environmental Concern	Dimensions / Area	Depth / Height	Volume / Mass
AEC01	Fill Materials Across the Site Footprint	≈ 4500 m^2	TBC	TBC
AEC02	On-Site Structures	TBC	TBC	TBC
AEC02	Off-Site Land Use Activities (Service Station)	TBC	TBC	TBC
AEC04	Asbestos Impacted Soil Materials associated with 'BH2' (JKE 2022)	5 x 5 m / 25 m^2 (BH2), extent TBC following supplementary DSI	≈ 1.2 m (BH2), extent TBC following supplementary DSI	≈ 30 m^3 / 54 tonnes extent TBC following supplementary DSI
AEC05	Nickel and Asbestos Impacted Soil Materials associated with 'BH6' (JKE 2022)	5 x 5 m / 25 m^2 (BH6), extent TBC following supplementary DSI	≈ 1.1 m (BH6), extent TBC following supplementary DSI	≈ 27.5 m^3 / 50 tonnes extent TBC following supplementary DSI
AEC06	Nickel Impacted Soil Materials associated with 'BH1' and 'BH4' (JKE 2022)	5 x 5 m / 25 m^2 (BH1) & 5 x 5 m / 25 m^2 (BH4), extent TBC following supplementary DSI	≈ 1 m (BH1) & ≈ 1.2 m (BH4), extent TBC following supplementary DSI	≈ 25 m^3 / 45 tonnes (BH1) ≈ 30 m^3 / 54 tonnes (BH4) extent TBC following supplementary DSI
AEC07	Heavy Metal Impacted Groundwater as identified within JKE 2022	TBC	TBC	TBC

Notes to Table: *N/A: Not Applicable, TBC: To Be Confirmed following the supplementary DSI and/or Hazardous Building Material Survey*

Refer to **Figure 3**, for an indication of the areas and lateral extents that will be subject to remediation.

It is noted that the lateral extent of remediation may be altered during remedial works based on site observations and validation soil sample analytical laboratory results.

Taking into consideration the client's objectives for the site, and the nature and extent of the proposed site redevelopment works, the preferred remedial options are outlined in **Table 8.4.1** below.

Table 8.4.1 Selected Remediation Strategies

Contamination Type	Preferred Remediation Strategy
Soil materials impacted with foreign materials and non-friable asbestos	Excavation and disposal off-site OR cap and containment
Soil materials impacted by friable asbestos *(if identified*)	Excavation and disposal off-site OR cap and containment
Soil materials impacted by direct contact risks (BTEX, Heavy Metals, PAH, PCBs, & TRH) *(if identified*)	Excavation and disposal off-site OR cap and containment
Hazardous building materials *(if identified)*	Excavation and disposal off-site
Soil materials impacted by ecological risks (BTEX, Heavy Metals, PAH & TRH)	Excavation and disposal off-site OR cap and containment

Based on the information presented in the historical contamination assessment reports, SE concludes that the remedial goal can be achieved, and the site made suitable for the proposed land use setting, subject to:

- Completion of a supplementary DSI to address data-gaps identified in previous contamination assessments undertaken for the site following demolition activities and prior to the start of remedial works, per **Figure 3**;
- Implementation of the strategies, methodologies and measures set out in this remedial action plan;
- Should newly identified unacceptable land contamination risks be identified during supplementary assessment works, an addendum or modification and revision to this RAP will be required. Any amendments are to be prepared by a suitably experienced environmental consultant;
- Prior to any removal of soils from site for offsite disposal during remedial works, a waste classification for those soils should be prepared by a suitably experienced environmental consultant; and
- Future remedial works should be monitored and validated by a suitably experienced environmental consultant.

This report must be read in conjunction with the limitations set out in **Section 14**.

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Appendices

LIST OF ABBREVIATIONS

A list of the common abbreviations used throughout this report is provided below:

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Aboveground storage tank
Bgs	Below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CoC	Chain of Custody
CSM	Conceptual Site Model
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
GS	Geological Survey of NSW
HIL	Health Investigation Levels
HSL	Health Screening Levels
IL	Investigation Levels
LOR	[Laboratory] Limit of reporting
NATA	National Association of Testing Laboratories
N/A	Not applicable
ND	Not detected
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NSW EPA	NSW Environment Protection Authority
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PID	Photo-ionisation detector
PSI	Preliminary Site Investigation
QA/QC	Quality assurance/Quality control
RPD	Relative percentage difference
SAQP	Sampling Analysis and Quality Plan
SE	Sydney Environmental Group Pty Ltd
SVOC	Semi-volatile organic compound
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UST	Underground storage tank
VOC	Volatile organic compound

1 INTRODUCTION

1.1 Background

Sydney Environmental Group (SE) were engaged by Bronxx Pty Ltd (the client), to prepare a Remedial Action Plan (RAP) for the property located at 277 The Grand Parade, Ramsgate NSW (refer **Figure 1** with the 'site' boundaries outlined in **Figure 2**).

SE has the following project appreciation:

- The entirety of the site covers an area of approximately 4500 m^2;
- The site is proposed for redevelopment, comprising demolition of existing structures prior to construction of a multistorey mixed use building underlain by two (2) basement levels;
- A Stage 1 Preliminary Site Investigation (PSI) with limited sampling was undertaken by JK Environments in June 2022 (JKE 2022) which identified several data gaps requiring further assessment following demolition works; and
- A Remedial Action Plan (RAP) is required to outline the objectives of the supplementary contamination assessment proposed to be undertaken following demolition works and to outline a preliminary remedial plan for potential Areas of Environmental Concern (AEC) which may be uncovered following the supplementary assessment.

1.2 Proposed Development

The site is proposed for redevelopment comprising demolition of the existing buildings and structures prior to construction of a multistorey mixed use building underlain by two (2) basement levels. SE understand the mixed use land use will comprise a combination of commercial and high-density residential.

This redevelopment scenario is consistent with the definition of 'HIL B – High-density residential with limited access to soils' per ASC NEPM 2013. Currently under the *State Environmental Planning Policy (SEPP) 'Resilience and Hazards'*, a consent authority must not consent to the carrying out of any redevelopment unless it has considered whether the land is contaminated.

This report has been prepared to satisfy Clause 7 (2) and (3) of SEPP *'Resilience and Hazards'* and local council planning policies.

1.3 Objectives

The objectives of this RAP are to:

- Undertake an additional Detailed Site investigation (DSI) to address data gaps identified in the previous contamination assessment undertaken for the site following the completion of demolition works;
- Prepare a preliminary Remedial Action Plan (RAP) to address the potential contamination that may be encountered following the DSI and to provide a preliminary strategy to mitigate the potential unacceptable human health and environmental risks from residual soil and groundwater by exploring available remediation options that will effectively and efficiently provide this outcome; and
- Achieve an acceptable outcome that is technically, logistically and financially feasible.

1.4 Scope of Remedial Action Plan

The scope of the RAP has been established on the basis of findings from the previous contamination investigation, with the RAP aimed at providing:

- Provision to undertake as supplementary detailed site investigation to address data gaps identified in the previous contamination assessment following demolition works and prior to the start of remedial works;
- An appropriate draft remedial strategy (to be informed by the yet to be completed supplementary detailed site investigation) to render the site suitable for the proposed high-density residential and commercial land-use;

- Appropriate requirements for the validation and verification of the successful implementation of the remediation strategy and the remediation acceptance criteria to be adopted;
- Appropriate environmental safeguards required to conduct the remediation works in an environmentally acceptable manner; and
- OH&S procedures required to conduct the remediation works in a manner that will not pose a threat to the health of site workers or users.

2 SITE IDENTIFICATION

The site identification details and associated information are presented in Error! Reference source not found..

Table 1.4.1 Site Identification Information

Attribute	Description
Street Address	277 The Grand Parade, Ramsgate NSW
Lot and Deposited Plan (DP)	Lot 8 DP11037
Geographical Coordinates	33°59'10.51"S 151°8'47.91"E (Centre of site)
Site Area	≈ 4500 m^2
Local Government Area (LGA)	Bayside Council
Parish	St George
County	Cumberland
Zoning	MU1 Mixed Use Bayside Local Environmental Plan 2021

The locality of the site is set out in **Figure 1**.

The general layout and boundary of the site is set out in **Figure 2**.

3 GEOLOGY, ACID SULFATE SOILS, TOPOGRAPHY AND HYDROGEOLOGY

Regional geology, topography, soil landscape and hydrogeological information are presented in **Table 1.4.1.**

Table 1.4.1 Regional Setting Information

Attribute	Description
Climate	A review of the closest weather station to the site (Sydney Airport AMO, ID: 066037) indicated that the climate is relatively mild with average maximum temperatures ranging from 17.2 to 26.7 °C and minimum temperatures ranging from 7.4 – 19.2 °C throughout the year. Rainfall is relatively varied across the year, ranging from 6.7 days of rain per month in August, to 9.5 average days of rainfall per month in March. Average monthly rainfall varied from 45.8 mm in August up to 100.4 mm in June.
Geology	A review of the Environment NSW 'eSpade V2.2' web application (environment.nsw.gov.au/eSpade2WebApp, accessed 21 October 2024), indicated that the site is likely to be underlain by Quaternary (Holocene and Pleistocene) wind-blown, fine to medium grained, well sorted marine quartz sands.
Acid Sulfate Soils (ASS)	A review of the Environment NSW 'eSpade V2.2' web application (environment.nsw.gov.au/eSpade2WebApp, accessed 21 October 2024), indicates that the site lies in an area mapped as ***'L2 Low Probability'*** with respect to acid sulfate soils. This infers that acid sulfate soils may be present 1-3 m below ground surface. Further assessment of acid sulfate soils in the context of this investigation is considered by SE as warranted during the supplementary DSI.
Topography	Per JKE (2022), the site and regional topography are generally flat, with a very gentle slope towards Botany Bay to the east. Given the surrounding topography, parts of the site appear to have been levelled to accommodate the existing development. The site is located at an elevation approximately 3 m to 9 m Australian Height Datum (AHD).
Hydrology and Hydrogeology	Per JKE (2022), the regional aquifer on-site and in the areas immediately surrounding the site include porous, extensive aquifers of low to moderate productivity. A total of six-hundred and three (603) groundwater bores were reported within a 2000 m buffer of the site. In summary: • A bore onsite was registered for general use; • The next closest bore was registered 5 m to the south-west of the site. This bore was registered for domestic purposes; • The majority of the bores were registered for domestic purposes; and • The drillers log information from the closest bores typically identified fill and/or sand soils to the maximum depth of 12.5 m. Standing water levels (SWLs) in the bores ranged from 1.52 m bgsl to 5.49 m bgsl. Subsurface conditions at the site are expected to consist of high permeability (marine) soils overlying relatively deep bedrock. Abstraction and use of groundwater at the site or in the immediate surrounds appears to be viable under these conditions based on the numerous registered bores in the vicinity of the site, however, the use of groundwater is not proposed as part of the development. There is a reticulated water supply in the area and consumption of groundwater is not expected to occur. SE understand Lady Robinsons Beach and Botany Bay are located approximately 75 m to the east of the site.
Adjacent Sensitive Receptors	A review of the Bureau of Meteorology Groundwater Dependent Ecosystem Map was undertaken to determine the closest sensitive ecological receptors. The closest ecological receptors are those residing in Botany Bay, located 75 m east of the site. The closest sensitive human receptors are the residential properties surrounding the site's boundary and any future onsite construction workers/ builders.

4 PREVIOUS CONTAMINATION ASSESSMENTS

The following report was reviewed during the project:

- JK Enivornments (JKE 2022), 'Report to Good Time Holdings on Preliminary (Stage 1) Site Investigation (PSI) for Proposed Mixed Use Development at 277 The Grand Parade, Ramsgate, NSW', dated 28 June 2022, Ref: E34871PTrpt.

A summary of the previous contamination assessment is provided in **Section 4.1** below.

4.1 JKE 2022 – Stage 1 Preliminary Site Investigation

Good Time Holdings NSW, care of Bronxx Pty Ltd, commissioned JK Environments (JKE) to undertake a Preliminary (Stage 1) Site Investigation (PSI) for the proposed mixed use development at 277 The Grand Parade, Ramsgate NSW. The purpose of the investigation was to make a preliminary assessment of site contamination.

The report was prepared to support the lodgement of a Development Application (DA) for the proposed mixed use development, with regards to State Environmental Planning Policy (Resilience and Hazards) 2021 (formerly known as SEPP55).

It was understood that the proposed development was in the concept stage, however is likely to include demolition of the existing buildings and structures prior to construction of a multi storey mixed use building underlain by two basement levels. The finished floor level of the lowest proposed basement level has not been provided. However, we assume excavation to a maximum depth of approximately 6m below existing ground surface levels will be required. The concept plans indicate that the proposed basement will extend to the site boundaries, with the exception of a small setback in the south-western corner of the site.

The primary aims of the investigation were to identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make a preliminary assessment of the soil and groundwater contamination conditions. Secondary aims were to provide a preliminary waste classification for disposal of waste soil to be generated during the proposed development works, and to assess the potential for acid sulfate soil (ASS) occurrence and the need for an ASS management plan (ASSMP). The objectives were to:

- Provide an appraisal of the past site use(s) based on a review of historical records;
- Assess the current site conditions and use(s) via a site walkover inspection;
- Identify potential contamination sources/areas of environmental concern (AEC) and contaminants of potential concern (CoPC);
- Assess the soil and groundwater contamination conditions via implementation of a preliminary sampling and analysis program;
- Prepare a conceptual site model (CSM);
- Assess the potential risks posed by contamination to the receptors identified in the CSM (Tier 1 assessment);
- Provide a preliminary waste classification assessment for off-site disposal of soil;
- Provide a preliminary assessment of the occurrence of ASS and assess the need for an ASSMP;
- Assess whether the site is suitable or can be made suitable for the proposed development (from a contamination viewpoint); and
- Assess whether further intrusive investigation and/or remediation is required.

The scope of works included the following:

- Review of site information, including background and site history information from various sources outlined in the report;
- Preparation of a CSM;
- Design and implementation of a sampling, analysis and quality plan (SAQP);
- Interpretation of the analytical results against the adopted Site Assessment Criteria (SAC);
- Data quality assessment; and
- Preparation of a report including a Tier 1 risk assessment.

The site history information and site walkover inspection identified the following AEC:

- Imported fill material;
- Historic onsite mechanics workshop;
- Use of pesticides;
- Hazardous building materials; and
- An off-site service station (located in close proximity to site).

Soil samples were obtained from seven (7) boreholes and groundwater sampling was undertaken from two (2) monitoring wells installed at the site. The boreholes encountered fill materials to depths of approximately 0.3m below ground level (BGL) to 1.5mBGL, underlain by sandy marine soils. The fill contained inclusions of igneous gravel, silt, concrete and terracotta fragments and ash. Asbestos and nickel were identified in soil at concentrations that exceeded the human health and ecological SAC respectively. Heavy metals (arsenic, copper and zinc) were also identified in groundwater above the ecological (marine) SAC.

The PSI had not identified contamination that would preclude the proposed development/use of the site. However, a Detailed Site Investigation (DSI) was recommended to address the data gaps identified in Section 10.4, characterise the risks and establish whether remediation is necessary (and inform the preparation of a remediation action plan (RAP) where required). JKE recommended the following:

- Prepare a Sampling, Analysis and Quality Plan (SAQP) for the DSI;
- Undertake a DSI in accordance with the SAQP; and
- Where required, develop and implement a RAP. Any requirements documented in the RAP are to be implemented and the site is to be remediated and validated.

The natural soil below a depth of 5mBGL is considered to be potential acid sulfate soils (PASS). An ASSMP should be prepared once specific details of the development are known, including final depths of disturbance etc. The need for additional sampling and analysis for ASS characteristics should be assessed as the design progresses.

JKE considered that there was no requirement to report any site contamination to the NSW EPA under the NSW EPA Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997 (2015) and that this would be further evaluated as part of the DSI.

SE note that a Detailed Site Investigation cannot be undertaken at the site prior to approval of the Development Application (DA) as the site is still in use under a commercial land use setting. As asbestos was encountered during the borehole assessment by JKE, test pits are required to be undertaken across the site following demolition works to ensure that the assessment is appropriate for the contamination previously identified, as borehole assessments present limitations for the detection of asbestos containing materials and their condition. As such, the Detailed Site Investigation will be undertaken per ***Sections 6*** *and* ***7*** *within this RAP, following approval of the DA and demolition of the existing structures.*

5 PRELIMINARY CONCEPTUAL SITE MODEL

5.1 Areas of Environmental Concern and Contaminants of Concern

The available site data was assessed within the objectives of this investigation and in the context of the proposed development works. That assessment identified areas of environmental concern (AECs) and contaminants of concern which have the potential to be present on site. The AECs identified are presented in attached **Figure 3** and associated contaminants of concern are presented in **Table 5.1.1** below.

