Sampling and Analysis Quality Plan for Additional Targeted Site Contamination Assessment of the Nuclear Powered Submarine Construction Yard, Osborne, South Australia

URPS

Final Report (Rev0)

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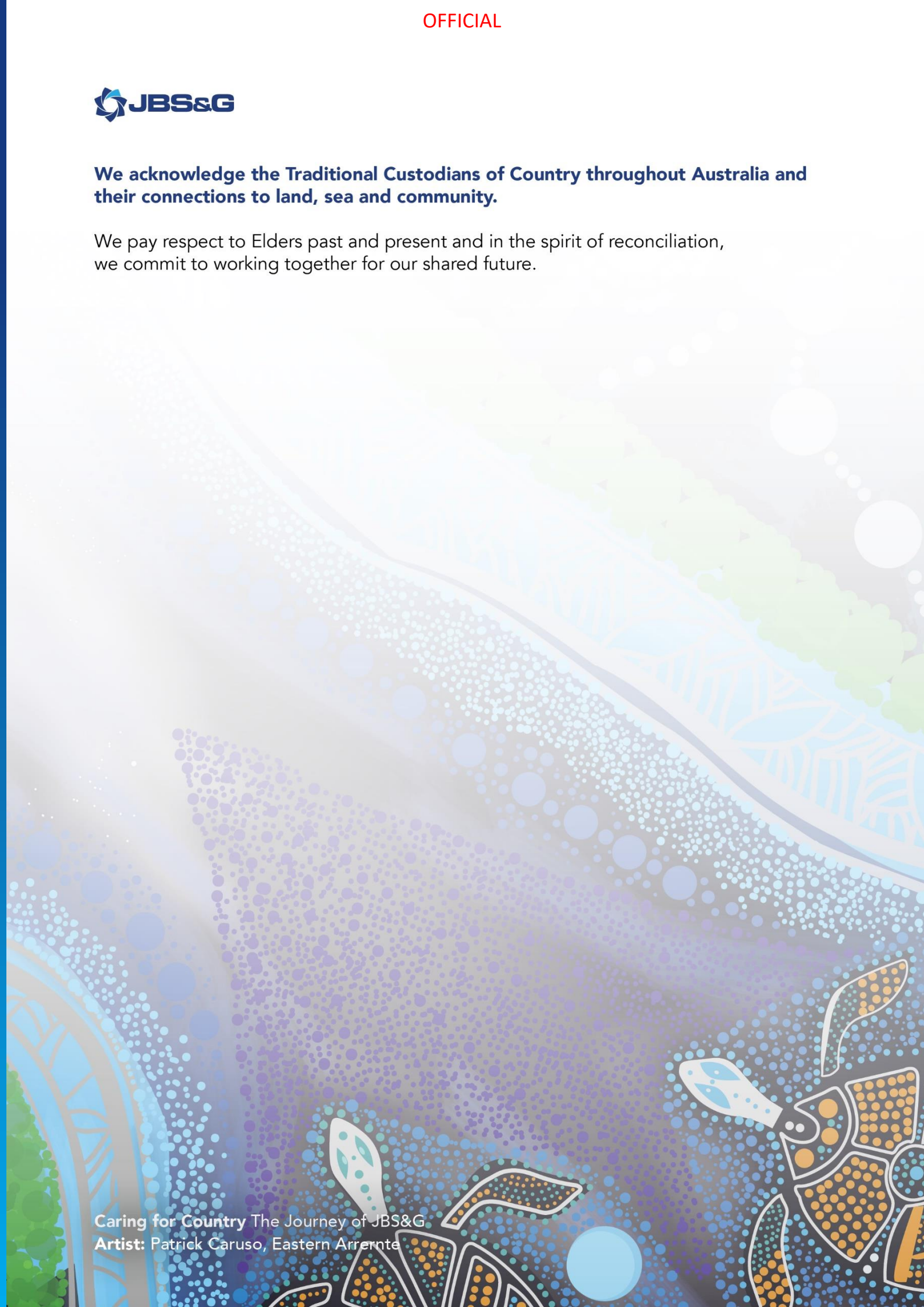
JBS&G

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.



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Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AEP	Annual Exceedance Probability
ANI	Australian Naval Infrastructure
ANSIS	Australian National Soil Information System
ASA	Australian Submarine Agency
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soil Management Plan
BTEXN	Benzene, toluene, ethylbenzene, xylenes and naphthalene
CEMP	Construction Environment Management Plan
COC	Chain of Custody
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
CT	Certificate of Title
DMP	Dewatering Management Plan
DO	Dissolved Oxygen
DQI	Data Quality Indictaor
DQO	Data Quality Objectives
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EPA SA	Environment Protection Authority South Australia
GDE	Groundwater Dependent Ecosystems
HDPE	High Density Polyethylene
IFD	Intensity-Frequency-Duration
LOR	Limit of Reporting
mAHD	Metres Australian Height Datum
NAPL	Non-aqueous Phase Liquid
NATA	National Association of Testing Authorities
OCPs	Organochlorine Pesticides
OPPs	Organophosphorous Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PARCCS	Precision, accuracy, representativeness, comparability, completeness and sensitivity
PASS	Potential Acid Sulfate Soils
PCA	Potentially Contaminating Activities
PCBs	Polychlorinated biphenyls
PFAS	Per- and polyfluoroalkyl substances
PFAS NEMP	PFAS National Environmental Management Plan
PSI	Preliminary Site Investigation

Term	Definition
QA / QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SAQP	Sampling, Analysis and Quality Plan
SCY	Submarine Construction Yard
SPOCAS	Suspension peroxide oxidation combined acidity and sulphur
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TRH	Total Recoverable Hydrocarbons
WDF	Waste Derived Fill

1. Introduction

The Australian Submarine Agency (ASA) was established in July 2023 to safely and securely acquire, construct, deliver, technically govern, sustain and dispose of Australia's conventionally-armed nuclear-powered submarine capability for Australia.

Australian Naval Infrastructure (ANI) as the owner and manager of the existing Osborne Naval Shipyard is proposing the development of adjacent land to construct a new, purpose-built, secure, nuclear-powered Submarine Construction Yard (SCY; the subject site – see **Figure 1**, attached). The SCY will provide a facility for the construction of the submarines by a third-party ship builder, for delivery to ASA.

The Minister for Planning declared the SCY as an impact assessed development under section 108 (1)(c) of the *Planning, Development and Infrastructure Act 2016*, which requires the preparation of an Environmental Impact Statement (EIS).

JBS&G Australia Pty Ltd (JBS&G) was engaged by URPS, acting on behalf of ANI, to complete the Physical Environment chapter of the EIS (land-based portion of the subject site only).

