TO

HAMMONDCARE

ON

SAMPLING, ANALYSIS AND QUALITY PLAN (SAQP)

FOR

ENVIRONMENTAL INVESTIGATIONS

AT

NERINGAH HOSPITAL, 4-12 NERINGAH AVENUE SOUTH, WAHROONGA NSW

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Abbreviations

Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Australian Drinking Water Guidelines	**ADWG**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Additional Site Investigation	**ASI**
Acid Sulfate Soil	**ASS**
Acid Sulfate Soil Management Plan	**ASSMP**
Below Ground Level	**BGL**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Dial Before You Dig	**DBYD**
Department of Land and Water Conservation	**DLWC**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Environmental Investigation Services	**EIS**
Environment Protection Authority	**EPA**
Ecological Screening Level	**ESL**
Health Investigation Level	**HILs**
Health Screening Level	**HSL**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
JK Geotechnics	**JKG**
Laboratory Control Spike	**LCS**
Light Non-Aqueous Phase Liquid	**LNAPL**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
National Environmental Management Plan	**NEMP**
National Health and Medical Research Council	**NHMRC**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Polychlorinated Biphenyls	**PCBs**
Per- and Polyfluoroalkyl Substances	**PFAS**
Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Preliminary Site Investigation	**PSI**
Quality Assurance	**QA**
Quality Control	**QC**
Relative Percentage Difference	**RPD**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Planning Secretary's Environment Assessment Requirements	**SEARs**

Salinity Management Plan	**SMP**
Source, Pathway, Receptor	**SPR**
Standard Penetration Test	**SPT**
State Significant Development Application	**SSDA**
Standing Water Level	**SWL**
Trip Blank	**TB**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Petroleum Hydrocarbons	**TPH**
Total Recoverable Hydrocarbons	**TRH**
Time Weighted Average	**TWA**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Volatile Organic Compounds	**VOC**
World Health Organisation	**WHO**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millilitres	**ml or mL**
Micrograms per Litre	**µg/L**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Parts Per Million	**ppm**
% Volume per Volume	**%V/V**
Percentage	**%**

1 INTRODUCTION

HammondCare ('the client') commissioned JK Environments (JKE) to undertake a Detailed Site Investigation (DSI), an Acid Sulfate Soil (ASS) assessment and a salinity investigation for the proposed hospital redevelopment at 4-12 Neringah Avenue South, Wahroonga, NSW. This report outlines the Sampling, Analysis and Quality Plan (SAQP) for the investigations. This report has been revised to include the amended development details.

This SAQP is to be submitted to the Department of Planning and Environment (DPE) in support of a State Significant Development Application (SSD-45121248) for the redevelopment of part of the site at 4-12 Neringah Avenue South, Wahroonga for the purposes of delivering additional community health services, seniors housing, as well as upgraded palliative care facilities that will contribute to the broader operation of 'Neringah Hospital.' The extent of the site is shown on Figure A below. The extent of the development area is shown on the figures attached in the appendices.

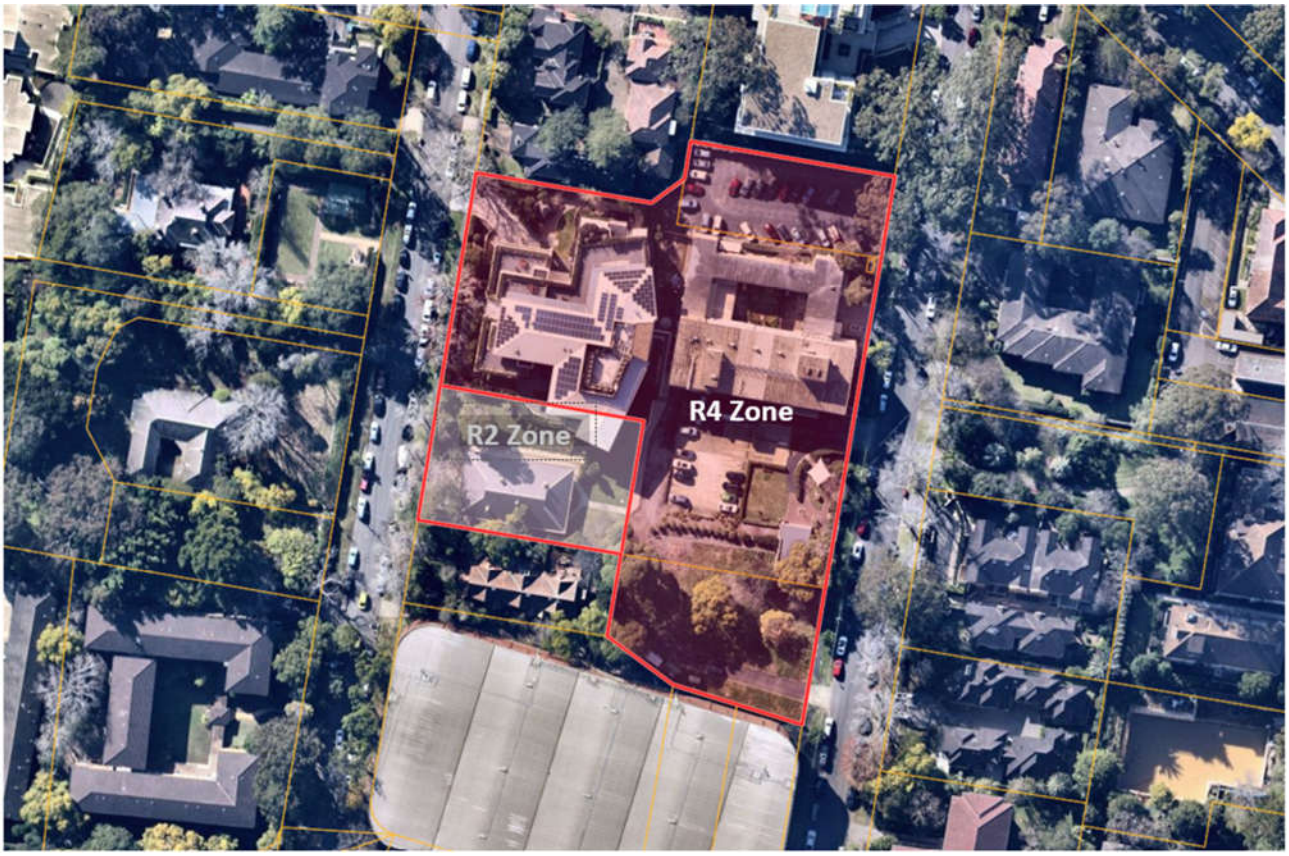

Figure A: Outline of the site, with the portion of the site subject to the SCC shaded dark red (R4 zone)

Specifically, this SSDA seeks approval for the following:

- Site preparation works comprising:
    - Demolition of the Neringah Hospital building, kiosk, and existing at-grade carparks;
    - Clearing of nominated vegetation on the proposed development areas;
    - Bulk earthworks including basement excavation; and
    - Remediation works where necessary across the site.