Table 5.1.1 AECs and Contaminants of Concern

ID	Area of Environmental Concern	Source	Contaminants of Concern	Affected mediums	Exposure risk
AEC01	Fill Materials Across the Site Footprint	Importation of impacted materials, Use of Pesticides	Metals, PAH, TRH/BTEX, OCP, PCB, Asbestos	Soil	Human Health, Ecological and Aesthetic
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AEC04	Asbestos Impacted Soil Materials associated with 'BH2' (JKE 2022)	Uncontrolled Demolition and Filling	Asbestos	Soil	Human Health and Aesthetic
AEC05	Nickel and Asbestos Impacted Soil Materials associated with 'BH6' (JKE 2022)	Uncontrolled Demolition and Filling	Nickel, Asbestos	Soil	Human Health, Ecological and Aesthetic
AEC06	Nickel Impacted Soil Materials associated with 'BH1' and 'BH4' (JKE 2022)	Uncontrolled Filling	Nickel	Soil	Ecological
AEC07	Heavy Metal Impacted Groundwater as identified within JKE 2022	Off-Site Land Use Activities	Arsenic, Copper, Zinc	Groundwater	Human Health

The potential contamination pathways are considered to be as follows:

- Inhalation/ingestion of contaminants released in dust during redevelopment by site workers;
- Direct contact, ingestion or inhalation of soil by future site inhabitants;
- Permeation of hydrocarbons / organic contamination into underground services onsite; and
- Migration of volatile compounds from surrounding land uses in groundwater.

Relevant potential receptors are considered to include:

- Onsite construction and maintenance workers;
- Third parties during construction (adjacent site users and adjacent residents);
- Onsite flora and fauna;
- Future residents/end users;
- Neighbouring residential land users; and
- Botany Bay.

5.2 Land Use Setting

SE understand that the proposed development will comprise of demolition of existing structures prior to the construction of a multi storey mixed use building underlain by two (2) basement levels. The estimated depth of excavation for the basement carpark is 6 m bgsl and is understood to laterally extend across the site footprint with the exception of a small setback in the south-western corner of the site.

Based on the presumed development works and guidance provided in NEPM ASC 2013, SE considers it reasonable to adopt the *'HIL B – high-density residential with limited access to soils'* land use setting for the purpose of assessing land contamination exposure risks. The land use is understood to be residential with minimal opportunities for soil access and includes dwelling with fully and permanently paved yard space such as high-rise building and flats.

5.3 Direct Contact – Human Health

SE notes that the proposed development will include a building across the entire site footprint with two (2) basement levels extending approximately 6 m bgsl. The building footprint would act as a direct contact barrier between potential land contamination and onsite receptors during operation of the site.

During construction, the public and construction employees, may complete the direct contact exposure pathway between potential contamination and receptors. Based on JKE (2022), there is potential direct contact risks may be present within the site in uncontrolled fill materials and as such, requires further assessment.

5.4 Inhalation / Vapour Intrusion – Human Health

In order for a potentially unacceptable inhalation / vapour intrusion human health exposure risk to exist, a primary vapour source (e.g. underground storage tank) or secondary vapour source (e.g. significantly contaminated soil or groundwater) must be present onsite. There is a moderate to high potential for a primary source to be present within an adjacent service station to the site. Based on JKE (2022), a groundwater source of vapours was not detected within sampling undertaken, however, further assessment is required to determine whether a vapour risk exists.

Based on JKE (2022), asbestos containing materials are present within fill materials at the site. The current extent of the asbestos contamination is currently unknown and further assessment is considered warranted.

5.5 Management Limits for Petroleum Hydrocarbon Compounds

NEPM ASC 2013 notes that there are a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosive hazards; and
- Effects on buried infrastructure (e.g. penetration of or damage to, in-ground services by hydrocarbons).

Schedule B1 of NEPM ASC 2013 includes 'management limits' to avoid or minimise these potential effects. Application of the management limits requires consideration of site-specific factors such as the depth of building basements and services and depth to groundwater, to determine the maximum depth to which the limits should apply. NEPM ASC 2013 also notes that management limits may have less relevance at operating industrial sites which have no or limited sensitive receptors in the area of potential impact, and when management limits are exceeded, further site-specific assessment and management may enable any identified risk to be addressed. Further assessment of this value is considered warranted.

5.6 Aesthetics

Section 3.6.3 of NEPM ASC 2013 advises that there are no specific numeric aesthetic guidelines, however site assessment requires a balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity.

SE notes that the proposed development will include a building across majority of the site footprint limiting access to soil materials at the site. The asbestos containing materials (ACM) identified at the site (JKE 2022) will likely pose an aesthetics risk at the site following bulk earthworks if contamination is not completely removed. As such, further assessment of this value is considered warranted.

5.7 Terrestrial Ecosystems – Ecological Health

Section 3.4.2 of Schedule B1 NEPM ASC 2013, advises a pragmatic risk-based approach should be taken when assessing ecological risks in residential and commercial / industrial land use settings.

SE notes that the proposed development will include a building across majority of the site footprint limiting access to soil materials at the site. As ecological risks are currently understood to be present at the site (JKE 2022), further assessment of this value is considered warranted.

5.8 Aquatic Ecosystems (Ground and Surface Water)

Surface water courses proximal to the site include Botany Bay, located approximately 75 m east of the site.

As a reticulated water supply is present within the general area and due to the presence of a marine water system within close proximity to the site, groundwater is not considered to be a likely resource of value for consumption.

There is high potential that the usage of these surface water courses within proximity to the site would include swimming, fishing for consumption and/or water sports. As such, this pathway should be considered and further assessed based on the results of the supplementary DSI, in the event contamination is identified.

6 SUPPLEMENTARY CONTAMINATION ASSESSMENT

In light of data-gaps identified within JKE (2022), it has been concluded that a supplementary contamination assessment is required to sufficiently characterise the site and meet statutory requirements per relevant legislation and guidelines.

As the entire site is currently still utilised within its existing land use, access to the site is currently not possible for the purposes of a Detailed Site Investigation. As such, SE propose a supplementary DSI to be undertaken following the completion of demolition works within the site.

6.1 Objectives and Scope of Work

The objectives of the DSI are to:

- Assess data-gaps identified in the previous contamination assessment undertaken for the site (JKE 2022);
- Undertake an intrusive site investigation to facilitate the collection of representative soil and groundwater samples;
- Engage a NATA accredited laboratory to analyse selected samples collected during the field investigation;
- Provide a thorough and conclusive assessment of the contamination status of the fill materials and groundwater within the site; and
- Provide updated advice to inform this RAP and detail any further investigation, management and/or remediation (if warranted).

6.2 Site Assessment Criteria

Taking into consideration the objectives of this project, and the conceptual site model and land use setting presented in **Section 5** of this project, the following assessment criteria have been adopted for this project:

- Human health direct contact – HILs in Table 1A (1) in NEPM ASC 2013 and HSLs in Table B4 of Friebel, E & Nadebaum, P (2011);
- Human health inhalation/vapour intrusion – HSLs in Table 1 (A) in NEPM ASC 2013;
- Human health (asbestos) – absence / presence for preliminary screening, and no visible ACM on surface;
- Petroleum hydrocarbon compounds (management limits) – Table 1 B (7) of NEPM ASC 2013;
- Ecological Investigation and Screening Levels as calculated per NEPM ASC 2013 Table 1 (B) 1-6; and
- Aesthetics – no highly malodorous site media (e.g. strong residual petroleum hydrocarbon odours, hydrogen sulphide in site media, organosulfur compounds), no hydrocarbon sheen on surface water, no discoloured chemical deposits or soil staining with chemical waste other than of a very minor nature, no large monolithic deposits of otherwise low risk material (e.g. gypsum as powder or plasterboard, cement kiln dust), no presence of putrescible refuse including material that may generate hazardous levels of methane such as a deep-fill profile of green waste or large quantities of timber waste, and no soils containing residue from animal burial (e.g. former abattoir sites).

7 SUPPLEMENTAY CONTAMINATION ASSESSMENT DATA QUALITY OBJECTIVES

Appendix B of NEPM ASC 2013 provides guidance on the development of data quality objectives (DQO) using a seven-step process.

The DQO for this project are set out in **Sections 7.1** to **7.7** of this report.

7.1 Step 1: State the problem

The first step involves summarising the contamination problem that will require new data and identifying the resources available to resolve the problem.

The objective of this project is to assess whether the remedial goal has been achieved, and whether the site presents an unacceptable human health exposure risk, for the proposed land use setting.

This project is being undertaken because:

- The site is the subject of proposed redevelopment works;
- A preliminary site investigation undertaken at the site has indicated that contamination may be present at the site and requires further assessment;
- Historically identified areas of environmental concern on the site, have the potential to present an unacceptable human health and ecological exposure risk in the context of the proposed land use setting;
- Previous investigations undertaken within the site were considered insufficient to characterise the site; and
- There are constraints to site access due to continued existing activities and as such, the supplementary DSI is proposed to be undertaken once current activities at the site have ceased and access to the entire site footprint is possible.

The project team identified for this project includes Sydney Environmental Group Pty Ltd, the client and the planning consent authority.

The regulatory authorities identified for this investigation include NSW EPA and the Local Council.

7.2 Step 2: Identify the decision/goal of the study

The second step involves identifying decisions that need to be made about the contamination problem and the new environmental data required to make them.

The decisions that need to be made during this investigation include:

- Is the environmental data collected for the project, suitable for assessing relevant land contamination exposure risks?
- Do concentrations of identified contaminants of potential concern (COPC) present an unacceptable exposure risk to identified receptors, for the proposed land use setting and require remediation?

7.3 Step 3: Identify the information inputs

The third step involves identifying the information needed to support decisions and whether new environmental data will be needed.

The inputs required to make the decisions set out in **Section 7.2** for this investigation, will include:

- Data obtained in the previous contamination assessment (JKE 2022);
- The nature and extent of sampling at the site, including both density and distribution;
- Samples of relevant site media;
- The measured physical and/or chemical parameters of the site media samples (including field screening and laboratory analysis, where relevant); and
- Assessment criteria adopted for each of the media sampled.

7.4 Step 4: Define the boundaries of the study

The fourth step involves specifying the spatial and temporal aspects of the environmental media that the data must represent to support decisions.

The spatial extent of the project will be limited to the site as defined by its boundaries.

The temporal boundaries of the project include:

- The project timeframes by SE for this project, and subsequent remediation contractor works program;
- Unacceptable weather conditions at the time of undertaking fieldwork, including rainfall, cold and/or heat;
- Access availability of the site (to be defined by the site owner/representative); and
- Availability of SE field staff (typically normal daylight working hours, Monday to Friday).

The lateral extent that contamination is expected to be distributed across, based on the conceptual site model, is defined by the inferred boundaries of the areas of environmental concern (AEC) and may be altered based on the data collected during the supplementary contamination assessment.

The vertical extent that contamination is expected to be distributed across, based on the conceptual site model, is defined by the inferred boundaries of the previously identified areas of environmental concern (AEC) and may be altered based on the data collected during the supplementary contamination assessment.

The scale of the decisions required will be based on the entire site.

Constraints which may affect the carrying out of this investigation may include access limitations, presence of above and below ground infrastructure, and hazards creating health and safety risks.

7.5 Step 5: Develop the analytical approach (or decision rule)

The fifth step involves defining the parameter of interest, specifying the action level, and integrating information from Steps 1 to 4 into a single statement that gives a logical basis for choosing between alternative actions.

7.5.1 Rinsate Blank Samples

One rinsate blank sample will be collected and scheduled for analysis, for each day of sampling undertaken where non-disposable sampling equipment is used. The rinsate blank will be analysed for at least one of the analytes that the samples will be scheduled for analysis for (with the exception of asbestos).

7.5.2 Trip Spikes and Trip Blank Samples

One trip spike and trip blank sample will be used and scheduled for analysis, for each day of sampling undertaken, if site samples being collected that day are being analysed for volatile contaminants of concern (typically BTEX and/or TRH C_6-C_{10}).

7.5.3 Intra-Laboratory and Inter-Laboratory Duplicates

Intra-laboratory and inter-laboratory field duplicates will be collected at a rate of one per twenty (5%) site samples collected. The duplicates collected will be analysed for at least one of the analytes that the parent sample of the duplicate/triplicate is being scheduled for analysis for (with the exception of asbestos).

The relevant percent difference (RPD) of concentrations of relevant analytes, between the parent sample and the duplicate will be calculated.

7.5.4 Laboratory Analysis Quality Assurance / Quality Control

The analytical laboratory QA/QC program will typically include laboratory method blank samples, matrix spike samples, surrogate spike samples, laboratory control samples, and laboratory duplicate samples.

7.5.5 If/Then Decision Rules

SE has adopted the following 'if/then' decision rules for this investigation:

- If the result of the assessment of field data and laboratory analytical data is considered acceptable, then that field data and laboratory analytical data is suitable for interpretation within the scope of this investigation; and
- If the field data and laboratory analytical data is within the constraints of the assessment criteria adopted for this investigation (refer **Section 8.3**), then the contamination exposure risks to identified receptors, are considered acceptable.

In the event the assessment of field data and/or laboratory analytical data results in the data being not suitable for interpretation, then SE will determine if additional data is required to allow interpretation to be undertaken.

In the event that field data and/or laboratory analytical data exceeds the assessment criteria adopted for this investigation (refer **Section 6.2**), SE will undertake an assessment of the exceedance in the context of the project objectives to determine if additional data is required and whether management and/or remediation is required.

7.6 Step 6: Specify the performance or acceptance criteria

The sixth step involves specifying the decision maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data. When assessing contaminated land, there are generally two types of errors in decision making:

- Contamination exposure risks for a specific land use setting are acceptable, when they are not; and
- Contamination exposure risks for a specific land use setting are not acceptable, when they are.

SE will mitigate the risk of decision error by:

- Calculation of the 95% upper confidence limit (UCL) statistic to assess the mean concentration of relevant contaminants of potential concern (excluding asbestos);
- Assignment of fieldwork tasks to suitably experienced SE consulting staff, and suitably experienced contractors;
- Assignment of laboratory analytical tasks to reputable NATA accredited laboratories; and
- Assignment of data interpretation tasks to suitably experienced SE consulting staff, and outsourcing to technical experts where required.

SE will also adopt a range of data quality indicators (DQI) to facilitate assessment of the completeness, comparability, representativeness, precision and accuracy (bias).

Table 7.6.1 Performance and Acceptance Criteria Summary

Completeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Critical locations sampled	Refer **Section 7.4**	Critical samples analysed according to DQO	Refer **Section 7.7.2**
Critical samples collected	Refer **Section 7.4**	Analytes analysed according to DQO	Refer **Section 7.7.2**
SOPs appropriate and complied with	100%	Appropriate laboratory analytical methods and LORs	Refer **Section 7.7.2**
Field documentation complete	All sampling point logs, calibration logs and chain of custody forms	Sample documentation complete	All sample receipt advices, all certificates of analysis
Sample Holding Times	Laboratory holding times provided by laboratory	Sample extraction and holding times complied with	Refer **Section 7.7.8**
Comparability			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Same SOPs used on each occasion	100%	Same analytical methods used by primary laboratory	Refer **Section 7.7.2**
Climatic conditions	Samples stored in 500ml zip-lock bags	Same LORs at primary laboratory	Refer **Section 7.7.2**
Same types of samples collected, and handled/preserved in same manner	All soil samples same size, all stored in 500ml zip-lock bags	Same laboratory for primary sample analysis	All primary samples to Eurofins | Environmental Testing
Analytical measurement units consistent	All measurement units the same between same analytes	Same analytical measurement units	Refer **Section 7.7.8**
Representativeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Appropriate media sampled according to SAQP	Refer **Section 7.4**	Samples analysed according to SAQP	Refer **Section 7.7.2**
Media identified in SAQP sampled	Refer **Section 7.4**	Nil	Nil
Precision			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Field duplicate / triplicate RPD (Metals & PAH only)	Minimum 5% duplicates No limit for results <10 times LOR 50% for results 10-20 times LOR 30% for results >20 times LOR	Laboratory duplicates	No exceedances of laboratory acceptance criteria
SOPs appropriate and complied with	100%	Nil	Nil
Accuracy (bias)			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Rinsate blanks	Analyte concentration <LOR None collected for asbestos.	-	No exceedances of acceptance criteria
Field trip spikes (BTEX only)	Recoveries between 60% and 140%	Matrix spike recovery	No exceedances of acceptance criteria
Field trip blanks (BTEX only)	Analyte concentration <LOR None collected for asbestos.	Surrogate spike recovery	No exceedances of acceptance criteria

7.7 Step 7: Develop the plan for obtaining data

The seventh step involves identifying the most resource effective sampling and analysis design for generating the data that is required to satisfy the DQOs.

7.7.1 Supplementary Contamination Assessment Sampling and Methodology

Table A in NSW EPA (2022) provides guidance on minimum sampling point densities required for site characterisation, based on detecting circular hot spots of defined diameter using a systematic sampling pattern. This guidance assumes the investigator has little knowledge about the probable locations of the contamination, the distribution of the contamination is expected to be random (e.g. land fill sites) or the distribution of the contamination is expected to be fairly homogenous (e.g. agricultural lands).

However, Section 3.1 of NSW EPA (2022) states that a judgemental sampling pattern can be used where there is enough information on the probable locations of contamination. Further to this, Section 6.2.1 of NEPM ASC 2013 states that the number and location or sampling points is based on knowledge of the site and professional judgement. Sampling should be localised to known or potentially contaminated areas identified from knowledge of the site either from site history or an earlier phase of site investigation. Judgemental sampling can be used to investigate sub-surface contamination issues in site assessment.

Table 4 in WA DOH (2021) indicates that where the 'likelihood of asbestos' is assessed as "possible" or "suspect", the investigation regimen should include a sampling density that is either judgemental or the same as that set out in Table A of NSW EPA (2022) for assessing asbestos.

As this project has included gathering data which provides a reasonable understanding of site history (in the context of potential areas of environmental concern on the site) and taking into consideration Table 4 in WA DOH (2021), it is considered reasonable to adopt a judgemental sampling pattern.