In order to complete this chapter of the EIS, JBS&G undertook a limited preliminary site investigation (PSI), soil investigation and groundwater investigation[1], noting some of this investigation was undertaken in a limited time period and hence some assessment work remained outstanding on completion of the EIS chapter. This Sampling and Analysis Quality Plan (SAQP) has been prepared to detail the objectives, scope, and methodology for the additional targeted site contamination assessment works to be undertaken to inform the EIS.

Note: At time of writing and parallel to this assessment, it is understood the Siting and Site Evaluation Report (SSER) was being prepared for the SCY site. The SSER documents and characterises the natural and human induced hazards that could affect the safety of the nuclear licenced activities where they occur at the site. The results of any assessment works undertaken as part of the SSER have not been shared with JBS&G, and hence have not informed the scope of the additional assessment works outlined herein.

1.1 Objective

The objective of this SAQP is to provide the necessary background and guidance for the completion of the additional targeted site contamination assessment works to be undertaken to inform the EIS.

The objectives of the initial site contamination assessment (JBS&G 2024) of the subject site were as follows:

- To assess the contamination status of the site in relation to proposed future use for submarine building purposes (commercial / industrial land use);
- Assess whether any management measurements were required to facilitate the proposed development, and where required, provide relevant management options; and
- Inform the commercial needs of the project, including providing indicative classification of soils which may be surplus to development requirements.

[1] *Nuclear-Powered Submarine Construction Yard – Site Contamination Assessment,* JBS&G Australia Pty Ltd, 11 November 2024 (JBS&G 2024).

2. Conceptual Site Model

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM)[2] identifies a conceptual site model (CSM) as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments.

The essential elements of a CSM (as outlined in the ASC NEPM [NEPC 2013]) include:

- Known and potential sources of contamination and contaminants of concern;
- Potentially affected media (soil, sediment, groundwater, surface water, indoor or ambient air);
- Land use and building design;
- Preferential pathways for vapour intrusion (where volatile chemicals are contaminants of concern);
- Human and ecological receptors; and
- Potential and complete exposure pathways.

The CSM for the subject site is presented in **Table 2.1.**

[2] *National Environment Protection (Assessment of Site Contamination) Measure 1999,* National Environment Protection Council, 1999 as amended 2013 (NEPC 2013).

Table 2.1: Conceptual Site Model

Element of CSM	Discussion
Potential sources of contamination on site	A number of potentially contaminating activities (PCAs) that have the potential to impact the subject site were identified in the limited PSI, including the following: <u>Moderate risk</u> • Fill or soil importation – onsite (sitewide) • Dredge spoil disposal or storage – onsite (Area 3) <u>Low to moderate risk</u> • Wetlands or detention basins – onsite; historic (sitewide) and current (CT DD and Falie Reserve) • Potential burial of asbestos containing materials – onsite; confirmed for CT DD, potential for sitewide • Fill or soil importation – offsite; across the broader northern LeFevre Peninsula <u>Low risk</u> • Railway operations – offsite; between CT DD and CT EE and west of Area 2 • Fuel terminal (Ampol Fuel Terminal Pelican Point) – offsite; adjacent to Areas A and B • Historical fuel / oil terminal – offsite; formerly present north-west of Area 1 and west of Area 2 • Electricity generation or power plants (Pelican Point Power Station) – offsite; adjacent to Areas B and C The soil investigation completed herein targeted the PCAs identified onsite, and did not identify significant contamination. The groundwater investigation completed herein also targeted the PCAs identified onsite. Whilst site contamination of groundwater exists across the site, the site contamination is unlikely to be site derived (with the possible exception of per- and polyfluoroalkyl substances [PFAS]), on the basis of the site history and reported soil concentrations. PFAS was reported at higher concentrations and in more wells across Area 1 than Area 2 and C, and hence this distribution could be associated with the current wetlands / detention basins on CT DD and Falie Reserve, depending on their construction (i.e. if not suitably lined).
Contaminants of potential concern (COPCs) associated with the potential sources of contamination	A broad range of COPCs may be associated with the identified PCAs outlined above, including: • Heavy metals • Organotins • Cyanide • PFAS • Acid sulfate soils • Total recoverable hydrocarbons (TRH) • Benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN) • Polycyclic aromatic hydrocarbons (PAH) • Organochlorine pesticides (OCP) / organophosphorous pesticides (OPP) • Asbestos • Phenols • MTBE
Potentially affected media	Soil was considered to be the most likely media to be impacted, however, the soil investigation completed herein did not identify significant soil contamination. Groundwater had the potential to be impacted due to the shallow depth to groundwater (below 0.5 mbgl in Area 3, generally between 1 mbgl and 2 mbgl across

Element of CSM	Discussion
Potentially affected media (cont.)	the remainder of the site). As outlined above, whilst site contamination of groundwater exists across the site, the site contamination is unlikely to be site derived (with the possible exception of PFAS), on the basis of the site history and reported soil concentrations. PFAS was reported at higher concentrations and in more wells across Area 1 than Area 2 and C, and hence this distribution could be associated with the current wetlands / detention basins on CT DD and Falie Reserve, depending on their construction (i.e. if not suitably lined). Volatile chemicals were not reported in soil at elevated concentrations, however, methane was reported in groundwater at elevated concentrations in the majority of wells. While this is likely to be naturally occurring rather than a result of PCAs at the site, methane is a volatile compound and has the potential to impact the project (both construction and operation) via the vapour pathway. Further assessment should be undertaken to assess the risks from methane via the vapour pathway.
Human and ecological receptors	The following human receptors were identified under the current / future land use (commercial / industrial): • On site workers (during site operation); • Construction workers (during the construction program); and • Sub-surface maintenance workers (during site operation). The following ecological receptors were identified under the current / future land use (commercial / industrial): • Native flora and fauna; • Introduced flora and fauna; • Transitory wildlife; and • Biota supporting ecological processes.
Potential exposure pathways for human receptors	The following potential exposure pathways have been identified: <u>Onsite workers (during site operation)</u> • Dermal contact with soil; • Incidental ingestion of soil; • Inhalation of dust; and • Vapour intrusion. <u>Construction workers (during the construction program)</u> • Dermal contact with soil; • Incidental ingestion of soil; • Inhalation of dust; • Dermal contact with groundwater; • Incidental ingestion of groundwater; • Vapour intrusion; and • Explosive risks due to methane. <u>Sub-surface maintenance workers (during site operation)</u> • Dermal contact with soil; • Incidental ingestion of soil; • Inhalation of dust; • Vapour intrusion; and • Explosive risks due to methane. All other exposure pathways have been excluded, assuming groundwater will not be extracted for beneficial purposes once the site has been developed.