- Construction and use of an integrated seniors housing and health services facility across two buildings ranging from 4-5 storeys above ground, comprising:
  - 2 basement levels containing minimum of 130 car parking spaces and service dock;
  - 12 residential aged care facility beds (extension to existing Stage 1 provision);
  - 18 palliative care hospice beds (Schedule 3 health services facility);
  - Community healthcare services, including outpatient palliative care, centre for positive ageing and Hammond at Home;
  - 57 seniors housing dwellings; and
  - On-site administration, amenities and ancillary operations space.
- Ground level and on-building landscaping works, including the provision of a through site pedestrian link connecting Archdale Park and Balcombe Park;
- Public domain works, specifically, regrading of part of the pedestrian walkway known as 'Archdale Walk' to provide accessible connection; and
- Extension and augmentation of infrastructure and services required including new site signage.

This report has been prepared to respond to the Secretary's Environmental Assessment Requirements (SEARs) for SSD-45121248 that were issued on 24 June 2022. A table referencing responses has been provided below.

SEAR	Relevant section of report
13. Ground and Water Conditions Provide an assessment of salinity and acid sulfate soil (ASS) impacts.	This report outlines the sampling, analysis and quality requirements for the ASS and salinity investigations.
17. Contamination and Remediation Assess and quantify any soil and groundwater contamination and demonstrate that the site is suitable (or will be suitable, after remediation) for the development.	This report outlines the sampling, analysis and quality requirements for the DSI.

1.1 Proposed Development Details

Based in the development plans issued to JKE, we understand that the proposed development includes major earthworks (cut/fill) over the majority of the site to achieve the development levels. The maximum cut is anticipated to be approximately 14m below ground level (BGL).

1.2 Aims and Objectives

The primary aims of the investigations include: identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make an assessment of the soil and groundwater contamination conditions; establish the potential for risks associated with dryland salinity and whether management is necessary; and establish the potential for acid sulfate soils (ASS) to be disturbed and whether a management plan is required.

A secondary aim is to provide preliminary waste classification data for off-site disposal of soil waste which may be generated during the proposed development works.

The DSI objectives are 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 sampling and analysis program;
- Assess the potential risks posed by contamination to the receptors identified in the Conceptual Site Model (CSM);
- Provide a preliminary waste classification for the in-situ soil;
- Assess whether the site is suitable or can be made suitable for the proposed development (from a contamination viewpoint);
- Assess whether further intrusive investigation and/or remediation is required;
- Assess whether an ASS management plan (ASSMP) is required for the proposed development; and
- Assess whether a salinity management plan (SMP) is required.

The ASS assessment and salinity investigation results will be issued under separate report covers.

1.3 Scope of Work

This SAQP has been prepared generally in accordance with a JKE proposal (Ref: EP56645BR) of 27 May 2022 and written acceptance from the client in the form of a purchase order dated 26 July 2022.

The scope of work included review of the previous environmental reports prepared for the site and preparation of an SAQP with regards to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[1], guidelines made under or with regards to the Contaminated Land Management Act (1997)[2], State Environmental Planning Policy (Resilience and Hazards) 2021[3] (formerly known as SEPP55), NSW DLWC Site Investigations for Urban Salinity (2002)[4] and the National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual (2018)[5].

A list of reference documents/guidelines is included in the appendices.

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[1] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

[2] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

[3] *State Environmental Planning Policy (Resilience and Hazards) 2021* (NSW) (referred to as SEPP Resilience and Hazards 2021)

[4] NSW DLWC, (2002). *Site Investigations for Urban Salinity.* (referred to as DLWC Salinity Guidelines 2002)

[5] Sullivan. L, Ward. N, Toppler. N, and Lancaster. G, (2018). *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual*. (Referred to as National ASS guidance 2018)

2 SITE INFORMATION

2.1 Background

2.1.1 Preliminary Site Investigation (PSI)

A Preliminary Site Investigation (PSI) was undertaken for the wider hospital property by Environmental Investigation Services (EIS, now JKE) in 2010[6]. The scope of the PSI included a review of various historical documents; a site walkover inspection and soil sampling from 12 boreholes drilled for the concurrent geotechnical investigation. Five boreholes (BH1 to BH6 inclusive) were within the current proposed development areas.

The site history information indicated that the site was likely used as a hospital since at least the 1970s. Prior to the 1970s, the site was likely used for residential purposes, and possibly activities associated with the church and the Red Cross Society.

During the site inspection, a suspected underground storage tank (UST) was identified beneath the driveway in the central-east section of the site (to the south of the main hospital building). No records relating to the UST were available for review.

Selected soil samples were analysed for: heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), total petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (Benzene, toluene, ethylbenzene, xylenes - BTEX), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs), and asbestos.

The investigation identified asbestos in one fill soil sample collected from BH1. All other soil results were below the site assessment criteria (SAC).

The EIS PSI concluded that the site could be made suitable for the proposed development (alterations/additions and continued hospital use), subject to the following:

- An additional investigation was to be undertaken in the vicinity of the suspected UST;
- An asbestos consultant was to be engaged prior to any works in the vicinity of BH1; and
- A hazardous building materials (HAZMAT) survey was to be prepared prior to demolition.

2.1.2 Additional Environmental Site Assessment

EIS undertook an additional environmental site assessment in 2012[7]. The purpose of the assessment was to assess whether the UST was present beneath the driveway in the central-east section of the site, and to inspect an area where subsurface asbestos was detected during the EIS PSI (i.e. vicinity of BH1).