Based on the size of the site, the minimum required locations for an area of 4500 m^2 is twelve (12) in order to meet the minimum sampling density requirements set out in NSW EPA 2022. The proposed sampling locations are provided in **Figure 3**.

The location of actual sampling points will be recorded by hand on a site plan.

The supplementary DSI assessment and hazardous building material survey sampling arrangements for this project are presented in **Table 7.7.1**Error! Reference source not found. below.

Table 7.7.1 Supplementary Contamination Assessment Methodology

AEC	Contamination Risk	Supplementary Assessment Methodology
AEC01	Fill Materials Across the Site Footprint	Test Pit to 1.0 m, practical refusal or 0.3 m into natural material, whichever occurs first. One (1) sample minimum per test-pit location with additional samples to be collected at changes in stratigraphy.
AEC02	On-Site Structures	Undertake a hazardous building materials survey
AEC03	Off-Site Land Use Activities (Service Station)	Groundwater sampling to be undertaken within the two (2) existing groundwater monitoring wells at the site.
AEC07	Heavy Metal Impacted Groundwater as identified within JKE 2022	Installation and subsequent sampling of two (2) additional groundwater monitoring wells along the eastern and north-eastern boundaries of the site.

7.7.2 Sampling Methodology

Soil samples will be obtained by excavating test-pits with the use of a hydraulic excavator. Grab soil samples will be collected at each required sampling point. Depending on the depth of the excavation footprint, an excavator may be required to obtain samples. In these instances, samples will be collected from soils in the centre of the excavator bucket, to avoid cross contamination from the excavator bucket.

Groundwater samples will be obtained from installed groundwater monitoring wells via use of a low-flow pump and will be guided by an interface probe. Groundwater samples will be collected using well-specific disposable sampling equipment.

Sampling will be guided by a combination of visual evidence (e.g. visible ACM, staining, etc), olfactory evidence (hydrocarbon odours) and field analytical instrumentation (e.g. portable PID soil headspace screening) where applicable.

Observations of the materials encountered during sampling will be recorded on the relevant field observation log with photographic record.

7.7.3 Identification, Storage and Handling of Samples

Sample identifiers will be used for each sample collected, based on the AEC, the number of samples collected and the depth/interval the sample was collected from, e.g. a sample collected from AEC01 from the excavation footprint base, would be identified as AEC01-Base.

Project samples will be stored in laboratory prepared glass jars, zip-lock bags (if collected for asbestos) and/or laboratory supplied water sampling bottles.

Soil samples in glass jars and groundwater samples will be placed in insulated container/s with ice.

Samples will be transported to the relevant analytical laboratory, with chain of custody (COC) documentation that includes the following information:

- SE project identification number
- Each sample identifier
- Date each sample was collected
- Sample type (e.g. soil or water)
- Container type/s for each sample collected
- Preservation method used for each sample (e.g. ice)
- Analytical requirements for each sample and turnaround times
- Date and time of dispatch and receipt of samples (including signatures)

7.7.4 Headspace Screening

Where the contaminants of potential concern include volatiles, project soil samples will be subjected to field screening for ionisable volatile organic compounds (VOC), using a photo-ionisation detector (PID). The results of field screening will be recorded on a field sampling point log and presented in test-pit logs.

7.7.5 Decontamination

In the unlikely event that non-disposable sampling equipment is used, that equipment will be decontaminated before and in between sampling events, to mitigate potential for cross contamination between samples collected. The decontamination methodology to be adopted for this project will include:

- Washing relevant sampling equipment using potable water with a phosphate free detergent (i.e. Decon 90 or similar) mixed into the water;
- Rinsing the washed non-disposable sampling equipment with distilled or de-ionised water; and
- Air drying as required.

All groundwater sampling equipment with the exception of the interface probe, will be well-specific and disposable and as such, will not require decontamination. The interface probe will require decontamination between monitoring wells as per the above methodology.

7.7.6 Laboratory Selection

The analytical laboratories used for this project will be NATA accredited for the analysis undertaken.

7.7.7 Laboratory Analytical Schedule

Project samples will be scheduled for NATA accredited laboratory analysis, using a combination of:

- Observations made in the field of the media sampled;
- Headspace screening results (where available); and
- The contaminants of potential concern (COPC) identified for the area of environmental concern that the sample was collected from.

Based on the site history, SE has adopted the laboratory analytical schedule for the supplementary DSI assessment. Project specific information is presented in **Table 7.2.2**.

Table 7.7.2 Laboratory Analytical Schedule (Supplementary Contamination Assessment)

ID	Area of Environmental Concern	Analytical Schedule	No. of samples
AEC01	Fill Materials Across the Site Footprint	Heavy Metals, TRH, BTEX, OCP, PCB, Asbestos	Twelve (12) soil samples minimum
AEC02	On-Site Structures	Asbestos, Lead	TBC (building material samples)
AEC03 **AEC07**	Off-Site Land Use Activities (Service Station) Heavy Metal Impacted Groundwater as identified within JKE 2022	Heavy Metals, TRH, BTEX, PAH, Phenols	Four (4) groundwater samples

7.7.8 Laboratory Holding Times, Analytical Methods and Limits of Reporting

The laboratory holding times, analytical methods and limits of reporting (LOR) being used for this project, are presented in **Table 7.7.3** and **Table 7.7.4** below.

Table 7.7.3 Laboratory Holding Times, Analytical Methods, and Limits of Reporting (Eurofins – Soil).

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/kg)
Asbestos Bulk ID	No limit	AS4964:2004	0.01% w/w
Asbestos Quantitative	No limit	WA DOH 2021 / NEPM 2013	0.001% w/w
BTEX and TRH C_6-C_{10}	14 days	NEPM Schedule B3	0.1-20
Metals	6 months	USEPA 6010, 6020	0.1-5
TRH >C_{10}-C_{40}	14 days	NEPM Schedule B3	20-100
OCP	14 days	USEPA 8081	0.2
PAH	14 days	USEPA 8270	0.1-0.5
VOC	14 days	USEPA 8260	0.1-0.5

Table 7.7.4 Laboratory Holding Times, Analytical Methods, and Limit of Reporting (ALS – Soil).

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/kg)
Asbestos	No limit	PLM/Disp. Stain.	Absence / presence
Asbestos	No limit	WA-DER	0.001% w/w
BTEX and TPH C_6-C_{10}	14 days	USEPA 8260	0.2-0.5
Metals	6 months	USEPA 200.8/3050/6010B	0.1-3
TPH >C_{10}-C_{40}	14 days	USEPA 8270	20-100
OCP/OPP	14 days	USEPA 8270	0.1-0.2/0.2-1
PAH	14 days	USEPA 8270	0.1
VOC	14 days	USEPA 8260	0.2-0.5
E.Coli	3 days	AS/NZS 4276.7	10 (cfu/g)
Faecal Coliforms	3 days	AS/NZS 4276.5	10 (cfu/g)

Table 7.7.5 Laboratory Holding Times, Analytical Methods, and Limit of Reporting (Eurofins – Water).

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/L)
BTEX and TRH C_6-C_{10}	14 days	USEPA 5030, 8260B and 8020	0.001-0.02
TRH >C_{10}-C_{40}	7 days	USEPA 8015B & C	0.1
VOC	14 days	USEPA 8260	0.001-0.005
SVOC	14 days	USEPA 8260	0.001-0.005
PAH	7 days	USEPA 8270	0.001
OCP	7 days	USEPA 8081	0.0002-0.005
Metals	6 months	USEPA 8015B & C	0.0001-0.005
Cyanide	14 days	USEPASW 8469010	0.005
PCB	7 days	USEPA 8270	0.005
Phenols	7 days	USEPA 8260	0.001-0.005

Table 7.7.6 Laboratory Holding Times, Analytical Methods, and Limit of Reporting (ALS – Water).

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/L)
BTEX and TRH C_6-C_{10}	14 days	EP080	0.001-0.02
TRH >C_{10}-C_{40}	7 days	EP080 and EP071	0.05-0.1
VOC	14 days	EP074E	0.005-0.05
SVOC	14 days	EP074E	0.005-0.05
PAH	7 days	EP075(SIM)B	0.0005-0.001
OCP	7 days	EP068A	0.0005
Metals	6 months	EG020F and EG035F	0.0001-0.005
PCB	7 days	EP066	0.001
Phenols	7 days	EP074E	0.005-0.05

8 REMEDIATION STRATEGY OPTIONS DISCUSSION

A range of soil remediation options have been considered for the site. The options considered based solely on the JKE (2022) site walkover include only those which are proven to be effective on past remediation or related projects. The following section comprises a review of each of the soil remediation options considered and outlines the selection process used.

SE note an addendum to this RAP or a letter outlining further remediation required, as identified following the supplementary DSI may be required.

8.1 Remediation Strategy Development Rationale

Given the distribution of contamination is within defined areas and thus visually identifying and delineating the areas of contamination can be considered possible, it is recommended that various remediation options should be considered.

Due to the nature and distribution of the contaminants in the underlying soil matrix and building materials, an effective remediation approach for the site must be tailored towards the key impacted sources, which is the impacted / reworked / imported fill material and identified hazardous building materials within the site. A discussion of remediation options for these areas is provided in the below sections.

8.2 Remediation Options for Impacted Soil

The potential list of remediation options associated with impacted soil is extensive. Consequently, only relevant remediation strategies that have been considered include:

- Off-site landfill disposal – excavation / removal and disposal; and
- On-site Containment and Management ("Cap and Contain").

SE understand a two-level basement has been proposed for the redevelopment works and will require removal of soil materials to approximately 6 m bgsl.

A summary of the advantages and disadvantages to these remediation options is provided overleaf in **Table 8.4.2**.

8.3 Remediation Options for Impacted Groundwater

As a supplementary contamination assessment for groundwater at the site is required to understand the flow and presence/movement of contaminants in groundwater through the site, remediation options have not been assessed as the current contamination status and requirement of remediation is currently unknown. If the groundwater assessment indicates groundwater risks are present and remediation and/or management is required, preparation of an addendum

8.4 Preferred Remediation Option

Based on SE's assessment detailed above, the most suitable remedial strategy will comprise of a combination of 'off-site removal / disposal' and potential 'cap and containment' as it will be consistent the ultimate end land use of the site. **Table 8.4.1** summarises the preferred remediation strategies with regards to the identified contamination within the site.

Table 8.4.1 Selected Remediation Strategies

Contamination Type	Preferred Remediation Strategy
Soil materials impacted with foreign materials and non-friable asbestos	Excavation and disposal off-site OR cap and containment
Soil materials impacted by friable asbestos *(if identified*)	Excavation and disposal off-site OR cap and containment
Soil materials impacted by direct contact risks (BTEX, Heavy Metals, PAH, PCBs, & TRH) *(if identified*)	Excavation and disposal off-site OR cap and containment
Hazardous building materials *(if identified)*	Excavation and disposal off-site
Soil materials impacted by ecological risks (BTEX, Heavy Metals, PAH & TRH)	Excavation and disposal off-site OR cap and containment

Areas subject to remediation are provided in **Figure 3**.

Table 8.4.2 Remedial Options Summary

Treatment Option	Description	Advantages			Disadvantages		
		Technical	Financial	Logistical	Technical	Financial	Logistical
Excavation and Offsite Disposal	Removal of contaminated soil to an EPA licensed facility. Validation sampling to demonstrate the conditions of the residual soil impact. Reinstatement of excavated areas with material validated as suitable for the intended land use.	Protective of human health including future tenants and construction workers. Facilitate future development of the entire site. No long-term EMP will be required.	No onsite operation and maintenance required.	No ongoing management required as the impacted soil will have been removed offsite.	Based on the soil investigation results, for off-site disposal purposes, the impacted soil to be excavated and removed offsite would require waste classification in accordance with the NSW EPA *Waste Classification Guidelines 2014.*	High remedial cost incurred to remediate the entire site.	Major excavation is potentially required. Odour, vapour and dust management required during the excavation works. May increase truck traffic in area to transport contaminated soil for a short period of time.
Cap and Contain	Soil capping and isolation to restrict direct access to soil. Impacted soil buried in-situ within a design containment cell.	Protective of human health including construction / maintenance workers. Direct access to soil will be restricted and can be isolated with the appropriate mitigation measures.	Significantly lower costs with no off-site disposal costs (transport and waste levy fee).	Moderate excavation is required to remove all the AECs across the entire site (< 1 month remediation time). Limited environmental management required during the works (e.g. dust, noise)	Impacted material would remain on-site indefinitely.	Land value may be reduced to presence of residual contamination on-site.	Impacted material would remain on-site indefinitely. Future works may require additional measures if likely to intercept the containment cell.

9 REMEDIAL ACTION PLAN

9.1 Remedial Goal

The remedial goal for this site is to remediate potential soil contamination (where identified) to a level that does not present an unacceptable human health exposure and environmental risks, based on the proposed land use setting. SE notes that the client would prefer that the remedial works be undertaken in a manner that does not result in the need for:

- Notation on a planning certificate for the site;
- A covenant registered on the title to the land; or
- A long-term environmental management plan (EMP).

9.2 Remediation Extent

The extent of contamination within the site is outlined within **Table 9.2.1** below. The extent of contamination is yet to be informed by the supplementary Detailed Site Investigation and as such, volumes may change following completion of the supplementary DSI.

Table 9.2.1 Approximate Remedial Extents

ID	Area of Environmental Concern	Dimensions / Area	Depth / Height	Volume / Mass
AEC01	Fill Materials Across the Site Footprint	≈ 4500 m^2	TBC	TBC
AEC02	On-Site Structures	TBC	TBC	TBC
AEC02	Off-Site Land Use Activities (Service Station)	TBC	TBC	TBC
AEC04	Asbestos Impacted Soil Materials associated with 'BH2' (JKE 2022)	5 x 5 m / 25 m^2 (BH2), extent TBC following supplementary DSI	≈ 1.2 m (BH2), extent TBC following supplementary DSI	≈ 30 m^3 / 54 tonnes extent TBC following supplementary DSI
AEC05	Nickel and Asbestos Impacted Soil Materials associated with 'BH6' (JKE 2022)	5 x 5 m / 25 m^2 (BH6), extent TBC following supplementary DSI	≈ 1.1 m (BH6), extent TBC following supplementary DSI	≈ 27.5 m^3 / 50 tonnes extent TBC following supplementary DSI
AEC06	Nickel Impacted Soil Materials associated with 'BH1' and 'BH4' (JKE 2022)	5 x 5 m / 25 m^2 (BH1) & 5 x 5 m / 25 m^2 (BH4), extent TBC following supplementary DSI	≈ 1 m (BH1) & ≈ 1.2 m (BH4), extent TBC following supplementary DSI	≈ 25 m^3 / 45 tonnes (BH1) ≈ 30 m^3 / 54 tonnes (BH4) extent TBC following supplementary DSI
AEC07	Heavy Metal Impacted Groundwater as identified within JKE 2022	TBC	TBC	TBC

Notes to Table: *N/A: Not Applicable, TBC: To Be Confirmed following the supplementary DSI and/or Hazardous Building Material Survey*

Refer to **Figure 3**, which indicates the previously identified contamination, as detected within JKE (2022) and areas subject to further assessment.

It is noted that the lateral extent of remediation may be altered, during remedial works based on site observations and validation soil sample analytical laboratory results.

9.3 Sequence of Works for Remediation

9.3.1 Remediation Schedule

Based on the extent and complexity of soil materials treatment, an estimated time-frame for supplementary assessment and currently understood remedial works is considered to be 2 – 4 months following the commencement of works. Referral to a remediation contractor should be made to better estimate remediation timeframes. It is expected that remediation timeframes will be further refined following appointment of the remediation contractor, and the staging of the remediation tasks in the contractor's works program.

9.3.2 Notifications and Approvals

Notification of an intention to undertake remediation works on the site, will be submitted to the relevant planning consent authority, 30 days prior to remediation works commencing. The proposed remediation works would likely be classed as Category 2 under State Environmental Planning Policy (SEPP) *'Resilience and Hazards'*, which do not require consent from the planning authority.

The following information will also be provided to the planning consent authority, 14 days prior to the commencement of remediation works:

- Copies of the contamination assessment report and this RAP; and
- Contact details of the contractor appointed to undertake the remediation works; and
- Contact details of the parties responsible (if not the remediation contractor) for ensuring remediation works comply with relevant regulatory requirements.

A notification will be submitted to SafeWork NSW prior to undertaking asbestos removal works (where applicable). The removal works will be undertaken by a suitably licensed contractor.

It should be noted that:

- Removal of friable asbestos will require the contractor to hold a Class A licence; and
- Removal of non-friable asbestos will require the contractor to hold a Class B licence.

Within one month of completion of remediation and validation works, a notification will be submitted to the planning consent authority.

9.3.3 Demolition

A pre-demolition hazardous building materials survey is to be undertaken prior to any demolition of on-site structures. Above ground structures and hardstand pavements will be demolished by a suitably licensed contractor, and associated wastes removed from site for recycling and/or disposal. The remediation contractor will retain transport and disposal records for all demolition wastes removed off site.

9.3.4 Remedial Works

Remedial works will be guided and monitored by the environmental consultant. The environmental consultant will assist the remediation contractor in setting out the inferred lateral extent of the identified AEC. The environmental consultant will monitor remedial works and provide guidance to the remedial contractor on:

- When to pause remedial works in an AEC, to allow validation works to be undertaken; and
- Where to extend remedial works in an AEC beyond the inferred extent (if observations or analytical results indicate a need for 'chasing out' additional contamination).