3. Data Gap Analysis

Data gaps identified by JBS&G (2024) are summarised below in **Table 3.1**.

Table 3.1: Summary of Identified Data Gaps (Area 1 Soils and Area 1-3 Groundwater)

Data Gap	Detail	Comment
Soil investigation of the Former Ferrocut site (Area 1)	Access to the Former Ferrocut site was not possible during the site works program undertaken in May / June 2024, and hence the four soil boreholes proposed for this portion of the site were unable to be drilled and sampled. The proposed four soil boreholes should be drilled and sampled to achieve the proposed 25 % sampling density outlined in AS4482.1[3].	Scope outlined herein to address this data gap
Extent of elevated lead concentrations (Area 2)	Elevated lead above the Tier 1 screening level for commercial / industrial land use was reported at one location Area 2 (SB127_2.3-2.5). The extent of elevated lead should be assessed to determine whether these elevated concentrations are wide-spread and/or are suitable to remain onsite under the proposed development.	Scope outlined herein to address this data gap
Assessment of potential acid sulfate soil (PASS) and actual acid sulfate soil (AASS) in deeper soils (i.e. at depths greater than 3 mbgl) in areas where dewatering is likely to be required	The assessment depth of PASS / ASS to date of depths up to 3 mbgl is considered suitable for the majority of the subject site (Areas A-C), with the exception of Area 3 where deep excavation and significant dewatering is likely to be required. Further assessment of PASS / ASS to the proposed depth of excavation in Area 3 should be undertaken.	Scope outlined herein to address this data gap
No assessment of the deeper aquifers	Assessment of the Q1 aquifer is appropriate for the assessment of the site contamination status of the site. Significant excavation (up to 20 mbgl) is proposed for Area 3 and the second Quaternary aquifer (Q2) is likely to be encountered during construction works. Furthermore, dewatering from both the Q1 and Q2 aquifers is likely to be required. To this end, an assessment of the Q2 aquifer should be undertaken to inform disposal options for waste water produced during dewatering from Area 3.	Scope outlined herein to address this data gap
Assessment of methane in the vapour phase	Methane was reported at elevated concentrations in the majority of groundwater wells across the site. Methane is a volatile chemical and has the potential to impact the project (both construction and operation) via the vapour pathway. Further assessment should be undertaken to assess the risks from methane via the vapour pathway.	Scope to be included in a separate SAQP for assessment of hazardous ground gas

[3] *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds, AS4482.1-2005*, Standards Australia, 2005 (SA 2005).

4. Data Quality Objectives (DQOs)

The DQO process outlined in the ASC NEPM (NEPC 2013) has been adopted to establish the type, quantity and quality of data needed to inform the study. The following sections address the seven-step DQO process with relevant inputs seeking to address the project objectives outlined in **Section 1.1**.

4.1 State the Problem

The following have been identified as data gaps that require further assessment:

- Sufficient grid based soil investigation has not been completed for the Former Ferrocut site (Area 1) due to access limitations in June 2024;
- The extent and significance of elevated lead reported at one borehole location on Area 2 is not known (i.e. whether the elevated lead is widespread and these concentrations are suitable to remain onsite under the proposed development), due to the large scale on which soil boreholes were drilled;
- Investigation of acid sulfate soils (ASS) and potential acid sulfate soils (PASS) within deeper soils (beyond 3 m below ground level [bgl]), and the contamination status of these soils, where significant excavation and dewatering is likely to be required (Area 3) has not been completed due to limited information on the development being provided until late in the investigation program completed in June 2024; and
- Investigation of the quality of groundwater in the second Quaternary aquifer (Q2) has not been completed due to limited information on the development being provided until late in the investigation program completed in June 2024.

It is noted that an additional data gap has been identified (assessment of hazardous ground gas) – further assessment of this data gap is outlined in a separate SAQP.

4.2 Goal of the Study

The objectives of the additional targeted site contamination assessment works are as follows:

- To assess the contamination status of the site in relation to proposed future use for submarine building purposes (commercial / industrial land use);
- Assess whether any additional management measurements are required to facilitate the proposed development, and where required, provide relevant management options; and
- Inform the commercial needs of the project, including:
    - Providing indicative classification of soils which may be surplus to requirements; and
    - Providing groundwater quality data for the Q2 aquifer in the area of the subject site where dewatering is likely to be required (and waste water is likely to require management/disposal).

4.3 Information Inputs

The primary information inputs will be the collection of site data through implementation of the following scope of work:

- Drilling and sampling of four shallow soil boreholes (to 1 mbgl) at approximate grid based locations (to the extent practicable outside of buildings) at the Former Ferrocut site (Area 1);
- Drilling and sampling of four shallow soil boreholes (to 3 mbgl) to delineate elevated lead reported at 2023 borehole location SB127 (Area 2);
- Drilling and sampling of three deep soil boreholes (to 20 mbgl) at the location of the non-tidal wet basin, caisson and the launch facility (Area 3);

- Installation and sampling of three groundwater wells in the Q2 aquifer at the location of the non-tidal wet basin, caisson and the launch facility in Area 3 (converted from the soil boreholes); and
- Laboratory analysis of soil and groundwater for COPCs associated with the PCAs identified in the limited PSI, ASS / PASS, and to inform management/disposal of waste water from dewatering.

Proposed investigation locations are shown in **Figure 2**.

4.4 Study Boundaries

The site location and physical boundaries of the subject site are shown in **Figure 1**. The additional targeted site contamination assessment works outlined herein are limited to the Former Ferrocut site (Area 1), one location on Area 2 (where elevated lead was reported in 2023), and Area 3 of the subject site.

Soil boreholes on the Former Ferrocut site (Area 1) are to be drilled to a depth of 1 mbgl.

Soil boreholes on Area 2 are to be drilled to a depth of 3 mbgl.

Deep soil boreholes at the location of the non-tidal wet basin, caisson and the launch facility (Area 3) are to be drilled to a depth of 20 mbgl.

Groundwater wells are to be installed within the Q2 aquifer, noting this aquifer is expected to be encountered at a depth of approximately 16 mbgl at the subject site and hence groundwater wells are expected to be installed to depths of approximately 18 mbgl to 20 mbgl. These wells will be installed in Area 3.

Site works are intended to be completed between August and December 2024.

4.5 Analytical Approach

4.5.1 Soil

The soil sample analytical program is outlined in **Table 4.1**.