[6] Environmental Investigation Services, (2010). *Report to HammondCare on stage 1 Preliminary Environmental Site Assessment for Proposed Hospital Redevelopment at Neringah Hospital, 3-9 Woonona Avenue South and 2-12 Neringah Avenue South, Wahroonga, NSW.* (Ref: E24031Krpt, dated June 2010). (Referred to as EIS PSI)

[7] Environmental Investigation Services, (2012). *Additional Environmental Site Assessment. Proposed Hospital Redevelopment. Neringah Hospital; 3-9-Woonona Avenue South, Wahroonga, NSW.* (Ref: E24031Klet2, dated 28 May 2012). (Referred to as EIS AESA).

A ground-penetrating radar (GPR) survey of the suspected UST was undertaken by a specialist sub-contractor. The scan confirmed the presence of the suspected UST. The UST was estimated to be approximately 4.6m long and 2.5m wide. The depth was not able to be determined.

EIS considered the risk of exposure to asbestos in soils in the vicinity of BH1 to be very low. This was based on the surface of this area being concrete paved, and that no development was planned in the vicinity of BH1 (i.e. the soil would remain undisturbed). EIS recommended:

- The building maintenance sections were notified of the presence of asbestos in soil in the vicinity of BH1;
- The pavement and/or soil in the vicinity of BH1 was not disturbed, unless necessary; and
- If the area is to be disturbed, a qualified asbestos consultant must be engaged to provide a work plan and appropriate asbestos clearance.

2.2 Site Identification

Table 2-1: Site Identification

Current Site Owner:	HammondCare
Site Address:	Part of 4-12 Neringah Avenue South, Wahroonga, NSW
Lot & Deposited Plan:	Lot 1 in DP960051, Lot 1 in DP19937, Lot 52 in DP2666 and Lot 1 in DP585805
Current Land Use:	Hospital (palliative care)
Proposed Land Use:	Hospital and Seniors housing
Local Government Authority (LGA):	Ku-ring-gai Council
Current Zoning:	R4: High-Density Residential
Development Area (m^2) (approx.):	5,700
RL (AHD in m) (approx.):	195 - 207
Geographical Location (decimal degrees) (approx. centre of site):	Latitude: -33.717627 Longitude: 151.114568
Site Location Plan:	Figure 1
Proposed Sample Location Plan:	Figure 2

2.3 Site Description Summary

The site is located in a predominantly residential area of Wahroonga. The site is bounded by Neringah Avenue South to the east. The site is located approximately 750m to the south of Cockle Creek.

The site is located within undulating regional topography which generally falls to the north and north-east at a slope of approximately 5°. The site itself falls to the north and north-east in line with the regional topography. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

A walkover inspection of the development area was undertaken by JKE on 26 July 2022 for preparation of the SAQP. An internal inspection of the buildings was not undertaken. At the time of the inspection, a 2-4 storey building (main hospital building) was located within the central and northern sections of the development area, and a single-storey building (kiosk) was located in the south-eastern section of the development area.

The main hospital building was of brick and concrete construction with fibre cement in-fill panels. The building appeared to be in generally good condition. The kiosk was located to the south of the main hospital building and was of sandstone block and concrete construction with fibre cement in-fill panels. Based on a cursory inspection, the kiosk appeared to be in reasonable condition. A brick-paved courtyard and formed gardens were to the north and east of the kiosk and appeared to be in good condition.

Asphaltic concrete (AC) and concrete paved carparks were observed to the north and south of the main hospital building, with driveways connecting to Neringah Avenue South to the east. A third concrete driveway provided vehicular access to the central courtyard of the main hospital and loading dock. The southern carpark and loading dock areas were in good condition, with minimal cracking observed. The northern carpark was in fair condition, with visible evidence of subsidence and potholes. No stains were observed on the paved surfaces.

The southern section of the development area was vacant and grass covered. Large trees and smaller shrubs were also observed in this area, generally near the kiosk and the western site boundary. Based on a cursory inspection, the vegetation appeared healthy with no visible evidence of stress or die-back.

A back-up generator was located adjacent to the north of the main hospital building. The generator was located on a raised concrete platform. JKE were advised by the facility manager that the fuel storage for the generator was built into the generator. No stains or evidence of leaks/spills were observed on the concrete platform. A second generator was located to the south of the site, within the wider property boundary. The generator was self-contained and appeared to be considerably newer that the generator in the north of the development area.

During the inspection of the development area, JKE observed the following land uses in the immediate surrounds:

- North – Residential properties (predominantly high-density residential) with basement parking;
- South – Sydney Water reservoir;
- East – Neringah Avenue South, with medium to high-density residential properties beyond; and
- West – Woonona Cottage and HammondCare Wahroonga (nursing home) within the wider site boundary.

JKE did not observe any land uses in the immediate surrounds that were identified as potential off-site contamination sources for the site.

2.4 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the SAQP in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration. A sewer main was located within the wider hospital property boundary, adjacent to the west of the development area. The sewer main ran in a north/south direction and extended beyond the southern and northern boundaries. The backfill around this service could act as a preferential pathway for contamination migration.

2.5 Summary of Geology and Hydrogeology

2.5.1 Regional Geology

Regional geological information reviewed for the EIS PSI indicated that the site is underlain by Ashfield Shale, which typically consists of black to dark grey shale and laminate.

2.5.2 Hydrogeology and Groundwater

Hydrogeological information reviewed for the EIS PSI identified six registered bores within 1km of the site. One bore was located approximately 90m to the north-west and down-gradient of the site and was registered for recreation purposes. The other bores were located up-gradient of the site.

Previous investigations undertaken at the site indicated that the subsurface conditions consisted of relatively low permeability (residual) soils overlying shallow bedrock. The potential for viable groundwater abstractions and use of groundwater under these conditions is considered to be low. There is reticulated water supply in the area and consumption of groundwater is not expected to occur. Use of groundwater is not proposed as part of the development.

Considering the local topography and surrounding land features, JKE would generally expect groundwater to flow towards the north.