The following remediation works outlined in **Table 9.3.1**, is based on data available at the time of preparing this RAP.

The validation strategy for each identified AEC is outlined in **Section 10**.

Table 9.3.1 Proposed Remedial Works

Contamination Risk	Proposed Remedial Strategy
Soil Materials Impacted by Non-Friable Asbestos	Excavation vertically to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Disposal off-site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines. The remediation contractor will retain transport and disposal records for all wastes removed off site. OR Excavation of soil materials to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Relocation of soil materials to the containment cell location.
Soil Materials Impacted by Friable Asbestos ***(if identified)***	Excavation vertically to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Disposal off-site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines. The remediation contractor will retain transport and disposal records for all wastes removed off site. OR Excavation of soil materials to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Relocation of soil materials to the containment cell location.
Soil Materials Impacted by Direct Contact Risks (Metals, PAHs, TRH, BTEX, PCBs)	Excavation vertically to base of fill (0.1 into natural) and laterally to edge of fill (or site boundary) and offsite disposal. The remediation contractor will retain transport and disposal records for all wastes removed off site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines (2014). OR Excavation of soil materials to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Relocation of soil materials to the containment cell location.
Hazardous Building Materials ***(if identified)***	Removal of identified hazardous building materials and separately prior to main demolition works. Subsequent off-site disposal of identified hazardous building materials (if identified) to a licensed waste receiving facility. The remediation contractor will retain transport and disposal records for all wastes removed off site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines (2014). OR Excavation of soil materials to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Relocation of soil materials to the containment cell location.
Soil Materials Impacted by Ecological Risks (Metals, PAHs, TRH, BTEX)	Excavation vertically to base of fill (0.1 into natural) and laterally to edge of fill (or site boundary) and offsite disposal. The remediation contractor will retain transport and disposal records for all wastes removed off site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines (2014). OR Excavation of soil materials to base of fill and laterally to the edge of fill or to the site boundary (whichever occurs first). Relocation of soil materials to the containment cell location.
Aesthetic Impacts	Offsite disposal of rubbishes and wastes. The remediation contractor will retain transport and disposal records for all wastes removed off site to a licensed waste receiving facility as per NSW EPA Waste Classification Guidelines (2014).

Contamination Risk	Proposed Remedial Strategy
Cap and Containment	Where soil materials are proposed for cap and containment within the site. A containment cell location will be excavated and the bottom of the cell surveyed by a certified surveyor with a minimum of one (1) survey mark per 100 m^2. Following relocation of containment materials to the cell, the top of the cell will be overlain by a high-visibility geofabric marker layer and the geofabric surface surveyed by a certified surveyor with a minimum of one (1) survey mark per 100 m^2. The containment cell will then be overlain by a minimum of 500 mm validated capping materials or hardstand, pending the final redevelopment plans.

9.3.5 Backfilling

Should remedial excavations require backfilling, then backfill soils will be limited to:

- Virgin excavated natural material (VENM);
- Excavated natural material (ENM);
- Other material that is the subject of a resource recovery exemption and the placement of that material is within the lawful constraints of the resource recovery exemption (and does not present an unacceptable exposure risk to human health or the environment, within the context of the proposed land use setting); or
- Site won natural soil materials. I.e. soil materials excavated from approximately 0.5 m bgs and deeper from within the site.

Consideration will be given to geotechnical engineering requirements associated with backfilling; however, those requirements will be specified by others elsewhere.

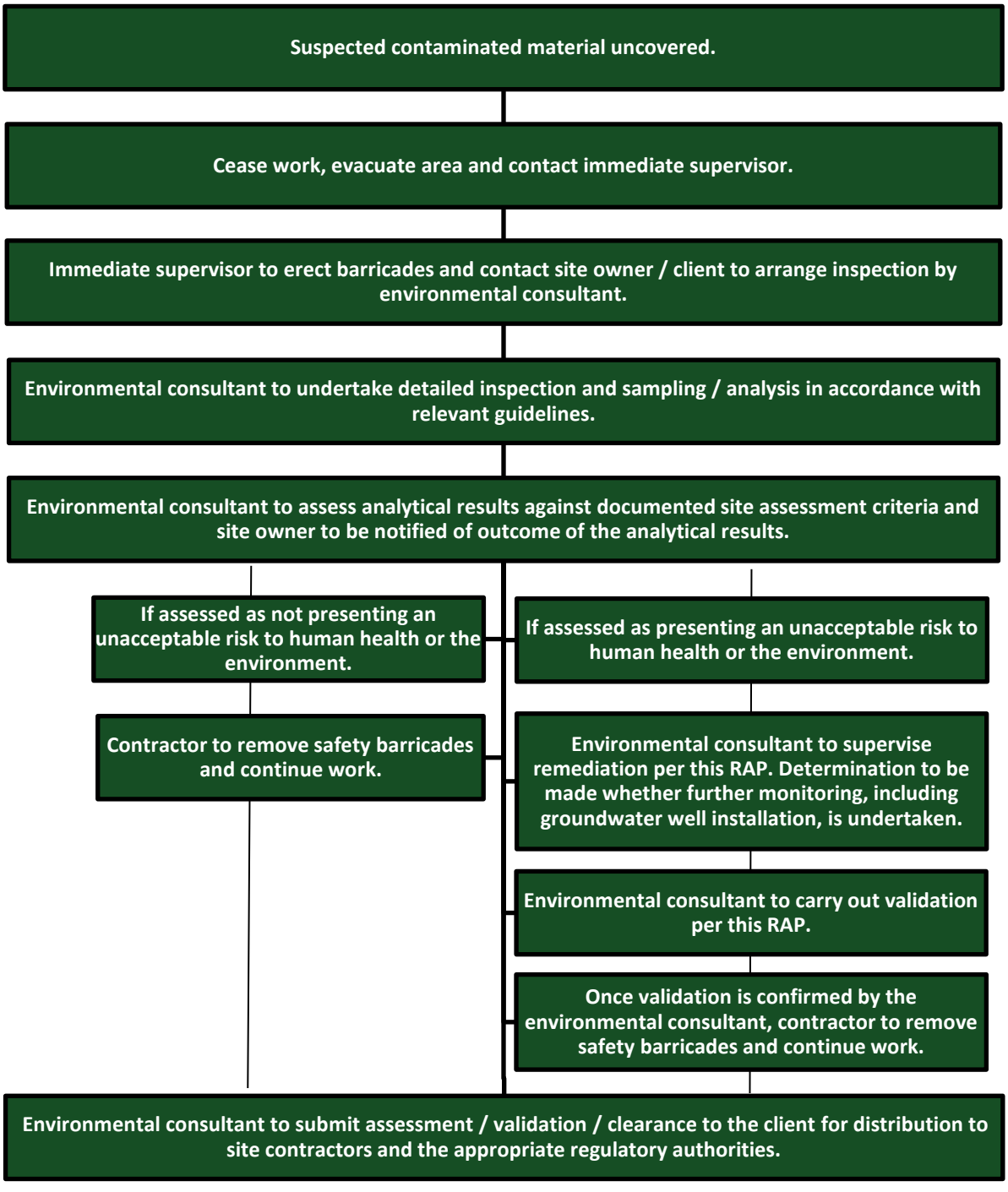
9.3.6 Unexpected Finds Protocol

The contamination assessments to date have not indicated the presence of significant soil and groundwater contamination that is unacceptable for the proposed land use beyond the area of remediation described in this RAP. However, it is possible that unexpected finds may be present within the fill material. To this end, an Unexpected Finds Protocol has been compiled, and is summarised herein. Unexpected finds could include, but are not limited to:

- Other underground storage tanks that are previously not identified;
- Buried containers and drums;
- Phase separated hydrocarbons;
- Powders and other suspicious buried material;
- Potentially hazardous materials; and
- Evidence of contamination including significant staining, odours and discolouration.

In the event that any material suspected of containing potentially hazardous substances is found during remediation works, the following Unexpected Finds Protocol is to be followed:

Unexpected Finds Protocol



10 VALIDATION DATA QUALITY OBJECTIVES

Appendix B of NEPM ASC 2013 provides guidance on the development of data quality objectives (DQO) using a seven-step process.

The DQO for this project are set out in **Sections 10.1** to **10.7** of this report.

10.1 Step 1: State the problem

The first step involves summarising the contamination problem that will require new data and identifying the resources available to resolve the problem.

The objective of this project is to assess whether the remedial goal has been achieved, and whether the site presents an unacceptable human health exposure risk, for the proposed land use setting.

This project is being undertaken because:

- The site is the subject of proposed redevelopment works comprising a mixed use commercial and high-density residential land use; and
- Historically identified areas of environmental concern on the site, have the potential to present an unacceptable human health and ecological exposure risk in the context of the proposed land use setting.

The project team identified for this project includes Sydney Environmental Group Pty Ltd, the client and the planning consent authority.

The regulatory authorities identified for this investigation include NSW EPA and the Local Council.

10.2 Step 2: Identify the decision/goal of the study

The second step involves identifying decisions that need to be made about the contamination problem and the new environmental data required to make them.

The decisions that need to be made during this investigation include:

- Is the environmental data collected for the project, suitable for assessing relevant land contamination exposure risks?
- Do concentrations of identified contaminants of potential concern (COPC) present an unacceptable exposure risk to identified receptors, for the proposed land use setting?
- Have the contaminated soils been effectively isolate by the remedial strategy?
- Is the site suitable for the proposed land use setting, in the context of land contamination as a result of the chosen remedial strategy?

10.3 Step 3: Identify the information inputs

The third step involves identifying the information needed to support decisions and whether new environmental data will be needed.

The inputs required to make the decisions set out in **Section 8.2** for this investigation, will include:

- Data obtained in previous contamination assessments;
- The nature and extent of sampling at the site, including both density and distribution;
- Samples of relevant site media;
- The measured physical and/or chemical parameters of the site media samples (including field screening and laboratory analysis, where relevant); and
- Assessment criteria adopted for each of the media sampled.

Taking into consideration the objectives of this project, and the conceptual site model and land use setting presented in **Section 5** of this project, the assessment criteria noted within **Section 6.2** of this project have been adopted for this investigation.

10.4 Step 4: Define the boundaries of the study

The fourth step involves specifying the spatial and temporal aspects of the environmental media that the data must represent to support decisions.

The spatial extent of the project will be limited to the site as defined by its boundaries.

The temporal boundaries of the project include:

- The project timeframes by SE for this project, and subsequent remediation contractor works program;
- Unacceptable weather conditions at the time of undertaking fieldwork, including rainfall, cold and/or heat;
- Access availability of the site (to be defined by the site owner/representative); and
- Availability of SE field staff (typically normal daylight working hours, Monday to Friday).

The lateral extent that contamination is expected to be distributed across, based on the conceptual site model, is defined by the inferred boundaries of the areas of environmental concern (AEC) and may be altered based on the data collected during the supplementary contamination assessment.

The vertical extent that contamination is expected to be distributed across, based on the conceptual site model, is defined by the inferred boundaries of the previously identified areas of environmental concern (AEC) and may be altered based on the data collected during the supplementary contamination assessment.

The scale of the decisions required will be based on the entire site.

Constraints which may affect the carrying out of this investigation may include access limitations, presence of above and below ground infrastructure, and hazards creating health and safety risks.

10.5 Step 5: Develop the analytical approach (or decision rule)

The fifth step involves defining the parameter of interest, specifying the action level, and integrating information from Steps 1 to 4 into a single statement that gives a logical basis for choosing between alternative actions.

10.5.1 Trip Spikes and Trip Blank Samples

One trip spike and trip blank sample will be used and scheduled for analysis, for each day of sampling undertaken, if site samples being collected that day are being analysed for volatile contaminants of concern (typically BTEX and/or TRH C_6-C_{10}).

10.5.2 Intra-Laboratory and Inter-Laboratory Duplicates

Intra-laboratory and inter-laboratory field duplicates will be collected at a rate of one per twenty (5%) site samples collected. The duplicates collected will be analysed for at least one of the analytes that the parent sample of the duplicate/triplicate is being scheduled for analysis for (with the exception of asbestos).

The relevant percent difference (RPD) of concentrations of relevant analytes, between the parent sample and the duplicate will be calculated.

10.5.3 Laboratory Analysis Quality Assurance / Quality Control

The analytical laboratory QA/QC program will typically include laboratory method blank samples, matrix spike samples, surrogate spike samples, laboratory control samples, and laboratory duplicate samples.

10.5.4 If/Then Decision Rules

SE has adopted the following 'if/then' decision rules for this investigation:

- If the result of the assessment of field data and laboratory analytical data is considered acceptable, then that field data and laboratory analytical data is suitable for interpretation within the scope of this investigation; and
- If the field data and laboratory analytical data is within the constraints of the assessment criteria adopted for this investigation (refer **Section 8.3**), then the contamination exposure risks to identified receptors, are considered acceptable.

In the event the assessment of field data and/or laboratory analytical data results in the data being not suitable for interpretation, then SE will determine if additional data is required to allow interpretation to be undertaken.

In the event that field data and/or laboratory analytical data exceeds the assessment criteria adopted for this investigation (refer **Section 10.2**), SE will undertake an assessment of the exceedance in the context of the project objectives to determine if additional data is required and whether management and/or remediation is required.

10.6 Step 6: Specify the performance or acceptance criteria

The sixth step involves specifying the decision maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data. When assessing contaminated land, there are generally two types of errors in decision making:

- Contamination exposure risks for a specific land use setting are acceptable, when they are not; and
- Contamination exposure risks for a specific land use setting are not acceptable, when they are.

SE will mitigate the risk of decision error by:

- Calculation of the 95% upper confidence limit (UCL) statistic to assess the mean concentration of relevant contaminants of potential concern (excluding asbestos);
- Assignment of fieldwork tasks to suitably experienced SE consulting staff, and suitably experienced contractors;
- Assignment of laboratory analytical tasks to reputable NATA accredited laboratories; and
- Assignment of data interpretation tasks to suitably experienced SE consulting staff, and outsourcing to technical experts where required.

SE will also adopt a range of data quality indicators (DQI) to facilitate assessment of the completeness, comparability, representativeness, precision and accuracy (bias).

Table 10.6.1 Performance and Acceptance Criteria Summary

Completeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Critical locations sampled	Refer **Section 10.4**	Critical samples analysed according to DQO	Refer **Section 10.7.1**
Critical samples collected	Refer **Section 10.4**	Analytes analysed according to DQO	Refer **Section 10.7.1**
SOPs appropriate and complied with	100%	Appropriate laboratory analytical methods and LORs	Refer **Section 10.7.1**
Field documentation complete	All sampling point logs, calibration logs and chain of custody forms	Sample documentation complete	All sample receipt advices, all certificates of analysis
Sample Holding Times	Laboratory holding times provided by laboratory	Sample extraction and holding times complied with	Refer **10.7.8**
Comparability			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Same SOPs used on each occasion	100%	Same analytical methods used by primary laboratory	Refer **Section 10.7.1**
Climatic conditions	Samples stored in 500ml zip-lock bags	Same LORs at primary laboratory	Refer **Section 10.7.1**
Same types of samples collected, and handled/preserved in same manner	All soil samples same size, all stored in 500ml zip-lock bags	Same laboratory for primary sample analysis	All primary samples to Eurofins | Environmental Testing
Analytical measurement units consistent	All measurement units the same between same analytes	Same analytical measurement units	Refer **Section 10.7.1**
Representativeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Appropriate media sampled according to SAQP	Refer **Section 10.4**	Samples analysed according to SAQP	Refer **Section 10.7.1**
Media identified in SAQP sampled	Refer **Section 10.4**	Nil	Nil
Precision			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Field duplicate / triplicate RPD (Metals & PAH only)	Minimum 5% duplicates and triplicates No limit for results <10 times LOR 50% for results 10-20 times LOR 30% for results >20 times LOR	Laboratory duplicates	No exceedances of laboratory acceptance criteria
SOPs appropriate and complied with	100%	Nil	Nil
Accuracy (bias)			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Rinsate blanks	*Disposable sampling equipment used. No rinsate blanks required.*		
Field trip spikes (BTEX only)	Recoveries between 60% and 140%	Matrix spike recovery	No exceedances of acceptance criteria
Field trip blanks (BTEX only)	Analyte concentration <LOR None collected for asbestos.	Surrogate spike recovery	No exceedances of acceptance criteria

10.7 Step 7: Develop the plan for obtaining data

The seventh step involves identifying the most resource effective sampling and analysis design for generating the data that is required to satisfy the DQOs.

10.7.1 Validation Sampling

Validation should focus on collecting clear evidence to assess whether the key objectives have been met. Validation sampling programs should identify and delineate the lateral and vertical extent of contamination (if any) and arrive at a scientifically defensible and statistically valid data set which characterises the chemical concentrations and human health risk present at the site.

An appropriately experienced environmental consultant should be present onsite at all stages of the remediation works, to assess the extent of remediation required to render the site suitable for the proposed development. Site observations and field screening equipment can be used to assist in decision-making in relation to:

- The location and extent of any excavations to trace contamination or whether to remove additional soil;
- Create a more focused sample collection (number and location) and laboratory analysis; and
- The need to consider (or implement) any specific health and safety measures.

A judgemental validation sampling pattern will be carried out, with one soil sample collected from the floor (per 25 m^2) and one soil sample collected from each wall (per 5 lineal meters) of the remedial excavation area.