Table 4.1: Soil Sample Analytical Program

Samples	Detail	Analysis
Primary Samples		
Former Ferrocut site	Six primary samples from four soil boreholes (to 1 mbgl)	• HM: 6 • pH: 2 • TRH: 3 • BTEX: 3 • VOCs: 1 • PAH: 5 • OCPs: 2 • OPPs: 2 • PCBs: 1 • PFAS: 2 • Cyanide: 1 • Organotins: 2 • SPOCAS: 2 • Asbestos: 2
Area 2	12 primary samples from four soil boreholes (to 3 mbgl)	• Lead: 12

Samples	Detail	Analysis
Non-tidal wet basin, caisson and the launch facility	15 primary samples from three soil boreholes (to 20 mbgl)	• HM: 15 • pH: 15 • TRH: 12 • BTEX: 12 • VOCs: 6 • PAH: 12 • OCPs: 6 • OPPs: 6 • PCBs: 6 • PFAS: 6 • Cyanide: 6 • Organotins: 6 • SPOCAS: 15 • Asbestos: 6
Quality Control (QC) Samples		
Intra-laboratory duplicates	4 (1 per 20 primary samples with the exception of PFAS analysis [1 per 10 primary samples])	• HM: 4 • TRH: 2 • BTEX: 2 • PAH: 2 • PFAS: 1 • OCPs: 1
Inter-laboratory splits	4 (1 per 20 primary samples with the exception of PFAS analysis [1 per 10 primary samples])	• HM: 4 • TRH: 2 • BTEX: 2 • PAH: 2 • PFAS: 1 • OCPs: 1
Rinsates	7 (one per day of soil borehole / groundwater well drilling)	• HM: 7 • TRH: 7 • BTEX: 7 • PFAS: 7
Validation samples of washdown water (supplied by driller) (PFAS only) – if required	7 (one per day of soil borehole / groundwater well drilling)	• PFAS: 7
Field blanks (PFAS only)	7 (one per day of soil sampling with PFAS analysis)	• PFAS: 7

Abbreviations:

HM – heavy metals; TRH – total recoverable hydrocarbons; BTEX – benzene, toluene, ethylbenzene, xylenes; VOCs – volatile organic compounds; PAH – polycyclic aromatic hydrocarbons; OCPs – organochlorine pesticides; OPPs – organophosphorus pesticides; PCBs – polychlorinated biphenyls; PFAS – per- and polyfluoroalkyl substances; SPOCAS – suspension peroxide oxidation combined acidity and sulfur (testing for acid sulfate soils).

4.5.2 Groundwater

The groundwater sample analytical program is outlined in **Table 4.2**.

Table 4.2: Groundwater Sample Analytical Program

Sample Type	Proposed Number of Samples for Analysis	Proposed Analytical Program
Primary Samples		
All wells	3	• Broad screen of COPC[#1] • Dewatering screen[#2]
QC Samples		
Intra-laboratory duplicate samples	1 (1 per 20 primary samples with the exception of PFAS analysis [1 per 10 primary samples])	• HM: 1 • TRH: 1 • BTEX: 1 • VOCs: 1 • PFAS: 1 • Cyanide: 1
Inter-laboratory split samples	1 (1 per 20 primary samples with the exception of PFAS analysis [1 per 10 primary samples])	• HM: 1 • TRH: 1 • BTEX: 1 • VOCs: 1 • PFAS: 1 • Cyanide: 1
Rinsate samples	1 (one per day of groundwater sampling)	• HM: 1 • TRH: 1 • BTEX: 1 • PFAS: 1
Field blanks (PFAS only)	1 (one per day of groundwater sampling)	• PFAS: 1

Notes:

#1: Broad screen of COPC includes heavy metals (arsenic, cadmium, chromium [total and CrVI], copper, nickel, lead, mercury, molybdenum, selenium and zinc), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOCs), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFAS), phenols, cyanide, organotins and methane.

#2: Dewatering screen includes turbidity, total suspended solids (TSS), total dissolved solids (TDS), salinity, pH, dissolved oxygen, biochemical oxygen demand, total nitrogen, ammonia, nitrate, total Kjeldahl nitrogen, total phosphorus, chloride, sulfate, and oil / grease.

4.6 Acceptance Criteria

This step is to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during the study must be appropriate to allow decisions to be made with confidence. A decision error may lead to either underestimation or overestimation on the nature and extent of chemicals in groundwater and/or soil vapour.

Acceptance limits on field and laboratory data collected for the additional targeted site contamination assessment works program will be in accordance with the ASC NEPM (NEPC 2013).

The potential for significant decision errors will be minimised by completing a Quality Assurance/Quality Control (QA/QC) program, including adoption of appropriate data quality indicators (DQIs) used to assess QA/QC performance.

The pre-determined DQIs established for the project are discussed below in relation to precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters), and are shown in **Table 4.3**. The DQIs are based on the ASC NEPM (NEPC 2013) and the requirements of the National Association of Testing Authorities (NATA) accreditation for the nominated laboratories.

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

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

Table 4.3: Summary of Analytical QA/QC Program

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Intra-laboratory duplicate samples	1 in 20 primary samples (5%) / 1 in 10 primary samples for PFAS (10%)	<30% RPD[#1]
Inter-laboratory split samples	1 in 20 primary samples (5%) / 1 in 10 primary samples for PFAS (10%)	<30% RPD[#1]
Laboratory duplicates[#2]	1 in 20 primary samples (5%) / 1 in 10 primary samples for PFAS (10%)	<30% RPD[#1]
Accuracy		
Method blanks	1 per lab batch	Less than the laboratory limit of reporting (<LOR)
Laboratory control samples	1 per lab batch	70-130% or as nominated in the laboratory's QC report
Matrix spikes	1 per lab batch	70-130% or as nominated in the laboratory's QC report
Representativeness		
Sampling appropriate for media and analytes	-	-[#3]
Samples extracted and analysed within holding times	All samples	Samples extracted and analysed within 7 days
Rinsate samples	1 per day of site work where reusable equipment is used (drilling of soil boreholes, drilling of groundwater wells, sampling of groundwater wells)	<LOR
Field blank samples (PFAS only)	1 per day of site work where soil / groundwater sampling occurs	<LOR
Validation samples of washdown water (supplied by driller) (PFAS only)[#4]	1 per day of site work where washdown occurs onsite using washdown water supplied by driller	<LOR
Laboratory blanks	1 per lab batch	<LOR
Comparability		
Standard operating procedures for sample collection and handling	All samples	Samples collected in accordance with relevant procedure[#3]
Standard analytical methods used for all analyses	All samples	All samples analysed by a laboratory that is NATA accredited for the analyses performed Primary laboratory to be consistent for all samples with the exception of inter-laboratory split samples

Data Quality Objectives	Frequency	Data Quality Indicator
Consistent field conditions, sampling staff and laboratory analysis	All samples	-#3
Limits of reporting appropriate and consistent	All samples	Laboratory LOR is below adopted guideline values and allows relevant comparability between results where more than one laboratory is used (i.e. for analysis of inter-laboratory split samples)
Completeness		
Sample description and COCs completed and appropriate	All samples	-#3
Appropriate documentation	All samples	-#3
Satisfactory frequency and result for QC samples	All QA/QC samples	As detailed above
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All samples	Laboratory LOR is below adopted guideline values

Notes:

#1: If the RPD between primary and duplicate / split sample is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

#2: Duplicate sample analysis performed by the laboratory as part of their internal QA/QC program for the data.