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is Cockle Creek located approximately 750m to the north of the site. Due to the distance from the site, this water body is not considered to be a potential receptor that could be impacted by direct migration.

2.5.3 Acid Sulfate Soil

A review of the acid sulfate soil (ASS) risk map prepared by Department of Land and Water Conservation (1997)[8] indicated that the site is not located within a risk area.

An ASS assessment will be undertaken to satisfy the SEARs conditions.

[8] Department of Land and Water Conservation, (1997). *1:25,000 Acid Sulfate Soil Risk Map (Series 9130S1, Ed 2)*

2.6 Summary of Site History

The historical information presented in the EIS PSI indicated that the site was historically used for various hospital activities (i.e. activities associated with patient care) since at least the early 1970s. Prior to the 1970s, the site was likely used for residential purposes and possibly for activities associated with the church and the Red Cross Society.

A further review of site history information will be undertaken for the DSI.

3 CONCEPTUAL SITE MODEL

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM for the site is presented in the following sub-sections and is based on the site information (including the site inspection information) and the review of site history information. Reference should also be made to the figures attached in the appendices.

3.1 Potential Contamination Sources and Contaminants of Potential Concern

The potential contamination sources/areas of environmental concern (AEC) and contaminants of potential concern (CoPC) are presented in the following table:

Table 3-1: Potential (and/or known) Contamination Sources/AEC and Contaminants of Potential Concern

Source / AEC	CoPC
Fill material – The site appears to have been historically filled to achieve the existing levels. The fill may have been imported from various sources and could be contaminated. The EIS PSI identified filling beneath paved areas to depths of approximately 0.4mBGL to 1.1mBGL. Previous investigations at the site by JKE/EIS indicated deep filling within the south-west and west of the site to a maximum depth of 5.3mBGL. The depth of fill was generally less than 1mBGL in other areas of the site.	Heavy metals, petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), BTEX, PAHs,, OCPs, OPPs, PCBs, and asbestos. The EIS PSI encountered asbestos in fill soil within the central-east of the site (to the east of the main hospital building).
Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. These materials may also be present in the existing buildings / structures on site.	Asbestos, lead and PCBs
Use of pesticides – Pesticides may have been used beneath the buildings and/or around the site.	Heavy metals and OCPs
Fuel storage – The EIS PSI identified at least one suspected UST. It is likely that the UST was used to store petrol and/or diesel. Leaks/spills or releases of stored fuel may have historically occurred.	Lead, TRH, BTEX, PAHs and Per-and Polyfluoroalkyl Substances (PFAS)

3.2 Mechanism for Contamination, Affected Media, Receptors and Exposure Pathways

The mechanisms for contamination, affected media, receptors and exposure pathways relevant to the potential contamination sources/AEC are outlined in the following CSM table:

Table 3-2: Conceptual Site Model

Potential mechanism for contamination	Potential mechanisms for contamination include: • Fill material – importation of impacted material and use of site generated waste as fill (such as incinerator waste), 'top-down' impacts (e.g. placement of fill, leaching from surficial material etc), or sub-surface release (e.g. impacts from buried material); • Use of pesticides – 'top-down' and spills (e.g. during normal use, application and/or improper storage); • On-site fuel storage – 'top-down' impacts and spills (during normal use, refilling), or sub-surface release (leaks from UST infrastructure); and • Hazardous building materials – 'top-down' (e.g. demolition resulting in surficial impacts in unpaved areas).
Affected media	Soil and groundwater have been identified as potentially affected media.
Receptor identification	Human receptors include site occupants/users (predominantly adults and aged, though may include child visitors), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users in a predominantly high-density residential setting, groundwater users and recreational water users within Cockle Creek. Ecological receptors include terrestrial organisms and plants within unpaved areas (including on-site landscaped areas), and freshwater ecology in Cockle Creek.
Potential exposure pathways	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRH, naphthalene, and BTEX). The potential for exposure would typically be associated with the construction and excavation works, and future use of the site. Potential exposure pathways for ecological receptors include primary contact and ingestion. Exposure during future site use could occur via direct contact with soil in unpaved areas such as gardens, inhalation of airborne asbestos fibres during soil disturbance, or inhalation of vapours within enclosed spaces such as buildings and basements. Exposure to groundwater is unlikely to occur in Cockle Creek through direct migration, however groundwater has the potential to enter the creek via the stormwater system (which is expected to discharge into the creek) in a drained basement scenario.
Potential exposure mechanisms	The following have been identified as potential exposure mechanisms for site contamination: • Vapour intrusion into the proposed building (from soil contamination and/or volatilisation of contaminants from groundwater); • Contact (dermal, ingestion or inhalation) with exposed soils in landscaped areas and/or unpaved areas; and • Migration of groundwater off-site and into nearby water bodies, including aquatic ecosystems and those being used for recreation.
Presence of preferential pathways for contaminant movement	A sewer main was located within the wider hospital property boundary, adjacent to the west of the site. The sewer main ran in a north/south direction and extended beyond the southern and northern boundaries. The backfill around this service could act as a preferential pathway for contamination migration.

4 SAMPLING, ANALYSIS AND QUALITY PLAN

4.1 Data Quality Objectives (DQO)

Data Quality Objectives (DQOs) have been developed to define the type and quality of data required to achieve the project objectives outlined in Section 1.2. The DQOs were prepared with reference to the process outlined in Schedule B2 of NEPM (2013). The seven-step DQO approach for this project is outlined in the following sub-sections.

4.1.1 Step 1 - State the Problem

The CSM identified potential sources of contamination/AEC at the site that may pose a risk to human health and the environment. Investigation data is required to characterise the development area, assess the potential risks posed by the contaminants in the context of the proposed development/intended land use, and assess whether remediation is required. This information will be considered by the project team in the design and delivery of the project as well as by the consent authority in exercising its planning functions in relation to the approval of the development consent and issue of construction/occupancy certificates.

A waste classification is required prior to off-site disposal of excavated soil/bedrock. An assessment of the potential for ASS and saline conditions to be encountered is required to determine whether management of ASS and/or salinity is required for the proposed development.