The validation sampling arrangements for this project are presented in **Table 10.7.1.**

Table 10.7.1 Validation Methodology

Contamination Risk	Validation Methodology
Soil Materials Impacted by Non-Friable Asbestos	Following removal: 1 x 500mL soil sample per 5 lineal metres of excavation wall, with a minimum of 1 per wall and one 500mL soil sample per 25 m^2 of excavation footprint Photographic record of treated soils. Photographic record of excavation.
Soil Materials Impacted by Friable Asbestos ***(if identified)***	Following removal: 1 x 500mL soil sample per 5 lineal metres of excavation wall, with a minimum of 1 per wall and one 500mL soil sample per 25 m^2 of excavation footprint Photographic record of treated soils. Photographic record of excavation.
Soil Materials Impacted by Direct Contact Risks (Metals, PAHs, TRH, BTEX, PCBs)	Visual inspection of excavation footprint to confirm removal of fill. One 250mL soil jar sample per 25 m^2 of excavation footprint. 1 x 250mL jar sample per 10 lineal metres of excavation wall (if present), with a minimum of 1 per wall. Photographic record of excavation.
Hazardous Building Materials ***(if identified)***	To be determined by the SafeWork NSW Licensed Asbestos Assessor (LAA). An asbestos clearance inspection report to be issued following asbestos remediation works.
Soil Materials Impacted by Ecological Risks (Metals, PAHs, TRH, BTEX)	Visual inspection of excavation footprint to confirm removal of fill. One 250mL soil jar sample per 25 m^2 of excavation footprint. 1 x 250mL jar sample per 10 lineal metres of excavation wall (if present), with a minimum of 1 per wall. Photographic record of excavation.
Aesthetic Impacts	Photographic record of former aesthetic impacted footprint.
Cap and Containment	Photographic record of the bottom of the containment cell prior to infill with contaminated soil materials. Following laydown of the geofabric marker layer, photographic record of the top of the containment cell prior to capping. Survey of containment cell will be reviewed by a suitably experienced environmental consultant to confirm suitability.
Imported Fill (VENM)	1 soil sample per 100 m^3 or 3 samples per stockpile / site.
Imported Fill (ENM)	Quantity dependent – refer to the NSW EPA 2014 *'Excavated Natural Material (ENM) exemption/order'* for further detail.

The quantity and movement of all waste materials excavated and removed offsite with be tracked by the remedial contractor. All waste disposal dockets issued by the suitably licensed waste receiving facility will be retained by the remedial contractor for reconciliation against the material tracking records, and for inclusion in the validation report. This will demonstrate that the waste was appropriately disposed to licensed facilities.

If visual or olfactory observations indicated a potential for soil contamination to be present, then collection of additional validation samples will be considered.

10.7.2 Validation Sampling Methodology

Grab soil samples will be collected at each required sampling point directly from the base and walls of the excavation. Depending on the depth of the excavation footprint, an excavator may be required to obtain samples. In these instances, samples will be collected from soils in the centre of the excavator bucket, to avoid cross contamination from the excavator bucket.

Sampling will be guided by a combination of visual evidence (e.g. visible ACM, staining, etc), olfactory evidence (hydrocarbon odours) and field analytical instrumentation (e.g. portable PID soil headspace screening) where applicable.

Observations of the materials encountered during sampling will be recorded on the relevant field observation log with photographic record.

10.7.3 Identification, Storage and Handling of Samples

Sample identifiers will be used for each sample collected, based on the AEC, the number of samples collected and the depth/interval the sample was collected from, e.g. a sample collected from AEC01 from the excavation footprint base, would be identified as AEC01-B01.

Project samples will be stored in laboratory prepared glass jars or zip-lock bags (if collected for asbestos).

Soil samples in glass jars will be placed in insulated container/s with ice.

Samples will be transported to the relevant analytical laboratory, with chain of custody (COC) documentation that includes the following information:

- SE project identification number
- Each sample identifier
- Date each sample was collected
- Sample type (e.g. soil or water)
- Container type/s for each sample collected
- Preservation method used for each sample (e.g. ice)
- Analytical requirements for each sample and turnaround times
- Date and time of dispatch and receipt of samples (including signatures)

10.7.4 Headspace Screening

Where the contaminants of potential concern include volatiles, project soil samples will be subjected to field screening for ionisable volatile organic compounds (VOC), using a photo-ionisation detector (PID). The results of field screening will be recorded on a field sampling point log and presented in test-pit logs.

10.7.5 Decontamination

In the unlikely event that non-disposable sampling equipment is used, that equipment will be decontaminated before and in between sampling events, to mitigate potential for cross contamination between samples collected. The decontamination methodology to be adopted for this project will include:

- Washing relevant sampling equipment using potable water with a phosphate free detergent (i.e. Decon 90 or similar) mixed into the water;

- Rinsing the washed non-disposable sampling equipment with distilled or de-ionised water; and
- Air drying as required.

10.7.6 Laboratory Selection

The analytical laboratories used for this project will be NATA accredited for the analysis undertaken.

10.7.7 Laboratory Analytical Schedule

Project samples will be scheduled for NATA accredited laboratory analysis, using a combination of:

- Observations made in the field of the media sampled;
- Headspace screening results (where available); and
- The contaminants of potential concern (COPC) identified for the area of environmental concern that the sample was collected from.

Based on the site history, SE has adopted the laboratory analytical schedule for validation sampling. Project specific information is presented in **Table 10.7.2** below.

Table 10.7.2 Laboratory Analytical Schedule (Validation Sampling)

AEC	Analytical Schedule	No. of samples
AEC01	Dependant on findings of supplementary assessment	TBC
AEC02	Visual Assessment	-
AEC03	Dependant on findings of supplementary assessment	TBC
AEC04 [c]	Asbestos [a]	Per **Section 10.7.1**
AEC05 [c]	Asbestos [a], Nickel	Per **Section 10.7.1**
AEC06 [c]	Nickel	Per **Section 10.7.1**
AEC07	Dependant on findings of supplementary assessment	TBC
Imported Fill – VENM	TRH, BTEX, PAH, 8 metals, OCP and Asbestos Bulk ID.	1 / 500 tonnes
Imported Fill – ENM	Per ENM Order [b]	Per ENM Order [b]

Notes to Table: [a] *Quantitative asbestos (WA DOH 2021 / NEPM 2013)* [b] *NSW EPA 2014 'Excavated Natural Material Order / Exemption.* [c] *SE notes that the extent of remediation and contaminants of concern will be confirmed following completion of the supplementary DSI.*

10.7.8 Laboratory Holding Times, Analytical Methods and Limits of Reporting

The laboratory holding times, analytical methods and limits of reporting (LOR) being used for this project, are presented in **Table 10.7.3** and **Table 10.7.4**.

Table 10.7.3 Laboratory Holding Times, Analytical Methods, and Limits of Reporting (Eurofins).

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/kg)
Asbestos Bulk ID	No limit	AS4964:2004	0.01% w/w
Asbestos Quantitative	No limit	WA DOH 2021 / NEPM 2013	0.001% w/w
BTEX and TRH C_6-C_{10}	14 days	NEPM Schedule B3	0.1-20
Metals	6 months	USEPA 6010, 6020	0.1-5
TRH >C_{10}-C_{40}	14 days	NEPM Schedule B3	20-100
OCP	14 days	USEPA 8081	0.2

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/kg)
PAH	14 days	USEPA 8270	0.1-0.5
VOC	14 days	USEPA 8260	0.1-0.5

Table 10.7.4 Laboratory Holding Times, Analytical Methods, and Limit of Reporting (Secondary Lab – ALS)

Analyte	Holding Time	Analytical Method	Limit of Reporting (mg/kg)
Asbestos	No limit	PLM/Disp. Stain.	Absence / presence
Asbestos	No limit	WA-DER	0.001% w/w
BTEX and TPH C_6-C_{10}	14 days	USEPA 8260	0.2-0.5
Metals	6 months	USEPA 200.8/3050/6010B	0.1-3
TPH >C_{10}-C_{40}	14 days	USEPA 8270	20-100
OCP/OPP	14 days	USEPA 8270	0.1-0.2/0.2-1
PAH	14 days	USEPA 8270	0.1
VOC	14 days	USEPA 8260	0.2-0.5
E.Coli	3 days	AS/NZS 4276.7	10 (cfu/g)
Faecal Coliforms	3 days	AS/NZS 4276.5	10 (cfu/g)

11 REPORTING

11.1 Site Validation Report

At the completion of remediation works, a site validation report will be prepared with reference to the relevant sections of NSW EPA 2020, 'Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites'. The site validation report must include:

- An executive summary;
- The scope of reporting work undertaken;
- Site identification details;
- A summary of site history;
- A summary of site condition and the surrounding environment;
- A summary of geology and hydrogeology;
- Information on the remediation works undertaken;
- The results of field and laboratory work;
- An assessment of field and laboratory quality assurance / quality control data;
- A discussion on site validation;
- Information on ongoing site monitoring requirements (if any); and
- Conclusions and recommendations.

12 SITE MANAGEMENT PLAN

The following site management plan will apply during undertaking of the remediation tasks.

12.1 Soil and Stormwater Management

12.1.1 Site Access/Egress

Vehicle access and egress to the site will be stabilised to prevent tracking of sediment onto roads and footpaths. Soil, mud and other similar materials will be removed from the roadway adjacent the access/egress point by sweeping, shovelling or a means other than washing, on a daily basis, or as required.

Trucks will be loaded adjacent to the remediation excavation (where practical). Spills of excavated soil will be scraped / swept up and combined with the soil being disposed offsite.

Soil and sediment will be broomed or washed off vehicle/plant tyres and tracks, prior to vehicles/plant leaving the remediation works zone. This soil and sediment will be scraped / swept up and managed onsite or disposed of, depending on its contamination status.

A site-specific sediment and erosion control plan will be prepared and maintained by the remediation contractor, to suit staging of the remediation works. Erosion and sediment control measures will be maintained in a functional condition. Sediment laden stormwater runoff will be controlled using measures outlined in Landcom 2004, '*Managing Urban Stormwater - Soils and Construction*' (the Blue Book).

12.1.2 Stockpiles

Stockpiles of soil or other materials:

- Will not be placed on footpaths or nature strips, unless approved by Council;
- Will be placed away from gutters, stormwater pits and other drainage lines;
- Will be stored in a secure area and be covered if remaining on site for more than 24 hours; and
- Will generally be constructed as low elongated mounds on level surfaces.

12.1.3 Excavation Pump Out

Should excavations require pumping out, water will be analysed for total suspended solids, pH, metals and petroleum hydrocarbons. Should analytical results be less than relevant marine ecosystem groundwater investigation levels in ANZECC (2000), excavation water may be discharged to stormwater.

Should analytical results exceed ANZWQG (2019) criteria, other options for disposal will be considered, including:

- Discharge to sewer (with prior approval from Sydney Water with a Trade Waste Agreement); and
- Removal and offsite disposal by a liquid waste contractor.

12.1.4 Rehabilitation and Landscaping

Stabilisation of exposed areas on the site, where required, will be undertaken in a progressive manner, as stages of remediation works are completed. Stabilisation will be maintained until such time as site redevelopment works commence.

As site redevelopment works are expected to be undertaken in conjunction with remediation works, revegetation of the site is considered unlikely to be required.

12.2 Waste Management

Removal of materials from site for recycling and/or disposal, will be undertaken with reference to the relevant provisions of the *Protection of the Environment Operations Act* (1997) and NSW EPA *Waste Classification Guidelines* (2014).

If waste classification is required for site material, the following is required (as a minimum):

- Waste classification documentation;
- Material source and description;
- Sampling density, pattern, COPCs;
- Result summary, including appropriate table with comparison to acceptance criteria; and
- Waste classification.

If offsite disposal is required for site material, the following is required (as a minimum):

- Source location;
- Estimated volume (based on excavation size;
- Actual volume of disposal;
- Waste classification;
- Transporter;
- Final destination, POEO license;
- Reconciliation of waste dockets with actual disposal volume; and
- Reconciliation of actual disposal volume and the estimated volume of disposal (based on excavation size.

The remediation contractor will maintain detailed records of materials removed from the site, including date/time of removal, quantities of materials, transport company details and vehicle registration details.

The remediation contractor will retain records verifying lawful disposal of the materials, including date / time the waste left site, approximate volume per load, the classified of the waste contained in each individual load, transport vehicle registration details, weighbridge / tipping dockets with receipt dates / times and tipped waste classification from the waste receiving facility.

Material placed onsite (stockpiles or moved to other location) must be tracked so that the source of material can be identified should unexpected finds be encountered.

12.3 Groundwater Management

Should dewatering of the site be required, development consent may be required from the planning consent authority. Dewatering may also require approvals from the NSW Department of Planning and Infrastructure, and the NSW Department of Primary Industry – Water.

Further, should unexpected significant contamination be encountered during remediation that may affect groundwater (e.g. the presence of unknown underground storage tanks), additional groundwater assessment will be required.

12.4 Noise Control

Noise levels from the site during the project will not exceed the limits indicated in AS2436-1981.

No ‘offensive noise’ as defined under the Protection of the Environment Operations Act 1997 will be created during remediation works/activities.

Plant and equipment will be fitted with noise attenuation devices (e.g. mufflers on exhausts). Consideration will be given to use of reversing alarms other than the standard pulsed tonal alarms.

Vehicle access roads will be designed in such a way to minimise the need for plant and vehicles to reverse (e.g. provision of a turning circle adjacent to the remediation works zone).

12.5 Dust Control

Dust may be generated during remediation works and associated tasks. To mitigate risk of dust emissions migrating beyond the site boundary, consideration will be given to implementing the following procedures:

- Erection of dust screens around the perimeter of the site (e.g. fencing with shade cloth attached);
- Securely covering all loads entering or exiting the site;
- Use of water sprays across the site to suppress dust;
- Covering stockpiles of contaminated soil remaining on site for more than 24 hours;
- Keeping excavation surfaces moist;
- Wetting down of placed fill material during spreading;
- Sweeping of hardstand surfaces;
- Minimising soil disturbance works during windy days; and
- Retaining stabilised site access/egress points for vehicles.

Airborne fibre monitoring will be implemented during all remedial works involving friable asbestos at the site, and will be carried out in accordance with SafeWork NSW (2022) *Code of Practice – How to Safely Remove Asbestos*. SE recommend that airborne fibre monitoring be implemented during works involving non-friable asbestos within the site, this however is not explicitly required but is highly recommended by SafeWork NSW.

Portable battery-operated air monitors are to be placed within static positions approximately 1.5m above the ground surrounding the work/removal area. The air sample analysis shall be carried out by a NATA-accredited laboratory. The results of asbestos air monitoring should be provided to the Site Project Management Representative the day following the removal or handling works. Project management will display results of air monitoring on the site's safety notice board for a period of 24hr.

Concentrations of asbestos fibres shall be dealt with as follows:

Table 12.5.1 Airborne Asbestos Fibre Concentration Action Levels

Action Level (airborne asbestos fibres/ml)	Action
< 0.01 fibres/ml	Continue with control measures
≥ 0.01 fibres/ml **< 0.02 fibres/ml**	Review control measures, Investigate the cause, Implement new controls to prevent further release.
≥ 0.02 fibres/mL	Stop removal works, Notify the relevant regulator that work has ceased, Investigate the cause, Extend the isolation area and implement controls to minimise further exposure, Do not recommence work until fibre levels are at or below 0.01 fibres/ml.

12.6 Odour Control

Generation of significant odours during the remediation works is considered to be unlikely.

If odours are generated, odours will be monitored at the site boundary. Should unacceptable odours be detected at the site boundary, consideration will be given to implementing the following procedures:

- Use of appropriate covering techniques such as plastic sheeting to cover excavation faces or stockpiles;
- Use of fine mist sprays (which may incorporate deodorizing agents);
- Use of hydrocarbon mitigating agents on impacted areas/materials; and
- Adequate maintenance of equipment and machinery to minimise exhaust emissions.

A record of unacceptable odours and corrective/preventative action taken, will be maintained by the remediation contractor.

12.7 Traffic Management

Haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site will be selected by the remediation contractor and will meet the following objectives:

- Compliance with all traffic road rules;
- Minimisation of noise, vibration and odour to adjacent premises; and
- Utilisation of state roads and minimisation of use of local roads.

The remediation contractor will ensure that site vehicles:

- Conduct deliveries of soil, materials, equipment or machinery during the hours of remediation work identified in **Section 12.13**;
- Securely cover all loads to prevent dust or odour emissions during transportation;
- Exit the site in a forward direction; and
- Do not track soil, mud or sediment onto the road.

12.8 Vibration Management

Vibration emissions during remediation works will be controlled to mitigate risk of potential damage to assets on adjacent properties, and to mitigate unreasonable loss of amenity to nearby residents.

12.9 Fill Importation

Material proposed to be imported to site as engineered fill, will be limited to materials certified as:

- Virgin Excavated Natural Material (VENM); or
- Excavated Natural Material (ENM).

VENM certification will be undertaken with reference to NSW EPA (1995). ENM certification will be undertaken with reference to NSW EPA Excavated Natural Material Exemption (2014).

The concentrations of potential contaminants in VENM and ENM proposed to be imported to site, will be less than the human health assessment criteria adopted for the site.

The remediation contractor will maintain detailed records of all fill imported to the site, including details of the supplier, the source of the fill, the quantities of the fill, vehicle registration numbers and the dates/times the fill was received on site.

The remediation contractor will inspect every load of material imported to site, to check the material is consistent with the material described in the VENM/ENM certification and each load is free of visual anthropogenic materials, staining or odours. The remediation contractor will maintain a documented record of each inspection.