#3: A qualitative assessment of compliance with standard procedures and appropriate sample collection methods will be completed during the DQI compliance assessment.

4.7 Plan for Obtaining Data

A detailed description of the soil and groundwater investigation methodology is provided in **Section 5**.

5. Methodology

5.1 Soil Investigation

A total of 11 soil boreholes are to be drilled at the locations shown in **Figure 1**, as follows:

- Former Ferrocut site (Area 1): four soil boreholes to a depth of 1 mbgl; and
- Area 2; location of elevated lead reported in 2023: four soil boreholes to a depth of 3 mbgl; and
- Non-tidal wet basin, caisson and the launch facility (Area 3): three soil boreholes to a depth of 20 mbgl.

The following describes the soil investigation methodology:

- Professional service location following review of dial before you dig plans will be undertaken for all proposed soil borehole locations;
- All drilling equipment will be decontaminated using a suitable detergent (Liquinox) prior to the start of drilling at each investigation location to minimise the potential for cross contamination between drilling locations. A rinsate sample will be collected on each day of drilling to validate decontamination procedures (analytical plan outlined in **Section 4.5**);
- Soil boreholes will be advanced using direct push techniques as far as practical (beyond 1 mbgl but to a maximum of 5 mbgl), after which time augers will be utilised to obtain the relevant target depth (1 mbgl / 3 mbgl / 20 mbgl). It is noted the Q1 aquifer will be isolated in the 20 m boreholes by installation of a 'pre-collar' consisting of nominal 225 mm sacrificial casing and grout plug, as follows:
    - The borehole will initially be drilled to approximately 1 m below the base of the Q1 aquifer (up to 10 mbgl), at which time a pre-collar will be installed as follows:
        - A 225mm sacrificial casing will be installed to the base of the borehole (approximately 1 m below the base of the Q1 aquifer); and
        - The sacrificial casing will then be pressure grouted using a 'Tremmi Line' from the base of the hole to at least 2 m above the standing water level (likely to surface) to seal off the upper water bearing zone.
    - The pre-collar will be left for a minimum of 72 hours to cure, after which time drilling will recommence using smaller diameter augers to drill through the pre-collar and then soils beyond.
- Soils encountered during drilling will be logged by an experienced field scientist in accordance with the procedures described in the ASC NEPM (NEPC 2013);
- The following sampling will be completed:
    - For the shallow soil boreholes (target depths of 1 mbgl and 3 mbgl), soil samples will be collected from the top of each lithological layer encountered with a maximum of 1 m between samples. Measurements of total volatile compounds will be recorded in duplicate soil samples from all sampling depths using a photoionisation detector (PID). The PID measurements will be taken in a timely manner following drilling to reduce the opportunity for volatilisation of the volatile chemical substances that may be present in the core; and
    - For the deep soil boreholes (target depth of 20 mbgl), samples will be collected from 500 mm intervals for field screening for the presence of AASS/PASS in accordance with *Site Contamination*

– *acid sulfate soil materials*[4] and with reference to *Identification and investigation of acid sulfate soils and acidic landscapes*[5]. The following field screening will be undertaken:

  - Sub-samples (from 500 mm intervals) will be placed into compartmentalised sampling trays;
  - Where necessary (i.e. if not sufficiently wet), laboratory-supplied deionised (DI) water will be added to samples to generate a paste for the initial screening of field-pH (pH_F);
  - Field-oxidised pH (pH_{FOX}) will then be measured following the addition of a 30% hydrogen peroxide solution (corrected to approximately pH 5.5 using a 0.1M sodium hydroxide solution), with sample pH tested immediately following solution addition using a calibrated pH meter, and again after 10 minutes and the conclusion of any field oxidised sample reaction; and
  - Five samples (from where the greatest pH change from initial pH to oxidised pH is observed in sub samples) will be collected for laboratory analysis.

- Samples will be collected into laboratory supplied sample containers and transported to NATA accredited laboratories under chain of custody documentation (COC) in chilled eskies. Eurofins MGT will be adopted as the primary laboratory and Envirolab will be adopted as the secondary laboratory (for QC purposes); and
- Following completion of drilling on the Former Ferrocut site and on Area 2, soil cuttings will be used to reinstate the soil boreholes. Following completion of drilling in the area of the non-tidal wet basin, caisson and the launch facility, groundwater wells will be installed. Soil cuttings from these soil boreholes will remain onsite.

5.2 Groundwater Investigation

5.2.1 Installation of Groundwater Wells

A total of three groundwater wells are to be installed at the locations **Figure 1**, targeting the non-tidal wet basin, caisson and the launch facility. The groundwater wells are to be installed in the Q2 aquifer – this aquifer is expected to be encountered at a depth of approximately 16 mbgl at the subject site and hence groundwater wells are expected to be installed to depths of between 18 mbgl to 20 mbgl.

The following describes the groundwater well installation methodology:

- Groundwater wells will be installed at the location of the deeper soil boreholes (see **Section 5.1** for drilling and soil sampling methodology, including details of pre-collar installation);
- Once the required drilling depth has been obtained (likely 18 mbgl to 20 mbgl), groundwater wells will be installed in accordance with the following:
  - Groundwater wells will be constructed using 50 mm Class 18 uPVC screen and casing;
  - A screen length of 3 m will be installed in the Q2 aquifer;
  - A graded sand pack will be installed from the bottom of the drilled borehole to approximately 500 mm above the screened interval;
  - An activated bentonite seal of approximately 500 mm will be installed above the sand layer, with a cement / bentonite grout installed to surface using a 'Tremmi Line'; and

[4] *Site Contamination – acid sulfate soil materials,* Environment Protection Authority South Australia, 2007 (EPA SA, 2007).
[5] *Identification and investigation of acid sulfate soils and acidic landscapes,* Western Australian Department of Environment Regulation, 2015 (WA DER 2015).

- Groundwater wells will be completed with monument covers concreted into the surface, with lockable end caps fitted over the top of the wells (beneath the well cover).