4.1.2 Step 2 - Identify the Decisions of the Study

The objectives of the assessment are outlined in Section 1.2. The decisions to be made reflect these objectives and are as follows:

- Did the inspection, or does the historical information identify potential contamination sources/AEC within the development area?
- Are any results above the SAC?
- Do potential risks associated with contamination exist, and if so, what are they?
- Is remediation required?
- Are the soil and groundwater characterisation sufficient to provide adequate confidence that remediation is/is not required?
- Is the development area suitable for the proposed development, or can the site be made suitable subject to further characterisation and/or remediation?
- Does the proposed development require an ASSMP?
- Does the proposed development require a SMP?

4.1.3 Step 3 - Identify Information Inputs

The primary information inputs required to address the decisions outlined in Step 2 include the following:

- Existing relevant environmental data from previous reports;
- Existing site information from the PSI, including the PSI site observations and site history documentation;
- Site information, including observations and site history documentation;
- Sampling of potentially affected media, including soil, groundwater and fibre cement fragments (FCF);

- Observations of sub-surface variables such as soil type, photo-ionisation detector (PID) concentrations, odours and staining, and groundwater physiochemical parameters;
- Laboratory analysis of soils, FCF and groundwater for the CoPC identified in the CSM; and
- Field and laboratory QA/QC data.

4.1.4 Step 4 - Define the Study Boundary

The sampling was confined to the development area boundaries as shown in Figure 2 and was limited vertically to maximum nominated sampling depths of approximately 14mBGL (spatial boundary). The sampling was completed between July and August 2022 (temporal boundary).

4.1.5 Step 5 - Develop an Analytical Approach (or Decision Rule)

4.1.5.1 Tier 1 Screening Criteria

4.1.5.1.1 Soil

Soil data will be compared to relevant Tier 1 screening criteria in accordance with NEPM (2013) and the Health Investigation Levels (HIL) presented in Table 2 of the HEPA PFAS National Environmental Management Plan (2020)[9]. HILs will be based on land use type B which is applicable to 'residential with minimal opportunities for soil access' exposure scenarios. The Health Screening Levels (HSL) will be based on land use Type A-B which is applicable to 'low-high density residential' exposure scenarios. HSLs for hydrocarbons will be derived conservatively using a sand soil type and a depth interval of 0-1m. Conservative screening criteria has been selected given the sensitive receptors (i.e. aged and hospital patients) at the site.

HSLs for direct soil contact will be adopted based on the values presented in the CRC Care Technical Report No. 10 – Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document (2011)[10]. Management limits for petroleum hydrocarbons (as presented in Schedule B1 of NEPM 2013) will also be considered following evaluation of human health and ecological risks, and risks to groundwater.

Regarding the ecological screening criteria, the Ecological Investigation Levels (EIL) will be derived using the Ecological Investigation Level Calculation Spreadsheet (NEPC, 2010)[11] accessed from the NEPM (2013) Toolbox. Inputs into the calculations will include site specific physiochemical data for soil pH, clay content, Cation Exchange Capacity (CEC) and organic carbon. Selected samples will be analysed, with the lowest value for each parameter adopted for the calculation. The ecological SAC will be applied to the top 2m of soil in accordance with the recommendations of the NEPM (2013).

In regard to PFAS, the soil data will be compared to the ecological soil guideline values for direct exposure as presented in Table 3 of the PFAS NEMP (2020). A modified guideline value of 0.14mg/kg will be adopted for indirect exposure given that the extensive hard surface coverings and the proposed development configuration would likely result in an immaterial impact on food chain transfer to secondary consumers.

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[9] Heads of EPAs Australia and New Zealand, (2020). *PFAS National Environmental Management Plan Version 2.0*. (referred to as PFAS NEMP)

[10] Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC Care), (2011). Technical Report No. 10 - *Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document*

[11] National Environment Protection Council, (2010). *Ecological Investigation Level Calculation Spreadsheet*

Waste classification data is to be assessed in accordance with the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014)[12].

Where appropriate, data will be assessed against valid statistical parameters to characterise the data population. This may include calculation and application of mean values and/or 95% upper confidence limit (UCL) values for the data set, with regards to the NEPM (2013) framework and other relevant guidelines made under the CLM Act 1997. UCLs are considered acceptable where the UCL is below the SAC, the standard deviation of the data is less than 50% of the SAC and none of the individual concentrations are more than 250% of the SAC.

4.1.5.1.2 Groundwater

Groundwater data will be compared to relevant Tier 1 screening criteria in accordance with NEPM (2013), following an assessment of environmental values in accordance with the Guidelines for the Assessment and Management of Groundwater Contamination (2007)[13]. Environmental values identified include aquatic ecosystems and human-health risks in use (e.g. recreation, irrigation) and non-use scenarios (e.g. exposure to volatile contamination above groundwater contaminant plumes).

The guideline values presented in the NHMRC Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy (2011)[14] are to be multiplied by a factor of 10 to assess potential risks associated with incidental/recreational-type exposure to groundwater (e.g. within down-gradient water bodies).

Groundwater Investigation Levels (GILs) for 95% protection of freshwater species are to be adopted based on the Default Guideline Values in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)[15]. The 99% trigger values are to be utilised, where required, to account for bioaccumulation. Low and moderate reliability trigger values are also to be adopted for some contaminants where high-reliability trigger values do not exist. PFAS data will be compared to the 99% trigger values for fresh waters presented in Table 5 of the PFAS NEMP (2020), to account for bioaccumulation.

4.1.5.2 Quality Assurance/Quality Control (QA/QC)

Field QA/QC will include analysis of inter-laboratory duplicates (minimum of 5% of primary samples), intra-laboratory duplicates (minimum of 5% of primary samples), and trip spike (for volatiles), trip blank (for selected organic and inorganic compounds) and rinsate (for selected organic and inorganic compounds) samples (one for each medium sampled to assess the adequacy of field practices).

The suitability of the laboratory data is to be assessed against the laboratory QA/QC criteria which will be outlined in the laboratory reports. These criteria are developed and implemented in accordance with the

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[12] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

[13] NSW Department of Environment and Conservation, (2007). *Guidelines for the Assessment and Management of Groundwater Contamination.*

[14] National Health and Medical Research Council (NHMRC), (2018). *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011, Version 3.5 Updated August 2018* (referred to as ADWG 2011)

[15] Australian and New Zealand Governments (ANZG), (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (referred to as ANZG 2018)

laboratory's National Association of Testing Authorities, Australia (NATA) accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence are reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory will be undertaken in an effort to establish the cause of the non-conformance. Where uncertainty exists, the most conservative concentration reported are to be adopted.