12.10 Work Health and Safety

12.10.1 Safe Work Method Statement

Each contractor and sub-contractor undertaking remediation works, or working within a remediation works zone, will prepare a project specific safe work method statement (SWMS), which will include, but not be limited to:

- The tasks to be undertaken;
- Hazards identified for each of the tasks to be undertaken;
- An assessment of risk for each hazard, considering likelihood and consequence; and
- Control measures to eliminate or mitigate risks associated with each identified hazard.

12.10.2 Personal Protective Equipment

The following minimum personal protective equipment (PPE) should be worn by all persons working in or visiting the remediation works zone:

- Long sleeves and long pants;
- High visibility vests (or clothing);
- Safety boots;
- Hard hats;
- Gloves; and
- Eye protection (e.g. safety glasses).

Additional PPE may be required in accordance with task specific control measures in SWMS (refer **Section 12.10.1**) for asbestos handling and removal works.

The following minimum personal protective equipment (PPE) are be worn by any persons entering a non-friable asbestos impacted remediation works zone:

- Disposable coveralls;
- Minimum P2 respirator;
- Disposable boot covers; and
- Disposable gloves.

Should friable asbestos be identified during the works, the following minimum PPE are to be worn by any persons entering a friable asbestos impacted remediation works zone:

- Disposable coveralls;
- Minimum P3 half-face respirator (Higher protection may be required during works. Refer to the licensed asbestos assessor on-site for further details);
- Disposable boot covers; and
- Disposable gloves.

Additionally, a 3 stage (minimum) decontamination unit must be present at the egress point to the friable asbestos works area and used by all personnel entering and exiting the area.

12.10.3 Decontamination of Personnel, Plant and Equipment

Personnel undertaking remediation tasks, or entering the remediation works zone, will be required to decontaminate upon exiting the remediation works zone. Decontamination of plant and equipment used to remediate will also need to be decontaminated upon exiting the remediation work zones. Decontamination procedures will include:

- Removal of all disposable PPE;
- Cleaning down of protective footwear (including removal of soil from the soles);
- Washing of hands and exposed dermal areas; and

- Decontamination of plant and equipment (as applicable).

12.11 Site Signage

A sign will be posted on the boundary of the site, adjacent to the site access point, which will include 24-hour contact details of the remediation contractor and appropriate notification of asbestos contamination/remediation works (in progress).

12.12 Site Security

Site security will be maintained throughout the duration of the remediation works, with appropriate boundary fencing and gate locks. Other security measures may be implemented, if the need arises.

12.13 Site Hours of Operation

Remediation works will be undertaken on Monday to Friday between the hours of 7:00am to 5:00pm, and Saturday between the hours of 8:00am and 1:00pm.

Remediation works will not be undertaken outside the hours stated above, or on Sundays or public holidays.

12.14 Community Relations and Complaints

Owners, occupants and tenants of properties adjoining the site and across the road from the site, will be provided with notification of remediation works, at least two days prior to those works commencing.

Personnel undertaking remediation works on the site, will direct all third-party communications and/or complaints to the Project Manager. The Project Manager will arrange for the communication/complaint to be assessed, a response prepared, corrective/preventative actions implemented (if necessary).

A register will be maintained on site for the recording of communications / complaints from third parties, including but not limited to, local residents and local businesses.

12.15 Emergency Preparedness

An emergency assembly point will be established at the site egress point. This point will be communicated to all site workers and visitors, during relevant site induction processes.

In the event of an emergency, site workers and visitors will assemble here and await further instructions from the site supervisor, project manager or emergency services.

Spill control kits and fire extinguishers will be located on site, as and where required.

Contact details to be used in the event of an emergency, are presented in **Section 12.16**.

12.16 Register of Contacts

A register of contacts for the project is presented in **Table 12.16** overleaf.

Table 12.16 Register of Contacts

Project Role	Person	Organisation	Contact
Emergency Services	-	Fire / Police / Ambulance	000
Project Manager	Lachlan McDonald	Bronxx Pty Ltd	0401 320 800
Planning Consent Authority	TBC	Bayside Council	1300 581 299
WHS Regulatory Authority	-	SafeWork NSW	131 050
Environmental Regulatory Authority	-	NSW EPA	131 500
Remediation Contractor	TBC	TBC	TBC
Environmental Consultant	Steven Wallace	Sydney Environmental Group	0434 215 998

12.17 Interim Site Management Plan

Prior to the implementation of the remedial action plan, the following site management activities will be enforced to reduce the contamination risk to human health and the environment:

- Site Isolation:
  - Site access and egress will be limited to nil (if possible) to prevent the tracking of contaminants outside of the site boundaries.
  - Appropriate boundary fencing with locked gates will be installed (if not already present), regularly maintained and remained locked when site is not in use.
  - Signage will be posted on the boundary of the site, adjacent to the site access point, which will include 'keep out, asbestos contamination' (or similar).

- Safe Work Method Statement:
  - Each contractor and sub-contractor gaining access to the site, will prepare a project specific safe work method statement (SWMS), which will include, but not be limited to:
    - The tasks to be undertaken;
    - Hazards identified for each of the tasks to be undertaken;
    - An assessment of risk for each hazard, considering likelihood and consequence; and
    - Control measures to eliminate or mitigate risks associated with each identified hazard.

- Personal Protective Equipment:
  - The following minimum personal protective equipment (PPE) should be worn by all persons working in or visiting the remediation works zone:
    - Hard hat;
    - Long sleeves and long pants;
    - High visibility vest (clothing);
    - Safety boots;
    - Gloves;
    - Eye protection (safety glasses); and
    - Respiratory protection (Only within asbestos impacted remediation areas).

- Decontamination of Personnel equipment:
  - Cleaning down of protective footwear (including removal of soil from the soles); and
  - Washing of hands.

13 CONCLUSIONS

Based on the information presented in the historical contamination assessment reports, SE concludes that the remedial goal can be achieved, and the site made suitable for the proposed land use setting, subject to:

- Completion of a supplementary DSI to address data-gaps identified in previous contamination assessments undertaken for the site following demolition activities and prior to the start of remedial works, per **Figure 3**;
- Implementation of the strategies, methodologies and measures set out in this remedial action plan;
- Should newly identified unacceptable land contamination risks be identified during supplementary assessment works, an addendum or modification and revision to this RAP will be required. Any amendments are to be prepared by a suitably experienced environmental consultant;
- Prior to any removal of soils from site for offsite disposal during remedial works, a waste classification for those soils should be prepared by a suitably experienced environmental consultant; and
- Future remedial works should be monitored and validated by a suitably experienced environmental consultant.

This report must be read in conjunction with the limitations set out in **Section 14**.

14 STATEMENT OF LIMITATIONS

The findings presented in this report are based on specific searches of relevant, government historical databases and anecdotal information that were made available during the course of this investigation. To the best of our knowledge, these observations represent a reasonable interpretation of the general condition of the site at the time of report completion.

This report has been prepared solely for the use of the client to whom it is addressed and no other party is entitled to rely on its findings.

No warranties are made as to the information provided in this report. All conclusions and recommendations made in this report are of the professional opinions of personnel involved with the project and while normal checking of the accuracy of data has been conducted, any circumstances outside the scope of this report or which are not made known to personnel and which may impact on those opinions is not the responsibility of Sydney Environmental Group Pty Ltd. Should information become available regarding conditions at the site including previously unknown sources of contamination, SE reserves the right to review the report in the context of the additional information.

This report must be reviewed in its entirety and in conjunction with the objectives, scope and terms applicable to SE's engagement. The report must not be used for any purpose other than the purpose specified at the time SE was engaged to prepare the report.

Logs, figures, and drawings are generated for this report based on individual SE consultant interpretations of nominated data, as well as observations made at the time site walkover/s were completed.

Data and/or information presented in this report must not be redrawn for its inclusion in other reports, plans or documents, nor should that data and/or information be separated from this report in any way.

Should additional information that may impact on the findings of this report be encountered or site conditions change, SE reserves the right to review and amend this report.

15 REFERENCES

JK Enivornments (JKE 2022), 'Report to Good Time Holdings on Preliminary (Stage 1) Site Investigation (PSI) for Proposed Mixed Use Development at 277 The Grand Parade, Ramsgate, NSW', dated 28 June 2022, Ref: E34871PTrpt.

Australian and New Zealand (ANZWQG), '*Guidelines for Fresh and Marine Water Quality*';

Landcom 2004, '*Managing Urban Stormwater - Soils and Construction'* (the Blue Book).

National Environment Protection Council (NEPC), '*Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater, National Environment Protection (Assessment of Site Contamination) Measure (NEPM) as amended in May 2013'*;

National Environment Protection Council (NEPC), '*Schedule B(2) Guideline on Site Characterisation, National Environment Protection (Assessment of Site Contamination) Measure (NEPM) as amended in May 2013'*;

NSW EPA 2022, '*Contaminated Sites: Sampling Design Guidelines'*;

NSW EPA 2017, '*Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (3rd edition)*';

NSW EPA 2020, '*Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites'*; and

WA DOH 2021, *'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia'* dated 2021

FIGURES

Source: Nearmap (apps.nearmap.com/maps/)

Sydney Environmental Group	Scale: 45 m	Site Locality		
	Client Name:	Bronxx Pty Ltd	N	Figure Number: 1
	Project Name:	Remedial Action Plan		Figure Date: 21 October 2024
	Project Location:	277 The Grand Parade, Ramsgate NSW		Report Number: 2731-RAP-01-211024.v1f

LEGEND

- Site Boundary
- JKE 2022 Sampling Locations
- **AEC01 / AEC03 / AEC07** - Fill Materials Across the Site Footprint / Off-Site Land Use Activities (Service Station) / Heavy Metal Impacted Groundwater as identified within JKE 2022
- **AEC02** - On-site Structures
- **AEC04** - Asbestos Impacted Soil Materials Associated with 'BH2' (JKE 2022)
- **AEC05** - Nickel & Asbestos Impacted Soil Materials Associated with 'BH6' (JKE 2022)
- **AEC06** - Nickel Impacted Soil Materials Associated with 'BH1' and 'BH4' (JKE 2022)

Source: Nearmap (apps.nearmap.com/maps/)

Sydney Environmental Group	Scale: 10 m	Site Layout and Remedial Extents		
	Client Name:	Bronxx Pty Ltd	N	Figure Number: 2
	Project Name:	Remedial Action Plan		Figure Date: 21 October 2024
	Project Location:	277 The Grand Parade, Ramsgate NSW		Report Number: 2731-RAP-01-211024.v1f

LEGEND

- Site Boundary
- JKE 2022 Sampling Locations
- **AEC01 / AEC03 / AEC07** - Fill Materials Across the Site Footprint / Off-Site Land Use Activities (Service Station) / Heavy Metal Impacted Groundwater as identified within JKE 2022
- SE Proposed Sampling Locations - Soil
- SE Proposed Sampling Locations - Soil and Groundwater

BH4
BH3
BH/MW1
BH6
BH2
BH7
BH/MW5
211
213
277
86-88
Ramsgate Rd
The Grand Pde
Opp Ramsgate Rd
The Grand Pde

Source: Nearmap (apps.nearmap.com/maps/)

Sydney Environmental Group

Scale: 10 m	Supplementary Contamination Assessment – Proposed Sampling Locations		
Client Name:	Bronxx Pty Ltd	Figure Number:	3
Project Name:	Remedial Action Plan	Figure Date:	21 October 2024
Project Location:	277 The Grand Parade, Ramsgate NSW	Report Number:	2731-RAP-01-211024.v1f

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APPENDIX A

LABORATORY SUMMARY TABLES

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZG	Australian and New Zealand Guidelines
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
GSW:	General Solid Waste
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
kg/L	kilograms per litre
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
%w/w:	weight per weight
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} :	pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} :	pH of filtered 1:20 1M KCl after peroxide digestion
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
RSW:	Restricted Solid Waste
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
S_{Cr}:	Chromium reducible sulfur
S_{POS}:	Peroxide oxidisable Sulfur
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
UCL:	Upper Level Confidence Limit on Mean Value
USEPA	United States Environmental Protection Agency
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-B: 'Residential with minimal opportunities for soil access; including dwellings with fully/permanently paved yards like high-rise buildings'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			500	150	500	30000	1200	120	1200	60000	400	4	15	400	500	10	90	600	10	340	1	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH1	0.15-0.25	F: Sand	<4	<0.4	**41**	**27**	**20**	<0.1	**37**	**65**	**0.1**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH1 - LAB DUP	0.15-0.25	F: Sand	<4	<0.4	**39**	**43**	**31**	<0.1	**38**	**91**	**0.1**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH1 - [TRIPLICATE]	0.15-0.25	F: Sand	<4	<0.4	**34**	**31**	**28**	<0.1	**31**	**74**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.3-0.5	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH2	0.15-0.25	F: Sand	<4	<0.4	**14**	**26**	**36**	<0.1	**13**	**96**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH2	0.8-1.0	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
BH3	0.15-0.25	F: Sand	<4	<0.4	**21**	**20**	**21**	<0.1	**19**	**67**	**0.1**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH4	0.2-0.3	F: Sand	<4	<0.4	**71**	**30**	**5**	<0.1	**68**	**45**	**0.4**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH4	1.3-1.5	Fill	<4	<0.4	<1	**7**	**2**	<0.1	<1	**5**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	0.16-0.3	F: Sandy gravel	<4	<0.4	**40**	**25**	**15**	<0.1	**39**	**56**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH5	0.3-0.5	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH6	0.15-0.25	F: Silty Sand	<4	<0.4	**65**	**36**	**10**	<0.1	**61**	**53**	**0.2**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH6	0.3-0.5	F: Silty Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
BH6	1.3-1.5	Fill	<4	<0.4	**2**	**2**	**5**	<0.1	**1**	**15**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH7	0.15-0.25	F: Sand	<4	<0.4	**7**	**27**	**50**	<0.1	**6**	**77**	**0.4**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	<4	<0.4	**9**	**28**	**27**	<0.1	**8**	**59**	**0.1**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	<4	<0.4	**11**	**49**	**38**	<0.1	**9**	**78**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH7	0.3-0.5	Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
SDUP1	-		<4	<0.4	**41**	**34**	**26**	<0.1	**38**	**81**	**1.4**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Total Number of Samples			14	14	14	14	14	14	14	14	12	12	10	10	10	10	10	10	10	10	10	7
Maximum Value			<PQL	<PQL	71	49	50	<PQL	68	96	1.4	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					**HSL-A/B: LOW/HIGH DENSITY RESIDENTIAL**							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH1	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH1 - LAB DUP	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH1	0.3-0.5	F: Sand	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA	0
BH2	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH3	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH4	0.2-0.3	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.1
BH4	1.3-1.5	Sand	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH5	0.16-0.3	F: Sandy gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH6	0.15-0.25	F: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH6	1.3-1.5	Sand	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH7	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA	NA
SDUP1	-	F: Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
Total Number of Samples					12	12	12	12	12	12	12	12
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH1	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1 - LAB DUP	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1	0.3-0.5	F: Sand	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA
BH2	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH3	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH4	0.2-0.3	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH4	1.3-1.5	Sand	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
BH5	0.16-0.3	F: Sandy gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH6	0.15-0.25	F: Silty Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH6	1.3-1.5	Sand	1m to <2m	Sand	70	240	0.5	220	NL	60	NL
BH7	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA
SDUP1	-	F: Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**RESIDENTIAL, PARKLAND & PUBLIC OPEN SPACE**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH1	0.15-0.25	Coarse	<25	<50	<100	<100
BH1 - LAB DUP	0.15-0.25	Coarse	<25	<50	<100	<100
BH1	0.3-0.5	Coarse	NA	NA	NA	NA
BH2	0.15-0.25	Coarse	<25	<50	<100	<100
BH3	0.15-0.25	Coarse	<25	<50	<100	<100
BH4	0.2-0.3	Coarse	<25	<50	<100	<100
BH4	1.3-1.5	Coarse	<25	<50	<100	<100
BH5	0.16-0.3	Coarse	<25	<50	<100	<100
BH6	0.15-0.25	Coarse	<25	<50	<100	<100
BH6	1.3-1.5	Coarse	<25	<50	<100	<100
BH7	0.15-0.25	Coarse	<25	<50	<100	<100
BH7 - (DUPLICATE)	0.15-0.25	Coarse	<25	<50	<100	<100
BH7 - [TRIPLICATE]	0.15-0.25	Coarse	NA	NA	NA	NA
SDUP1	-	Coarse	<25	<50	<100	<100
Total Number of Samples			12	12	12	12
Maximum Value			<PQL	<PQL	<PQL	<PQL

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH1	0.15-0.25	Coarse	700	1000	2500	10000
BH1 - LAB DUP	0.15-0.25	Coarse	700	1000	2500	10000
BH1	0.3-0.5	Coarse	NA	NA	NA	NA
BH2	0.15-0.25	Coarse	700	1000	2500	10000
BH3	0.15-0.25	Coarse	700	1000	2500	10000
BH4	0.2-0.3	Coarse	700	1000	2500	10000
BH4	1.3-1.5	Coarse	700	1000	2500	10000
BH5	0.16-0.3	Coarse	700	1000	2500	10000
BH6	0.15-0.25	Coarse	700	1000	2500	10000
BH6	1.3-1.5	Coarse	700	1000	2500	10000
BH7	0.15-0.25	Coarse	700	1000	2500	10000
BH7 - (DUPLICATE)	0.15-0.25	Coarse	700	1000	2500	10000
BH7 - [TRIPLICATE]	0.15-0.25	Coarse	NA	NA	NA	NA
SDUP1	-	Coarse	700	1000	2500	10000