- The wells will be developed within 24 hours of installation to ensure adequate hydraulic connection with the aquifer. The development of the wells will consist of removal of a minimum of four bore volumes, with purging to continue until indicator parameters of dissolved oxygen (DO), electrical conductivity (EC), redox potential, pH and temperature recorded every bore volume purged are within the ranges outlined by EPA SA[6] in three consecutive measurements;
- All groundwater purge water will be placed in 205 L drums, and then stored in a designated area on the subject site. Groundwater results will be provided for the water drums to facilitate offsite disposal. Drums will be collected by a contractor licensed to transport and receive contaminated water at the end of the site works program. Soil cuttings will remain onsite; and
- The newly installed groundwater wells will be surveyed by a licensed surveyor. Survey data including coordinates (easting and northings in Geocentric Datum of Australia [GDA94]), top of casing measurements in metres relate to the Australian Hight Datum (mAHD) and ground level measurements (in mAHD) will be provided in the report.

5.2.2 Groundwater Sampling

The three newly installed groundwater wells will be included in a groundwater sampling event a minimum of 7 days following completion of groundwater well installation works. All groundwater wells will be sampled using low flow methods.

The following describes the groundwater sampling methodology:

- All sampling equipment (interface probe, low flow pump, water quality meter) will be decontaminated using a suitable detergent (Liquinox) prior to the start of sampling at each well location to minimise the potential for cross contamination. A rinsate sample will be collected on the day of groundwater sampling to validate decontamination procedures;
- The three wells will be gauged within a 1-hour period prior to commencement of sampling. Groundwater well gauging will be undertaken using an electronic interface probe to measure the depth to water, depth to non-aqueous phase liquid (NAPL) (if present) and total depth of each well;
- Groundwater sampling will be completed via low flow methods, as follows:
  - Dedicated tubing (high density polyethylene [HDPE]) will be used for each groundwater well;
  - The low flow pump will be lowered into the well so that the intake point is set in the approximate centre of the water column and screened interval. The depth of the intake point will be recorded on the field sampling sheets;
  - The low flow pump will then be used to purge the well at a rate to establish a stabilised pumping rate while minimising drawdown. A maximum drawdown of 100 mm is proposed for the investigation. In the event that low flow sampling cannot be undertaken (i.e. the maximum drawdown is exceeded at the lowest flow rate of 50 ml/minute due to low yield), a grab sample will be collected before groundwater becomes turbid;
  - Following the establishment of the flow rate, indicator parameters (including DO, EC, redox potential, pH and temperature) will be measured to determine when purging has been completed (i.e. when indicator parameters are considered stable in accordance with EPA SA [2019]), with a minimum of one bore volume required to be removed prior to sampling. The presence or absence

[6] *Guidelines for regulatory monitoring and testing – Groundwater sampling,* Environment Protection Authority South Australia, April 2019 (EPA SA, 2019).

of visual and/or olfactory evidence of contamination will also be noted on the field sampling sheets; and

- Following removal of a minimum of one bore volume and stabilisation of indictor parameters, a groundwater sample will be collected in appropriately preserved sample bottles for the chemicals of interest (provided by the laboratory).

- Samples will be collected into laboratory supplied sample bottles and transported to NATA accredited laboratories under COC documentation in chilled eskies. Eurofins MGT will be adopted as the primary laboratory and Envirolab will be adopted as the secondary laboratory (for QC purposes); and
- All groundwater purge water will be placed in 205 L drums, and then stored in a designated area on the subject site. Groundwater results will be provided for the water drums to facilitate offsite disposal. Drums will be collected by a contractor licenced to transport and receive contaminated water at the end of the site works program.

6. Assessment Criteria

6.1 Soil

The adopted criteria will be consistent with that outlined by JBS&G (2024), including the following:

- Commercial / industrial land use:
  - Human health
    - ASC NEPM (NEPC 2013) Health Based Investigation Levels (HILs), Soil Health Screening Levels (HSLs) for Vapour Intrusion (sand, all depths), and Management Limits (coarse soils); and
    - *PFAS National Environmental Management Plan, Version 2.0*, National Chemicals Working Group of the Heads of EPAs Australia and New Zealand, January 2020 (HEPA 2020) Human health investigation levels for soil.
  - Ecological
    - ASC NEPM (NEPC 2013) Ecological Investigation Levels (EILs) – site specific for chromium (III), copper, nickel and zinc, Ecological Screening Levels (ESLs; coarse soils); and
    - PFAS NEMP (HEPA 2020) Ecological guideline values for soil: all land uses, direct and indirect.
- Acid sulfate soils:
  - *Site Contamination – acid sulfate soil materials,* Environment Protection Authority South Australia, 2007 (EPA SA, 2007).
- Waste classification (offsite reuse or disposal):
  - Offsite reuse
    - *Standard for the production and use of Waste Derived Fill*, Environment Protection Authority South Australia, October 2013 (EPA SA 2013); and
    - *EPA 1130/23 PFAS in waste soils interim guideline,* Environment Protection Authority South Australia, July 2023 (EPA SA 2023).
  - Offsite disposal
    - *Current criteria for the classification of waste – including Industrial and Commercial Waste (Listed) and Waste Soil*, Environment Protection Authority South Australia, March 2010 (EPA SA 2010); and
    - *EPA 1125/20 Landfill disposal criteria for PFAS-contaminated waste,* Environment Protection Authority South Australia, March 2020 (EPA SA 2020).

6.2 Groundwater

An assessment of the relevant environmental values and beneficial uses of groundwater in accordance with the *Guidelines for the assessment and remediation of site contamination*, Environment Protection Authority South Australia, 2019 (EPA SA 2019) will be undertaken for the Q2 aquifer as part of the reporting. Sources of the adopted criteria will be in accordance with EPA SA (2019) and consistent with JBS&G (2024).

The groundwater results will also be compared against *EPA 1093/21 Environmental management of dewatering during construction activities,* Environment Protection Authority South Australia, June 2021 (EPA SA 2021) to assist in development of management requirements for dewatering waste water.

7. Naming Conventions

Soil boreholes are to be labelled as follows:

- Former Ferrocut site: BH68, BH69, BH77 and BH78;
- Area 2: SB127_D1 to SB127_D4; and
- Non-tidal wet basin, caisson and the launch facility: BHD01 to BHD03.

Groundwater wells are to be labelled MWQ2_01 to MWQ2_03.