4.1.5.3 Appropriateness of Practical Quantitation Limits (PQLs)

The PQLs of the analytical methods are to be considered in relation to the SAC to confirm that the PQLs are less than the SAC. In cases where the PQLs are greater than the SAC, a discussion of this will be provided.

4.1.6 Step 6 – Specify Limits on Decision Errors

To limit the potential for decision errors, a range of quality assurance processes are adopted. A quantitative assessment of the potential for false positives and false negatives in the analytical results will be undertaken with reference to Schedule B(3) of NEPM (2013) using the data quality assurance information collected.

Decision errors can be controlled through the use of hypothesis testing. The test can be used to show either that the baseline condition is false or that there is insufficient evidence to indicate that the baseline condition is false. The null hypothesis is an assumption that is assumed to be true in the absence of contrary evidence. For the DSI, the null hypothesis will be adopted which is that, there is considered to be a complete source-pathway-receptor (SPR) linkage for the CoPC identified in the CSM unless this linkage can be proven not to (or unlikely to) exist.

Data Quality Indicators (DQI) for field and laboratory QA/QC samples are defined below. An assessment of the DQI's is to be made in relation to precision, accuracy, representativeness, completeness and comparability.

Field Duplicates
Acceptable targets for precision of field duplicates will be 30% or less, consistent with NEPM (2013). RPD failures will be considered qualitatively on a case-by-case basis taking into account factors such as the concentrations used to calculate the RPD (i.e. RPD exceedance where concentrations are close to the PQL are typically not as significant as those where concentrations are reported at least five or 10 times the PQL), sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Trip Blanks and Rinsates
Acceptable targets for field blank and rinsate samples in this report will be less than the PQL for organic analytes. Metals will be considered on a case-by-case basis with regards to typical background concentrations in soils and published drinking water guidelines for waters.

Trip Spikes
Acceptable targets for trip spike samples will be 70% to 130%.

Laboratory QA/QC

The suitability of the laboratory data will be assessed against the laboratory QA/QC criteria. These criteria are developed and implemented in accordance with the laboratory's NATA accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

A summary of the typical limits is provided below:

RPDs

- Results that are <5 times the PQL, any RPD is acceptable; and
- Results >5 times the PQL, RPDs between 0-50% are acceptable.

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics; and
- 60-140% recovery acceptable for organics.

Surrogate Spikes

- 60-140% recovery acceptable for general organics.

Method Blanks

- All results less than PQL.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence will be reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory is to be undertaken in an effort to establish the cause of the non-conformance. Where uncertainty exists, we will adopt the most conservative concentration reported.

4.1.7 Step 7 - Optimise the Design for Obtaining Data

The most resource-effective design will be used in an optimum manner to achieve the objectives. Adjustment of the investigation design can occur following consultation or feedback from project stakeholders. For this investigation, the design will be optimised via consideration of the various lines of evidence used to select the sample locations, the media being sampled, and also by the way in which the data will be collected. The sampling plan and methodology are outlined in the following sub-sections.

4.2 Soil Sampling Plan and Methodology

The soil sampling plan and methodology adopted for the DSI is outlined in the table below:

Table 4-1: Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	Samples for the DSI will be collected from 15 boreholes as shown on Figure 2 attached in Appendix A. This number of locations meets than the minimum sampling density for hotspot identification as outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)[16]. The number of locations corresponds to a sampling density of approximately one sample per 380m2. JKE note that at the time of preparing this report, the NSW EPA released the updated sampling guidelines titled NSW EPA Sampling design part 1 – application (August 2022)[17]. The recommended sampling density in the updated guidelines remains unchanged for the development area. Samples will be collected from four boreholes (BH102, BH107, BH109 and BH114 inclusive) for ASS and salinity analysis. This number of locations met the minimum sampling density outlined in National ASS Guidance (2018) and the initial site investigation for moderately intensive construction outlined in DLWC Salinity Guidelines (2002) based on the development area.
Sampling Plan	The sampling locations are placed on a systematic plan with a grid spacing of approximately 20m between sampling locations. A systematic plan is considered suitable to identify hotspots to a 95% confidence level and calculate UCLs for specific data populations. The boreholes will generally be limited to depths of approximately 1-2mBGL. Four boreholes will be extended to depths of up to approximately 6-14mBGL or prior refusal for the installation of groundwater monitoring wells.
Set-out and Sampling Equipment	Sampling locations will be set out using taped measurements from existing site features. The sampling locations will be checked for underground services by an external contractor prior to sampling. The relative surface levels of the borehole locations will be interpolated from spot height measurements outlined on the provided survey plan. Samples will be collected using a drill rig equipped with spiral flight augers, and hand tools as required. Soil samples from the boreholes drilled using the drill rig will be obtained using a Standard Penetration Test (SPT) split-spoon sampler, or directly from the auger when conditions do not allow the use of the SPT Sampler. Auger sampling will be utilised for field screening for asbestos quantification.
Sample Collection and Field QA/QC	All locations will be logged to an appropriate standard in accordance with NEPM (2013) and all samples were documented on the logs. Contamination samples (except for PFAS analysis) will be placed in glass jars with plastic caps and Teflon seals with minimal headspace. Samples for PFAS analysis will be placed in laboratory provided plastic jars with plastic caps (no Teflon). Samples for asbestos analysis will placed in zip-lock plastic bags. ASS samples and salinity samples will be placed in plastic bags and sealed with twist ties with minimal headspace. During sampling, soil at selected depths will be split into primary and duplicate samples for field QA/QC analysis. The splitting procedure includes alternate filling of the jars with soil.