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		5,600	4,200	5,800	8,100	140	21,000	5,900	17,000	2,200	
Site Use		HIGH DENSITY RESIDENTIAL - DIRECT SOIL CONTACT									
Sample Reference	**Sample Depth**										
BH1	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH1 - LAB DUP	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH1	0.3-0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
BH2	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH3	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH4	0.2-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.1**
BH4	1.3-1.5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH5	0.16-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH6	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH6	1.3-1.5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH7	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH7 - (DUPLICATE)	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0
BH7 - [TRIPLICATE]	0.15-0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	NA
Total Number of Samples		12	12	12	12	12	12	12	12	12	12
Maximum Value		<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HSL-B: Residential with minimal opportunities for soil access

FIELD DATA															LABORATORY DATA											
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample reference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.04**			**0.001**			**0.001**											**0.04**	**0.001**
2/05/2022	BH1	0.15-1.6	No	10	6,040	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	294592	BH1	0.3-0.5	378.17	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
2/05/2022	BH2	0.5-1.0	No	10	4,950	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	294592	BH2	0.8-1.0	463.08	Chrysotile asbestos detected:Amosite asbestos detected:Crocidolite asbestos detected:Organic Fibres detected	No asbestos detected	0.1846	No visible asbestos detected	0.0855	–	0.0185	<0.001
2/05/2022	BH3	0.15-0.6	No	10	4,490	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294592	BH3	0.15-0.25	323.97	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
2/05/2022	BH4	0.2-0.5	No	10	2,280	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294592	BH4	0.2-0.3	603.81	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
2/05/2022	BH4	0.5-1.2	No	10	6,530	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2/05/2022	BH5	0.3-1.5	No	10	6,640	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294592	BH5	0.3-0.5	440.59	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
2/05/2022	BH6	0.15-1.1	No	10	9,230	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	294592	BH6	0.3-0.5	526.25	Chrysotile asbestos detected:Organic Fibres detected	No asbestos detected	0.7923	No visible asbestos detected	0.417	–	0.0792	<0.001
2/05/2022	BH7	0.3-0.5	No	10	4,150	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294592	BH7	0.3-0.5	753.53	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001

Concentration above the SAC **VALUE**

TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH1	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**41**	**27**	**20**	**37**	**65**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH1 - LAB DUP	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**39**	**43**	**31**	**38**	**91**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH1 - [TRIPLICATE]	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**34**	**31**	**28**	**31**	**74**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**14**	**26**	**36**	**13**	**96**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH3	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**21**	**20**	**21**	**19**	**67**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH4	0.2-0.3	F: Sand	Coarse	NA	NA	NA	<4	**71**	**30**	**5**	**68**	**45**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH4	1.3-1.5	Sand	Coarse	NA	NA	NA	<4	<1	**7**	**2**	<1	**5**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH5	0.16-0.3	F: Sandy gravel	Coarse	NA	NA	NA	<4	**40**	**25**	**15**	**39**	**56**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH6	0.15-0.25	F: Silty Sand	Coarse	NA	NA	NA	<4	**65**	**36**	**10**	**61**	**53**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH6	1.3-1.5	Sand	Coarse	NA	NA	NA	<4	**2**	**2**	**5**	**1**	**15**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH7	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**7**	**27**	**50**	**6**	**77**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**9**	**28**	**27**	**8**	**59**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	Coarse	NA	NA	NA	<4	**11**	**49**	**38**	**9**	**78**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUP1	-	F: Sand	Coarse	NA	NA	NA	<4	**41**	**34**	**26**	**38**	**81**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.1**
Total Number of Samples				0	0	0	14	14	14	14	14	14	12	10	12	12	12	12	12	12	12	12	12
Maximum Value				NA	NA	NA	<PQL	71	49	50	68	96	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 - LAB DUP	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 - [TRIPLICATE]	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH2	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH3	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH4	0.2-0.3	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH4	1.3-1.5	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH5	0.16-0.3	F: Sandy gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH6	0.15-0.25	F: Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH6	1.3-1.5	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH7	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
SDUP1	-	F: Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20

TABLE S7
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH1	0.15-0.25	F: Sand	<4	<0.4	**41**	**27**	**20**	<0.1	**37**	**65**	**0.1**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH1 - LAB DUP	0.15-0.25	F: Sand	<4	<0.4	**39**	**43**	**31**	<0.1	**38**	**91**	**0.1**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH1 - [TRIPLICATE]	0.15-0.25	F: Sand	<4	<0.4	**34**	**31**	**28**	<0.1	**31**	**74**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.3-0.5	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH2	0.15-0.25	F: Sand	<4	<0.4	**14**	**26**	**36**	<0.1	**13**	**96**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH2	0.8-1.0	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
BH3	0.15-0.25	F: Sand	<4	<0.4	**21**	**20**	**21**	<0.1	**19**	**67**	**0.1**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH4	0.2-0.3	F: Sand	<4	<0.4	**71**	**30**	**5**	<0.1	**68**	**45**	**0.4**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH4	1.3-1.5	Sand	<4	<0.4	<1	**7**	**2**	<0.1	<1	**5**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH5	0.16-0.3	F: Sandy gravel	<4	<0.4	**40**	**25**	**15**	<0.1	**39**	**56**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH5	0.3-0.5	F: Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH6	0.15-0.25	F: Silty Sand	<4	<0.4	**65**	**36**	**10**	<0.1	**61**	**53**	**0.2**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH6	0.3-0.5	F: Silty Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
BH6	1.3-1.5	Sand	<4	<0.4	**2**	**2**	**5**	<0.1	**1**	**15**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH7	0.15-0.25	F: Sand	<4	<0.4	**7**	**27**	**50**	<0.1	**6**	**77**	**0.4**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH7 - (DUPLICATE)	0.15-0.25	F: Sand	<4	<0.4	**9**	**28**	**27**	<0.1	**8**	**59**	**0.1**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH7 - [TRIPLICATE]	0.15-0.25	F: Sand	<4	<0.4	**11**	**49**	**38**	<0.1	**9**	**78**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH7	0.3-0.5	Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
SDUP1	-	F: Sand	<4	<0.4	**41**	**34**	**26**	<0.1	**38**	**81**	**1.4**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
Total Number of Samples			14	14	14	14	14	14	14	14	12	12	10	10	10	10	10	12	12	12	12	12	12	12	12	12	7
Maximum Value			<PQL	<PQL	71	49	50	<PQL	68	96	1.4	0.1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Detected

Concentration above the CT1 — VALUE
Concentration above SCC1 — VALUE
Concentration above the SCC2 — VALUE
Concentration above PQL — **Bold**

TABLE S8
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Nickel
PQL - Envirolab Services			0.02
TCLP1 - General Solid Waste			2
TCLP2 - Restricted Solid Waste			8
TCLP3 - Hazardous Waste			>8
Sample Reference	**Sample Depth**	**Sample Description**	
BH4	0.2-0.3	F: Sand	**0.06**
BH6	0.15-0.25	F: Silty Sand	<0.02
Total Number of samples			2
Maximum Value			0.06

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

Preliminary (Stage 1) Site Investigation (PSI)
277 The Grand Parade, Ramsgate, NSW
E34871PT

TABLE Q1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH1	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
laboratory	SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.4	0.3	0.2	0.2	<0.2	0.1	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.15	nc	0.225	0.175	0.125	0.125	nc	0.0625	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	67%	nc	156%	143%	120%	120%	nc	120%	nc	nc	nc
Field	TB	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
Blank	2/05/22																									
Field	FR	µg/L	62	<50	<100	<100	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1
Rinsate	2/05/22																									
Trip	TS		-	-	-	-	103%	103%	104%	103%	103%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	2/05/22																									

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH1	0.15-0.25	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	2/05/22																					
Field	FR	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	2/05/22																					
Trip	TS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	2/05/22																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra	BH1	0.15-0.25	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<4	<0.4	41	27	20	<0.1	37	65
laboratory	SDUP1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<4	<0.4	41	34	26	<0.1	38	81
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	41	30.5	23	nc	37.5	73
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	23%	26%	nc	3%	22%
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	2	<1	3	<0.1	<1	2
Blank	2/05/22																						
Field	FR	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	<0.01	<0.01	0.07	<0.03	<0.0005	<0.02	<0.02
Rinsate	2/05/22																						
Trip	TS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	2/05/22																						

Result outside of QA/QC acceptance criteria

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ADWG: AustralianDrinking Water Guidelines
ANZG Australian and New Zealand Guidelines
B(a)P: Benzo(a)pyrene
CRC: Cooperative Research Centre
ESLs: Ecological Screening Levels
GIL: Groundwater Investigation Levels
HILs: Health Investigation Levels
HSLs: Health Screening Levels
HSL-SSA: Health Screening Level-SiteSpecific Assessment
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NHMRC: National Health and Medical Research Council
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
ppm: Parts per million
PCBs: Polychlorinated Biphenyls
PCE: Perchloroethylene (Tetrachloroethylene or Tetrachloroethene)
PQL: Practical Quantitation Limit
RS: Rinsate Sample
RSL: Regional Screening Levels
SAC: Site Assessment Criteria
SSA: Site Specific Assessment
SSHSLs Site Specific Health Screening Levels
TB: Trip Blank
TCA: 1,1,1 Trichloroethane (methyl chloroform)
TCE: Trichloroethylene (Trichloroethene)
TS: Trip Spike
TRH: Total Recoverable Hydrocarbons
UCL: Upper Level Confidence Limit on Mean Value
USEPA United States Environmental Protection Agency
VOCC: Volatile Organic Chlorinated Compounds
WHO: World Health Organisation

TABLE G1
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL GILs SAC
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLES			
			MW1	MW1 LAB DUP	MW5	WDUP1
Inorganic Compounds and Parameters						
pH		7 - 8.5	7.6	NA	7.4	NA
Electrical Conductivity (µS/cm)	1	NSL	**380**	NA	**500**	NA
Metals and Metalloids						
Arsenic (As III)	1	2.3	**6**	NA	**4**	**6**
Cadmium	0.1	0.7	<0.1	NA	<0.1	<0.1
Chromium (SAC for Cr III adopted)	1	27	**1**	NA	**16**	**1**
Copper	1	1.3	**1**	NA	**35**	**2**
Lead	1	4.4	<1	NA	<1	<1
Total Mercury (inorganic)	0.05	0.1	<0.05	NA	<0.05	<0.05
Nickel	1	7	<1	NA	<1	<1
Zinc	1	15	**6**	NA	**26**	**7**
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)						
Benzene	1	500	<1	<1	<1	<1
Toluene	1	180	<1	<1	<1	<1
Ethylbenzene	1	5	<1	<1	<1	<1
m+p-xylene	2	75	<2	<2	<2	<2
o-xylene	1	350	<1	<1	<1	<1
Total xylenes	2	NSL	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs						
Dichlorodifluoromethane	10	NSL	<10	<10	<10	NA
Chloromethane	10	NSL	<10	<10	<10	NA
Vinyl Chloride	10	100	<10	<10	<10	NA
Bromomethane	10	NSL	<10	<10	<10	NA
Chloroethane	10	NSL	<10	<10	<10	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	NA
1,1-Dichloroethene	1	700	<1	<1	<1	NA
Trans-1,2-dichloroethene	1	NSL	<1	<1	<1	NA
1,1-dichloroethane	1	250	<1	<1	<1	NA
Cis-1,2-dichloroethene	1	NSL	<1	<1	<1	NA
Bromochloromethane	1	NSL	<1	<1	<1	NA
Chloroform	1	370	<1	<1	<1	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	NA
1,2-dichloroethane	1	1900	<1	<1	<1	NA
1,1,1-trichloroethane	1	270	<1	<1	<1	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	NA
Cyclohexane	1	NSL	<1	<1	<1	NA
Carbon tetrachloride	1	240	<1	<1	<1	NA
Benzene	1	500	<1	<1	<1	NA
Dibromomethane	1	NSL	<1	<1	<1	NA
1,2-dichloropropane	1	900	<1	<1	<1	NA
Trichloroethene	1	330	<1	<1	<1	NA
Bromodichloromethane	1	NSL	<1	<1	<1	NA
trans-1,3-dichloropropene	1	NSL	<1	<1	<1	NA
cis-1,3-dichloropropene	1	NSL	<1	<1	<1	NA
1,1,2-trichloroethane	1	1900	<1	<1	<1	NA
Toluene	1	180	<1	<1	<1	NA
1,3-dichloropropane	1	1100	<1	<1	<1	NA
Dibromochloromethane	1	NSL	<1	<1	<1	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	NA
Tetrachloroethene	1	70	<1	<1	<1	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	NA
Chlorobenzene	1	55	<1	<1	<1	NA
Ethylbenzene	1	5	<1	<1	<1	NA
Bromoform	1	NSL	<1	<1	<1	NA
m+p-xylene	2	75	<2	<2	<2	NA
Styrene	1	NSL	<1	<1	<1	NA
1,1,2,2-tetrachloroethane	1	400	<1	<1	<1	NA
o-xylene	1	350	<1	<1	<1	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	NA
Isopropylbenzene	1	30	<1	<1	<1	NA
Bromobenzene	1	NSL	<1	<1	<1	NA
n-propyl benzene	1	NSL	<1	<1	<1	NA
2-chlorotoluene	1	NSL	<1	<1	<1	NA
4-chlorotoluene	1	NSL	<1	<1	<1	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	NA
1,3-dichlorobenzene	1	260	<1	<1	<1	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	NA
1,4-dichlorobenzene	1	60	<1	<1	<1	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	NA
1,2-dichlorobenzene	1	160	<1	<1	<1	NA
n-butyl benzene	1	NSL	<1	<1	<1	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	NA
1,2,4-trichlorobenzene	1	20	<1	<1	<1	NA
Hexachlorobutadiene	1	NSL	<1	<1	<1	NA
1,2,3-trichlorobenzene	1	3	<1	<1	<1	NA
Polycyclic Aromatic Hydrocarbons (PAHs)						
Naphthalene	0.2	50	<0.2	NA	<0.2	<0.2
Acenaphthylene	0.1	NSL	<0.1	NA	<0.1	<0.1
Acenaphthene	0.1	NSL	<0.1	NA	<0.1	<0.1
Fluorene	0.1	NSL	<0.1	NA	<0.1	<0.1
Phenanthrene	0.1	0.6	<0.1	NA	<0.1	<0.1
Anthracene	0.1	0.01	<0.1	NA	<0.1	<0.1
Fluoranthene	0.1	1	<0.1	NA	<0.1	<0.1
Pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(a)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Chrysene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	NA	<0.2	<0.2
Benzo(a)pyrene	0.1	0.1	<0.1	NA	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(g,h,i)perylene	0.1	NSL	<0.1	NA	<0.1	<0.1

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G2
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT GILs
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	SAMPLES			
			MW1	MW1 LAB DUP	MW5	WDUP1
Inorganic Compounds and Parameters						
pH		6.5 - 8.5	7.6	NA	7.4	NA
Electrical Conductivity (µS/cm)	1	NSL	380	NA	500	NA
Metals and Metalloids						
Arsenic (As III)	1	100	6	NA	4	6
Cadmium	0.1	20	<0.1	NA	<0.1	<0.1
Chromium (total)	1	500	1	NA	16	1
Copper	1	20000	1	NA	35	2
Lead	1	100	<1	NA	<1	<1
Total Mercury (inorganic)	0.05	10	<0.05	NA	<0.05	<0.05
Nickel	1	200	<1	NA	<1	<1
Zinc	1	30000	6	NA	26	7
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)						
Benzene	1	10	<1	<1	<1	<1
Toluene	1	8000	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2
o-xylene	1	NSL	<1	<1	<1	<1
Total xylenes	2	6000	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs						
Dichlorodifluoromethane	10	NSL	<10	<10	<10	NA
Chloromethane	10	NSL	<10	<10	<10	NA
Vinyl Chloride	10	3	<10	<10	<10	NA
Bromomethane	10	NSL	<10	<10	<10	NA
Chloroethane	10	NSL	<10	<10	<10	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	NA
1,1-Dichloroethene	1	300	<1	<1	<1	NA
Trans-1,2-dichloroethene	1	600	<1	<1	<1	NA
1,1-dichloroethane	1	NSL	<1	<1	<1	NA
Cis-1,2-dichloroethene	1	600	<1	<1	<1	NA
Bromochloromethane	1	2500	<1	<1	<1	NA
Chloroform	1		<1	<1	<1	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	NA
1,2-dichloroethane	1	30	<1	<1	<1	NA
1,1,1-trichloroethane	1	NSL	<1	<1	<1	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	NA
Cyclohexane	1	NSL	<1	<1	<1	NA
Carbon tetrachloride	1	30	<1	<1	<1	NA
Benzene	1	10	<1	<1	<1	NA
Dibromomethane	1	NSL	<1	<1	<1	NA
1,2-dichloropropane	1	NSL	<1	<1	<1	NA
Trichloroethene	1	NSL	<1	<1	<1	NA
Bromodichloromethane	1	NSL	<1	<1	<1	NA
trans-1,3-dichloropropene	1	1000	<1	<1	<1	NA
cis-1,3-dichloropropene	1	1000	<1	<1	<1	NA
1,1,2-trichloroethane	1	NSL	<1	<1	<1	NA
Toluene	1	8000	<1	<1	<1	NA
1,3-dichloropropane	1	NSL	<1	<1	<1	NA
Dibromochloromethane	1	NSL	<1	<1	<1	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	NA
Tetrachloroethene	1	500	<1	<1	<1	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	NA
Chlorobenzene	1	3000	<1	<1	<1	NA
Ethylbenzene	1	3000	<1	<1	<1	NA
Bromoform	1	NSL	<1	<1	<1	NA
m+p-xylene	2	NSL	<2	<2	<2	NA
Styrene	1	300	<1	<1	<1	NA
1,1,2,2-tetrachloroethane	1	NSL	<1	<1	<1	NA
o-xylene	1	NSL	<1	<1	<1	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	NA
Isopropylbenzene	1	NSL	<1	<1	<1	NA
Bromobenzene	1	NSL	<1	<1	<1	NA
n-propyl benzene	1	NSL	<1	<1	<1	NA
2-chlorotoluene	1	NSL	<1	<1	<1	NA
4-chlorotoluene	1	NSL	<1	<1	<1	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	NA
1,3-dichlorobenzene	1	200	<1	<1	<1	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	NA
1,4-dichlorobenzene	1	400	<1	<1	<1	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	NA
1,2-dichlorobenzene	1	15000	<1	<1	<1	NA
n-butyl benzene	1	NSL	<1	<1	<1	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	NA
1,2,4-trichlorobenzene	1	300	<1	<1	<1	NA
1,2,3-trichlorobenzene	1		<1	<1	<1	NA
Hexachlorobutadiene	1	7	<1	<1	<1	NA
Polycyclic Aromatic Hydrocarbons (PAHs)						
Naphthalene	0.2	NSL	<0.2	NA	<0.2	<0.2
Acenaphthylene	0.1	NSL	<0.1	NA	<0.1	<0.1
Acenaphthene	0.1	NSL	<0.1	NA	<0.1	<0.1
Fluorene	0.1	NSL	<0.1	NA	<0.1	<0.1
Phenanthrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Fluoranthene	0.1	NSL	<0.1	NA	<0.1	<0.1
Pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(a)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Chrysene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	NA	<0.2	<0.2
Benzo(a)pyrene	0.1	0.1	<0.1	NA	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(g,h,i)perylene	0.1	NSL	<0.1	NA	<0.1	<0.1