8. Reporting

A report will be provided detailing the additional targeted site contamination assessment works. The report will include the following:

- Introduction and objectives;
- Site identification details;
- Scope of work undertaken;
- Methodology;
- Summary of adopted human health and ecological (Tier 1) screening levels;
- Data quality assessment;
- Results and discussion, including:
  - Field observations;
  - Geology and hydrogeology, including inferred groundwater flow and inferred depth to groundwater across the site; and
  - Comparison of soil and groundwater analytical results against the adopted Tier 1 screening levels for commercial / industrial land use, waste classification criteria and dewatering guideline values.
- Discussion of results;
- Summary of outcomes;
- Updated conceptual site model; and
- Conclusions and recommendations.

9. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties. The report has been prepared specifically for the client for the purposes of the commission, and no warranties, express or implied, are offered to any third parties and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. This report should not be amended in any way without prior approval by JBS&G, or reproduced other than in full including all attachments as originally provided to the client by JBS&G.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements or agreed scope of work.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

10. References

Environment Protection Authority South Australia (2023) EPA 1130/23 PFAS in waste soils interim guideline, July 2023.

Environment Protection Authority South Australia (2021) EPA 1093/21 Environmental management of dewatering during construction activities, June 2021.

Environment Protection Authority South Australia (2020) EPA 1125/20 Landfill disposal criteria for PFAS-contaminated waste, March 2020.

Environment Protection Authority South Australia (2019) Guidelines for the assessment and remediation of site contamination, October 2019.

Environment Protection Authority South Australia (2019) Guidelines for regulatory monitoring and testing – Groundwater sampling, Environment Protection Authority South Australia, April 2019.

Environment Protection Authority South Australia (2013) Standard for the production and use of Waste Derived Fill, October 2013.

Environment Protection Authority South Australia (2010) Current criteria for the classification of waste – including Industrial and Commercial Waste (Listed) and Waste Soil, March 2010.

Environment Protection Authority South Australia (2007) Site contamination – Acid sulfate soil materials, EPA 638/07, Environment Protection Authority South Australia, November 2007.

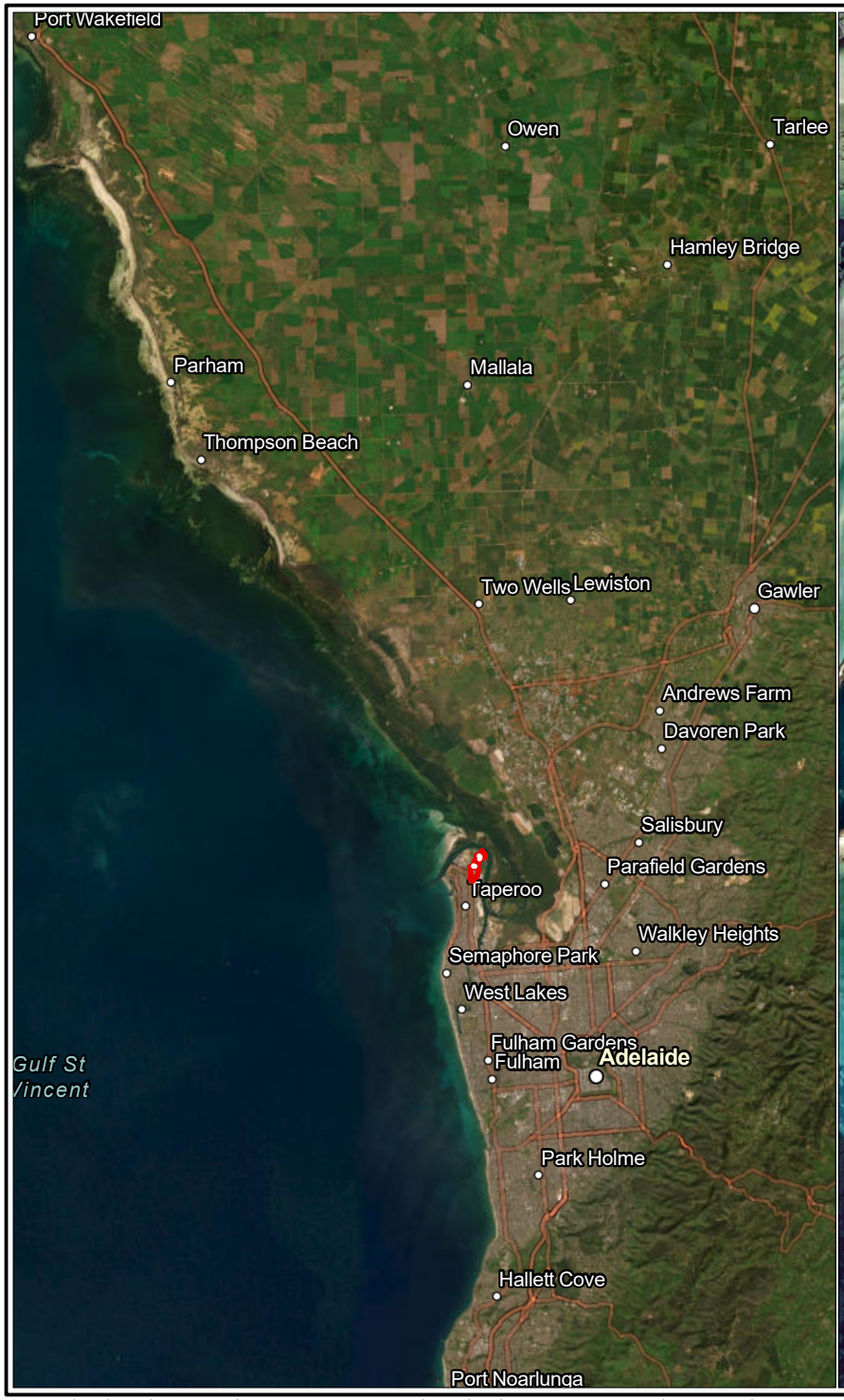
JBS&G Australia Pty Ltd (2024) Nuclear Powered Submarine Construction Yard, Site Contamination Assessment, 11 November 2024.