[16] NSW EPA, (1995). *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)
[17] NSW EPA, (2022), Sampling design part 1 – application, Contaminated Land Guidelines (referred to as EPA Sampling design guidelines 2022)

Aspect	Input
	Homogenisation of duplicate samples will not occur to minimise the potential for the release of volatile organic compounds.
Field Screening	A portable PID fitted with a 10.6mV lamp will be used to screen the samples for the presence of VOCs. This will be undertaken on soil samples using the soil sample headspace method (i.e. from partly filled zip-lock plastic bags following equilibration of the headspace gases). PID calibration records will be maintained throughout the project. The field screening for asbestos quantification from the boreholes includes the following: • A representative bulk sample (approximately 10L sample, to the extent achievable based on sample return) is to be collected from fill at approximately 1m intervals, or from each distinct fill profile. The bulk sample intervals will be recorded on the borehole logs; • Each bulk sample will be weighed using an electronic scale; • Each bulk sample will be passed through a sieve with a 7.1mm aperture and inspected for the presence of FCF. Any soil clumps/nodules were to be disaggregated. If cohesive soils (i.e. stiff clays) are encountered, the bulk sample will be placed on a contrasting support (i.e. blue tarpaulin) and inspected for the presence of FCF; • The condition of FCF or any other suspected asbestos materials was noted on the field records; and • If observed, any FCF in the bulk sample were collected, placed in a zip-lock bag and assigned a unique identifier. Calculations for asbestos content will be undertaken based on the requirements outlined in Schedule B1 of NEPM (2013).
Decontami-nation and Sample Preservation	Sampling personnel will use disposable nitrile gloves during sampling activities. Re-usable sampling equipment will be decontaminated using potable water (with rags and scrubbing brush), followed by a rinse with potable water. Detergents (such as Decon90) will not be utilised during the decontamination process as they may result in interference during PFAS analysis. Soil samples will be preserved by immediate storage in an insulated sample container with ice. On completion of the fieldwork, the samples may be stored temporarily in fridges in the JKE warehouse before being delivered in the insulated sample container to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures.

4.3 Groundwater Sampling Plan and Methodology

The groundwater sampling plan and methodology is outlined in the table below:

Table 4-2: Groundwater Sampling Plan and Methodology

Aspect	Input
Sampling Plan	Four groundwater wells will be installed in BH102 (MW102), BH107 (MW107), BH109 (MW109), and BH114 (MW114), as shown on Figure 2 in Appendix A. Considering the topography and the location of the nearest down-gradient water body, MW114 is considered to be in the up-gradient of the site and are expected to provide an indication of groundwater flowing onto (beneath) the site. MW107 is considered to be in the intermediate area of the site and is expected to provide an indication of groundwater flowing beneath the site. MW102 is considered to be in the down-gradient of the site and is expected to provide an

Aspect	Input
	indication of groundwater flowing off-site. MW109 is targeted to the down-gradient location of the abandoned UST.
Monitoring Well Installation Procedure	The monitoring well construction details are to be documented on the corresponding borehole log. The wells will be installed to maximum depth of approximately 6mBGL to 14mBGL based on site conditions and generally constructed as follows: • 50mm diameter Class 18 PVC (machine slotted screen) installed in the lower section of the well to intersect groundwater; • 50mm diameter Class 18 PVC casing installed in the upper section of the well (screw fixed); • A 2mm sand filter pack around the screen section for groundwater infiltration; • A hydrated bentonite seal/plug on top of the sand pack to seal the well; and • A gatic cover installed at the surface with a concrete plug to limit the inflow of surface water. The well construction is considered to be appropriate for screening purposes to assess general aquifer conditions with regards to the recommended monitoring well installation requirements in Schedule B2 of NEPM 2013.
Monitoring Well Development	The monitoring wells will be developed using a submersible electrical pump with single-use tubing. A calibrated water quality meter will be used to measure pH, EC, DO, Eh and temperature. Development is to occur until steady state conditions are achieved. For the DSI, steady state conditions are defined as the pH measurements over a one-minute time interval varying by less than 0.2 units, the difference in EC over the same period varying by less than 10%, and the SWL not being in drawdown. In the event that groundwater in-flow is relatively slow, the development will continue until the wells are effectively dry.
Groundwater Sampling	Prior to sampling, the monitoring wells will be checked for the presence of Light Non-Aqueous Phase Liquids (LNAPLs) using an inter-phase probe electronic dip meter. The monitoring well head space will also be checked for VOCs using a calibrated PID unit. Samples will be obtained using a peristaltic pump, after purging to achieve steady state conditions. Where steady state conditions cannot be achieved, the wells will be sampled whilst the SWL is in drawdown. Groundwater samples will be obtained directly from the single use tubing and placed in the sample containers. Duplicate samples are to be obtained by alternate filling of sample containers. This technique will be adopted to minimise disturbance of the samples and loss of volatile contaminants associated with mixing of liquids in secondary containers, etc. Groundwater removed from the wells during development and sampling will be transported to JKE in jerry cans and stored in holding drums prior to collection by a licensed wastewater contractor for off-site disposal.
Decontaminant and Sample Preservation	The inter-phase probe electronic dip meter will be decontaminated between monitoring wells using potable water (with rags and scrubbing brush), followed by a rinse with potable water. Detergents (such as Decon 90) will not be utilised during the decontamination process as they may result in interference during PFAS analysis. The groundwater sampling process utilises a peristaltic pump and single-use tubing, therefore no decontamination procedure for the sampling is considered necessary. The samples will be preserved with reference to the analytical requirements and placed in an insulated container with ice. On completion of the fieldwork, the samples may be temporarily stored in a fridge at the JKE office, before being delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures.