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE G3
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO DRINKING WATER GILs
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NHMRC ADWG 2011	SAMPLES			
			MW1	MW1 LAB DUP	MW5	WDUP1
Inorganic Compounds and Parameters						
pH		6.5 - 8.5	7.6	NA	7.4	NA
Electrical Conductivity (µS/cm)	1	NSL	380	NA	500	NA
Metals and Metalloids						
Arsenic (As III)	1	10	6	NA	4	6
Cadmium	0.1	2	<0.1	NA	<0.1	<0.1
Chromium (total)	1	50	1	NA	16	1
Copper	1	2000	1	NA	35	2
Lead	1	10	<1	NA	<1	<1
Total Mercury (inorganic)	0.05	1	<0.05	NA	<0.05	<0.05
Nickel	1	20	<1	NA	<1	<1
Zinc	1	3000	6	NA	26	7
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)						
Benzene	1	1	<1	<1	<1	<1
Toluene	1	800	<1	<1	<1	<1
Ethylbenzene	1	300	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2
o-xylene	1	NSL	<1	<1	<1	<1
Total xylenes	2	600	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs						
Dichlorodifluoromethane	10	NSL	<10	<10	<10	NA
Chloromethane	10	NSL	<10	<10	<10	NA
Vinyl Chloride	10	0.3	<10	<10	<10	NA
Bromomethane	10	NSL	<10	<10	<10	NA
Chloroethane	10	NSL	<10	<10	<10	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	NA
1,1-Dichloroethene	1	30	<1	<1	<1	NA
Trans-1,2-dichloroethene	1	60	<1	<1	<1	NA
1,1-dichloroethane	1	NSL	<1	<1	<1	NA
Cis-1,2-dichloroethene	1	60	<1	<1	<1	NA
Bromochloromethane	1	250	<1	<1	<1	NA
Chloroform	1		<1	<1	<1	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	NA
1,2-dichloroethane	1	3	<1	<1	<1	NA
1,1,1-trichloroethane	1	NSL	<1	<1	<1	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	NA
Cyclohexane	1	NSL	<1	<1	<1	NA
Carbon tetrachloride	1	3	<1	<1	<1	NA
Benzene	1	1	<1	<1	<1	NA
Dibromomethane	1	NSL	<1	<1	<1	NA
1,2-dichloropropane	1	NSL	<1	<1	<1	NA
Trichloroethene	1	NSL	<1	<1	<1	NA
Bromodichloromethane	1	NSL	<1	<1	<1	NA
trans-1,3-dichloropropene	1	100	<1	<1	<1	NA
cis-1,3-dichloropropene	1	100	<1	<1	<1	NA
1,1,2-trichloroethane	1	NSL	<1	<1	<1	NA
Toluene	1	800	<1	<1	<1	NA
1,3-dichloropropane	1	NSL	<1	<1	<1	NA
Dibromochloromethane	1	NSL	<1	<1	<1	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	NA
Tetrachloroethene	1	50	<1	<1	<1	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	NA
Chlorobenzene	1	300	<1	<1	<1	NA
Ethylbenzene	1	300	<1	<1	<1	NA
Bromoform	1	NSL	<1	<1	<1	NA
m+p-xylene	2	NSL	<2	<2	<2	NA
Styrene	1	30	<1	<1	<1	NA
1,1,2,2-tetrachloroethane	1	NSL	<1	<1	<1	NA
o-xylene	1	NSL	<1	<1	<1	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	NA
Isopropylbenzene	1	NSL	<1	<1	<1	NA
Bromobenzene	1	NSL	<1	<1	<1	NA
n-propyl benzene	1	NSL	<1	<1	<1	NA
2-chlorotoluene	1	NSL	<1	<1	<1	NA
4-chlorotoluene	1	NSL	<1	<1	<1	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	NA
1,3-dichlorobenzene	1	20	<1	<1	<1	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	NA
1,4-dichlorobenzene	1	40	<1	<1	<1	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	NA
1,2-dichlorobenzene	1	1500	<1	<1	<1	NA
n-butyl benzene	1	NSL	<1	<1	<1	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	NA
1,2,4-trichlorobenzene	1	30	<1	<1	<1	NA
1,2,3-trichlorobenzene	1		<1	<1	<1	NA
Hexachlorobutadiene	1	0.7	<1	<1	<1	NA
Polycyclic Aromatic Hydrocarbons (PAHs)						
Naphthalene	0.2	NSL	<0.2	NA	<0.2	<0.2
Acenaphthylene	0.1	NSL	<0.1	NA	<0.1	<0.1
Acenaphthene	0.1	NSL	<0.1	NA	<0.1	<0.1
Fluorene	0.1	NSL	<0.1	NA	<0.1	<0.1
Phenanthrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Fluoranthene	0.1	NSL	<0.1	NA	<0.1	<0.1
Pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(a)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Chrysene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	NA	<0.2	<0.2
Benzo(a)pyrene	0.1	0.01	<0.1	NA	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	NA	<0.1	<0.1
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	NA	<0.1	<0.1
Benzo(g,h,i)perylene	0.1	NSL	<0.1	NA	<0.1	<0.1

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE G5
GROUNDWATER LABORATORY RESULTS COMPARED TO SITE SPECIFIC HSLs - RISK ASSESSMENT
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NHMRC ADWG 2011	WHO 2008	USEPA RSL Tapwater 2017	SAMPLES MW1	MW1 LAB DUP	MW5	WDUP1
Total Recoverable Hydrocarbons (TRH)								
C_6-C_9 Aliphatics (assessed using F1)	10	-	15000	-	<10	<10	<10	<10
>C_9-C_{14} Aliphatics (assessed using F2)	50	-	100	-	<50	NA	<50	<50
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)								
Benzene	1	1	-	-	<1	<1	<1	<1
Toluene	1	800	-	-	<1	<1	<1	<1
Ethylbenzene	1	300	-	-	<1	<1	<1	<1
Total xylenes	2	600	-	-	<2	<2	<2	<2
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	1	-	-	6.1	<1	<1	<1	<1
Volatile Organic Compounds (VOCs), including chlorinated VOCs								
Dichlorodifluoromethane	10	-	-	-	<10	<10	<10	NA
Chloromethane	10	-	-	-	<10	<10	<10	NA
Vinyl Chloride	10	0.3	-	-	<10	<10	<10	NA
Bromomethane	10	-	-	-	<10	<10	<10	NA
Chloroethane	10	-	-	-	<10	<10	<10	NA
Trichlorofluoromethane	10	-	-	-	<10	<10	<10	NA
1,1-Dichloroethene	1	30	-	-	<1	<1	<1	NA
Trans-1,2-dichloroethene	1	60	-	-	<1	<1	<1	NA
1,1-dichloroethane	1	-	-	-	<1	<1	<1	NA
Cis-1,2-dichloroethene	1	60	-	-	<1	<1	<1	NA
Bromochloromethane	1	250	-	-	<1	<1	<1	NA
Chloroform	1		-	-	<1	<1	<1	NA
2,2-dichloropropane	1	-	-	-	<1	<1	<1	NA
1,2-dichloroethane	1	3	-	-	<1	<1	<1	NA
1,1,1-trichloroethane	1	-	-	-	<1	<1	<1	NA
1,1-dichloropropene	1	-	-	-	<1	<1	<1	NA
Cyclohexane	1	-	-	-	<1	<1	<1	NA
Carbon tetrachloride	1	3	-	-	<1	<1	<1	NA
Benzene	1	1	-	-	<1	<1	<1	NA
Dibromomethane	1	-	-	-	<1	<1	<1	NA
1,2-dichloropropane	1	-	-	-	<1	<1	<1	NA
Trichloroethene	1	-	-	-	<1	<1	<1	NA
Bromodichloromethane	1	-	-	-	<1	<1	<1	NA
trans-1,3-dichloropropene	1	100	-	-	<1	<1	<1	NA
cis-1,3-dichloropropene	1	100	-	-	<1	<1	<1	NA
1,1,2-trichloroethane	1	-	-	-	<1	<1	<1	NA
Toluene	1	800	-	-	<1	<1	<1	NA
1,3-dichloropropane	1	-	-	-	<1	<1	<1	NA
Dibromochloromethane	1	-	-	-	<1	<1	<1	NA
1,2-dibromoethane	1	-	-	-	<1	<1	<1	NA
Tetrachloroethene	1	50	-	-	<1	<1	<1	NA
1,1,1,2-tetrachloroethane	1	-	-	-	<1	<1	<1	NA
Chlorobenzene	1	300	-	-	<1	<1	<1	NA
Ethylbenzene	1	300	-	-	<1	<1	<1	NA
Bromoform	1	-	-	-	<1	<1	<1	NA
m+p-xylene	2	-	-	-	<2	<2	<2	NA
Styrene	1	30	-	-	<1	<1	<1	NA
1,1,2,2-tetrachloroethane	1	-	-	-	<1	<1	<1	NA
o-xylene	1	-	-	-	<1	<1	<1	NA
1,2,3-trichloropropane	1	-	-	-	<1	<1	<1	NA
Isopropylbenzene	1	-	-	-	<1	<1	<1	NA
Bromobenzene	1	-	-	-	<1	<1	<1	NA
n-propyl benzene	1	-	-	-	<1	<1	<1	NA
2-chlorotoluene	1	-	-	-	<1	<1	<1	NA
4-chlorotoluene	1	-	-	-	<1	<1	<1	NA
1,3,5-trimethyl benzene	1	-	-	-	<1	<1	<1	NA
Tert-butyl benzene	1	-	-	-	<1	<1	<1	NA
1,2,4-trimethyl benzene	1	-	-	-	<1	<1	<1	NA
1,3-dichlorobenzene	1	20	-	-	<1	<1	<1	NA
Sec-butyl benzene	1	-	-	-	<1	<1	<1	NA
1,4-dichlorobenzene	1	40	-	-	<1	<1	<1	NA
4-isopropyl toluene	1	-	-	-	<1	<1	<1	NA
1,2-dichlorobenzene	1	1500	-	-	<1	<1	<1	NA
n-butyl benzene	1	-	-	-	<1	<1	<1	NA
1,2-dibromo-3-chloropropane	1	-	-	-	<1	<1	<1	NA
1,2,4-trichlorobenzene	1	30	-	-	<1	<1	<1	NA
1,2,3-trichlorobenzene	1		-	-	<1	<1	<1	NA
Hexachlorobutadiene	1	7	-	-	<1	<1	<1	NA

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE Q2
GROUNDWATER QA/QC SUMMARY

		TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD	*10*	*50*	*100*	*100*	*1*	*1*	*1*	*2*	*1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
	PQL Envirolab VIC	*10*	*50*	*100*	*100*	*1.0*	*1.0*	*1.0*	*2.0*	*1.0*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
Intra	MW1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	6	<0.1	1	1	<1	<0.05	<1	6
laboratory	WDUP1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	6	<0.1	1	2	<1	<0.05	<1	7
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	6	nc	1	1.5	nc	nc	nc	6.5
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	nc	0%	67%	nc	nc	nc	15%
Field	TB-W1	NA	NA	NA	NA	<1	<1	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	5/05/2022																																
Trip	TS-W1	-	-	-	-	73%	80%	99%	95%	98%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Spike	5/05/2022																																

Result outside of QA/QC acceptance criteria Value

ABBREVIATIONS AND EXPLANATIONS FOR ACID SULFATE SOIL TABLE

Abbreviations used in the Tables:

ANC_{BT}	Acid Neutralising Capacity - Back Titration
ANCE	Excess Acid Neutralising Capacity
$CaCO_3$	Calcium Carbonate
kg	kilogram
mol H^+/t	moles hydrogen per tonne
pHF	Field pH
pHFOX	Field peroxide pH
pH_{KCl}	Pottasium chloride pH
S	Sulfur
SCr	The symbol given to the result from the Chromium Reducible Sulfur method
S_{NAS}	Net Acid Soluble Sulfur
% w/w	Percentage by mass

Results have been assessed against the criteria specified in Table 1.1 of National Acid sulfate Soil Guidance - National acid sulfate soil identification and laboratory method manual. Water Quality Australia. June 2018

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TABLE I
SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOIL ANALYSIS

Soil Texture: Coarse		Analysis	pH_F and pH_{FOX}				pH_{KCL}	Actual Acidity (Titratable Actual Acidity - TAA)	Potential Sulfidic Acidity		Retained Acidity	Acid Neutralising Capacity (ANC_{BT})	a-Net Acidity without ANCE	s-Net Acidity without ANCE	Liming Rate - without ANCE
			pH_F	pH_{FOX}	Reaction	pH_F - pH_{FOX}		(mol H^+/t)	(% SCr)	(mol H^+/t)	(%S_{NAS})	(% $CaCO_3$)	(mol H^+/t)	(%w/w S)	(kg $CaCO_3$/tonne)
National Acid Sulfate Soils Guidance (2018)			-	-	-	-	-	-	-	-	-	-	18	0.03	-
Sample Reference	**Sample Depth (m)**	**Sample Description**													
BH1	0.3-0.5	F: Sand	10	8.2	High reaction	1.8	10.2	<5	<0.005	<3	[NT]	6.4	<5	<0.005	<0.75
BH1	0.3-0.5	F: Sand	9.9	8	High reaction	1.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	1.3-1.5	Sand	10	7.2	Low reaction	2.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	1.8-2.0	Sand	9.4	7.1	Low reaction	2.3	9.9	<5	<0.005	<3	[NT]	0.35	<5	<0.005	<0.75
BH1	2.9-3.0	Sand	8.9	7.1	Low reaction	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	3.9-4.0	Sand	8.5	6.7	Low reaction	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	4.9-5.0	Sand	8.8	6.7	Low reaction	2.1	9.9	<5	0.006	4	[NT]	0.9	<5	0.01	<0.75
BH1	5.9-6.0	Sand	8.6	6.8	Low reaction	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	6.9-7.0	Sand	8.4	6.7	Low reaction	1.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	0.3-0.5	F: Sand	8.7	7.6	Low reaction	1.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	1.3-1.5	F: Sand	9	6.6	Low reaction	2.4	9.9	<5	0.007	4	[NT]	0.25	<5	0.01	<0.75
BH5	1.8-2.0	Sand	8.2	7.1	Low reaction	1.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	1.8-2.0	Sand	8.1	6.9	Low reaction	1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	2.9-3.0	Sand	8.1	6	Low reaction	2.1	7.1	<5	0.007	4	[NT]	0.25	<5	0.01	<0.75
BH5	3.9-4.0	Sand	8.1	6.3	Low reaction	1.8	9.8	<5	0.005	3	[NT]	<0.05	<5	0.01	<0.75
BH5	4.9-5.0	Sand	8.4	6.5	Low reaction	1.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	5.9-6.0	Sand	8.1	6.6	Low reaction	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	6.9-7.0	Sand	8.4	6.4	Low reaction	2	9.9	<5	0.05	29	[NT]	1.6	29.0	0.05	2.2
Total Number of Samples			18	18	-	18	7	7	7	7	7	7	7	7	7
Minimum Value			8.1	6.0	-	1.1	7.1	<PQL	0.005	3	<PQL	0.25	29.0	0.005	2.2
Maximum Value			10.0	8.2	-	2.8	10.2	<PQL	0.05	29	<PQL	6.40	29.0	0.047	2.2

Values Exceeding Action Criteria