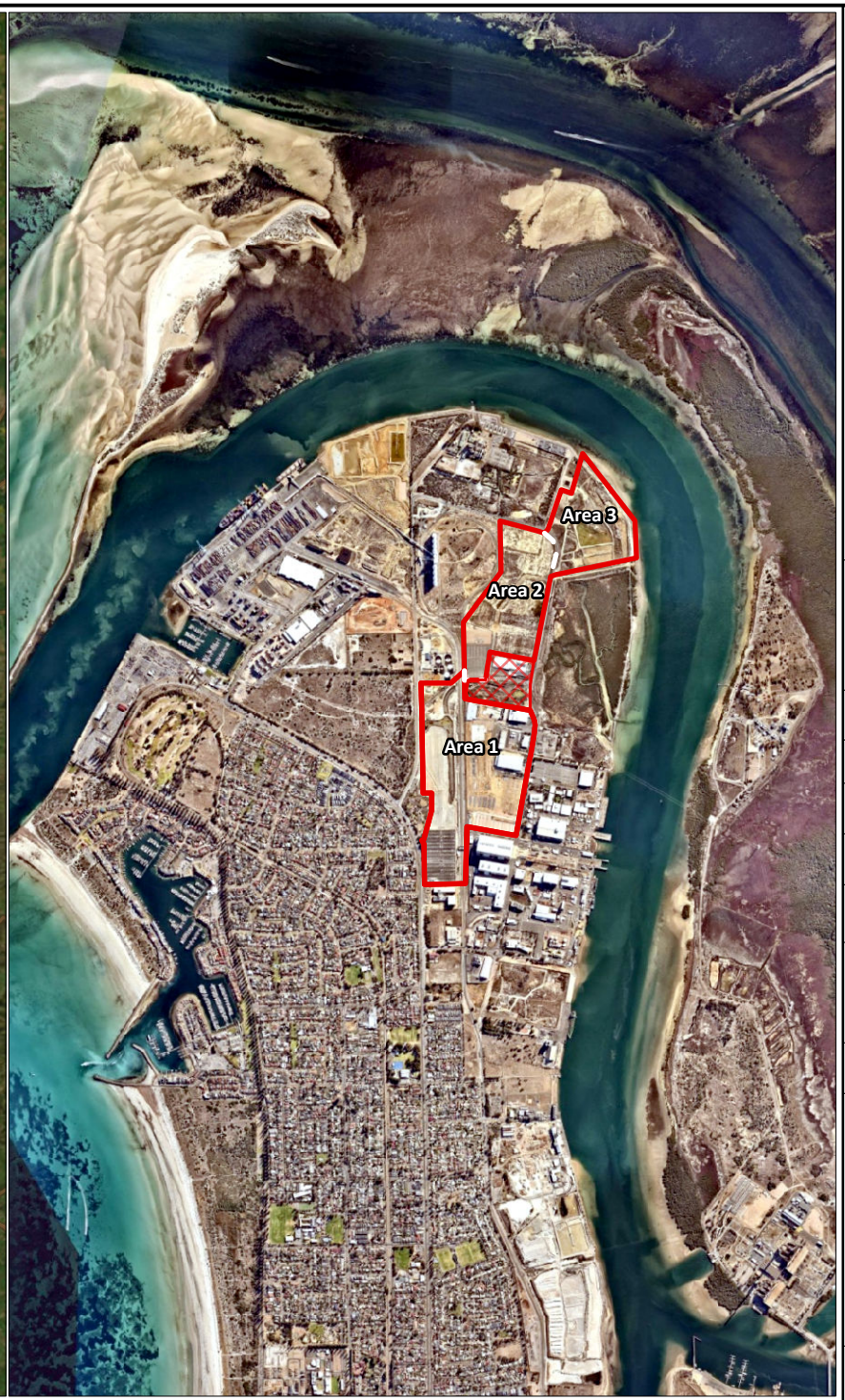
National Chemicals Working Group of the Heads of EPAs Australia and New Zealand (2020) PFAS National Environmental Management Plan, Version 2.0, National Chemicals Working Group of the Heads of EPAs Australia and New Zealand, January 2020.

National Environment Protection Council (1999 as amended 2013) National Environment Protection (Assessment of Site Contamination) Measure 1999.

Western Australian Department of Environment Regulation (2015) Identification and investigation of acid sulfate soils and acidic landscapes.

Figures





Legend

- Site Boundary
- Not Subject to Site Contamination Investigation - Not Included in EIS

JBS&G

Job No: 67064	
Client: URPS	
Version: FINAL	Date: 04-Nov-2024
Drawn By: FF	Checked By: KL
Scale 1:39,586	

0 250 500
Metres

Coord. Sys. GDA2020 MGA Zone 54

Osborne, South Australia

LOCATION OF THE NUCLEAR-POWERED SUBMARINE CONSTRUCTION YARD (OSBORNE)

FIGURE 1

File Name: C:\Users\jstrauss\JBS&G Australia\JBS&G - DCS - Internal - Documents\Projects\URPS\64648_OsborneSouthAustralia\02_MapProjects\67064_URPS_Osborne_FigReq_v2.aprx; Name:67064_01_Location of Nuclear Submarine Construction Yard (Osborne)
Reference: ESRI Topographic Basemap - Accessed Imagery: 04/11/2024 & www.nearmap.com - Imagery Date: 4/05/2024

Legend

- Site Boundary
- Not Subject to Site Contamination Investigation - Not Included in EIS
- Proposed Deep Soil Boreholes/Q2 Groundwater Wells
- Proposed Soil Boreholes to 1 mbgl
- SB127
- Proposed Soil Boreholes to 3 mbgl

JBS&G

Job No: 67064

Client: URPS

Version: FINAL | Date: 04-Nov-2024

Drawn By: FF | Checked By: KL

Scale 1:19,471

0 250 500
metres

Coord. Sys. GDA2020 MGA Zone 54

Osborne, South Australia

PROPOSED ADDITIONAL TARGETED SITE CONTAMINATION ASSESSMENT INVESTIGATIONS LOCATIONS (SOIL BOREHOLES AND Q2 GROUNDWATER WELLS)

FIGURE 2

File Name: C:\Users\jstrauss\JBS&G Australia\JBS&G - DCS - Internal - Documents\Projects\URPS\64648_OsborneSouthAustralia\02_MapProjects\67064_URPS_Osborne_FigReq_v2.aprx; Name:67064_04_Proposed Additional Targeted Assessment Locations (SB and Q2 GW)
Reference: Nearmap.com.au - Imagery Date: 4/05/2024

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www.jbsg.com.au

JBS&G

Adelaide
Kaurna Country | 100 Hutt St,
Adelaide, SA 5000
T: 08 8431 7113

Brisbane
Turrbal/Yuggera Country | Level 37,
123 Eagle Street, Brisbane, QLD 4000
T: 07 3211 5350

Bunbury
Wardandi Country | 177 Spencer
Street Bunbury, WA 6230
T: 08 9792 4797

Canberra
Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
T: 02 6198 3278

Darwin
Larrakia Country | Suite G1, Level 1,
48-50 Smith Street, Darwin NT 0800
T: 08 8943 0600

Hobart
Muwununa/Nuenon Country | L2, 137
Liverpool Street, Hobart TAS 7000
T: 03 6208 3700

Melbourne
Wurundjeri Country | Level 19,
31 Queen Street, Melbourne VIC 3000
T: 03 9642 0599

Newcastle
Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

Perth
Whadjuk Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney
Gadigal Country | Level 1,
50 Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong
Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
T: 02 4225 2647