4.4 Laboratory Analysis and Analytical Rationale

Samples are to be analysed by an appropriate, NATA Accredited laboratory using the analytical methods detailed in Schedule B(3) of NEPM 2013. The laboratory details are provided in the table below:

Table 4-3: Laboratory Details

Samples	Laboratory
All primary samples and field QA/QC samples including (intra-laboratory duplicates, trip blanks, trip spikes and field rinsates)	Envirolab Services Pty Ltd NSW, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)
Inter-laboratory duplicates	Envirolab Services Pty Ltd VIC, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)

For the DSI, an allowance has been made for the following analysis:

- Up to 30 selected soil samples for: heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); PAHs; TRH; and BTEX;
- Up to 15 selected soil samples for: OCP; OPP; PCBs; and PFAS;
- Up to 15 selected soil samples (500mL) for asbestos using laboratory quantification (gravimetric) methods;
- Up to five selected FCF, if found on or in soil, analysed for asbestos;
- Up to 22 selected soil/rock samples will be analysed for pH, electrical conductivity (EC), resistivity (calculated from EC results), sulphate and chloride and soil texture;
- Up to 10 selected soil samples will be analysed for cation exchange capacity (CEC);
- Up to three targeted soil samples will be analysed for pH; CEC; and clay content for the calculation of EILs for selected metals;
- Targeted toxicity characteristic leachate procedure (TCLP) analysis for selected metals, PAHs and PFAS for waste classification purposes;
- Up to 32 selected soil samples for ASS characteristics using the pH field test (pH_f and pH_{fox}) methods;
- Up to eight selected soil samples for ASS using the chromium reducible sulfur (S_{cr}) acid base accounting method; and
- Up to four groundwater samples for: heavy metals; TRH/BTEX; low level PAHs; trace levels of PFAS; VOCs; pH; EC; sulphate; and chloride.

The soil analysis will generally target the fill soils and the first contact of natural soils. Deeper samples may be analysed based on the results of the shallow soils and site observations. A staged approach to soil sample analysis has been undertaken to allow for targeting areas based on the results of the initial analysis round.

ASS analysis will be targeted to natural soils. Salinity analysis will include representative samples to assess the encountered fill and natural soil profiles, and underlying rock formations, to a depth of approximately 14mBGL.

4.5 Reporting Requirements

A DSI report is to be prepared presenting the results of the investigation, in accordance with the NSW EPA Consultants Reporting on Contaminated Land, Contaminated Land Guidelines (2020)[18]. Stand-alone salinity and ASS reports will be prepared presenting the results of the investigation, in accordance with the relevant guidelines previously discussed in this SAQP.

[18] NSW EPA, (2020). *Consultants Reporting on Contaminated Land, Contaminated Land Guidelines*

5 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the PSI; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or land use. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors

This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions

Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data

Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations

Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

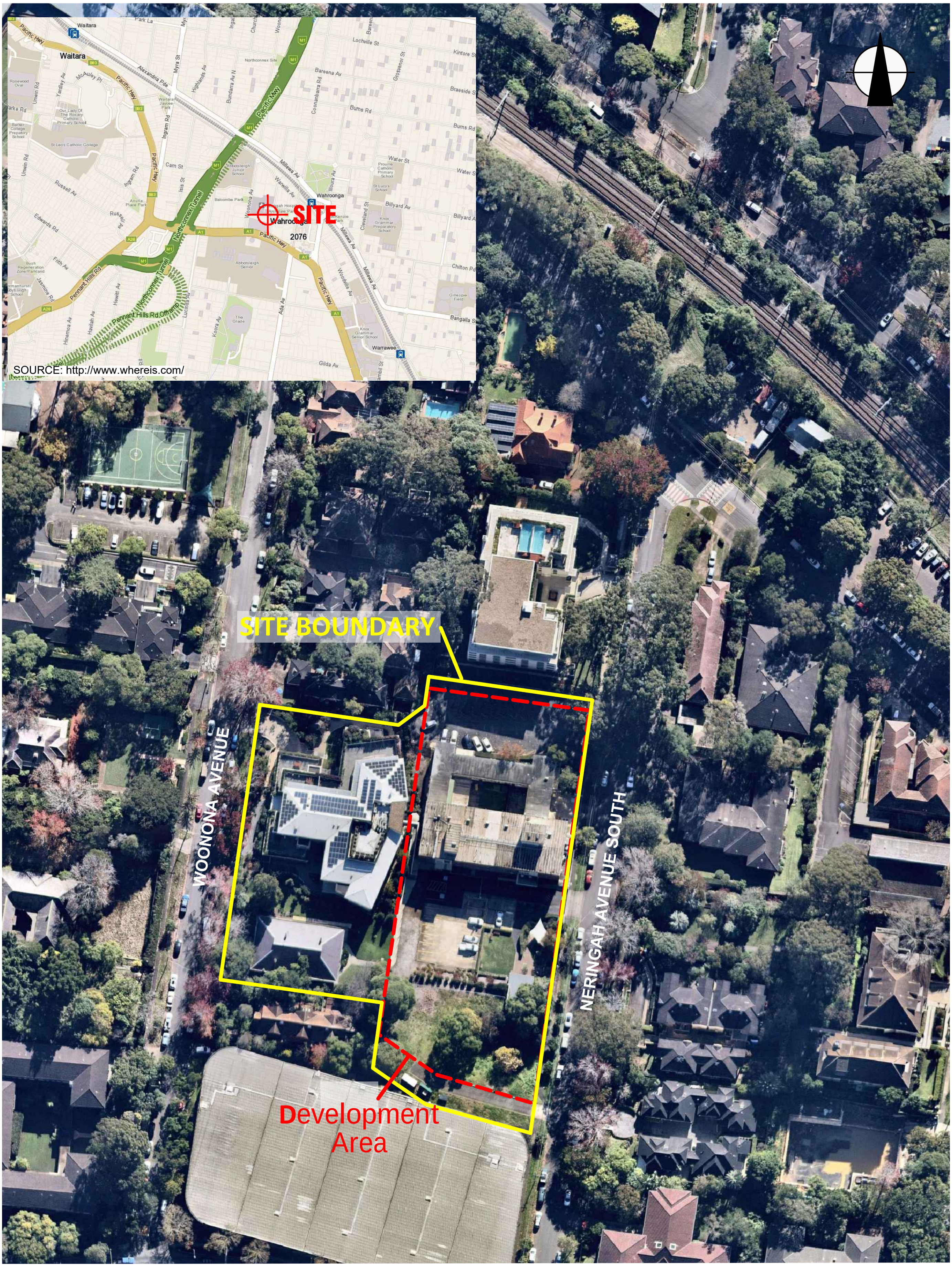
Misinterpretation of Site Assessments by Design Professionals
Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report
Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely
Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Figures



AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title:	SITE LOCATION PLAN
Location:	NERINGAH HOSPITAL, 4-12 NERINGAH AVENUE SOUTH, WAHROONGA, NSW
Project No: E35312BR	Figure No: 1

JKEnvironments

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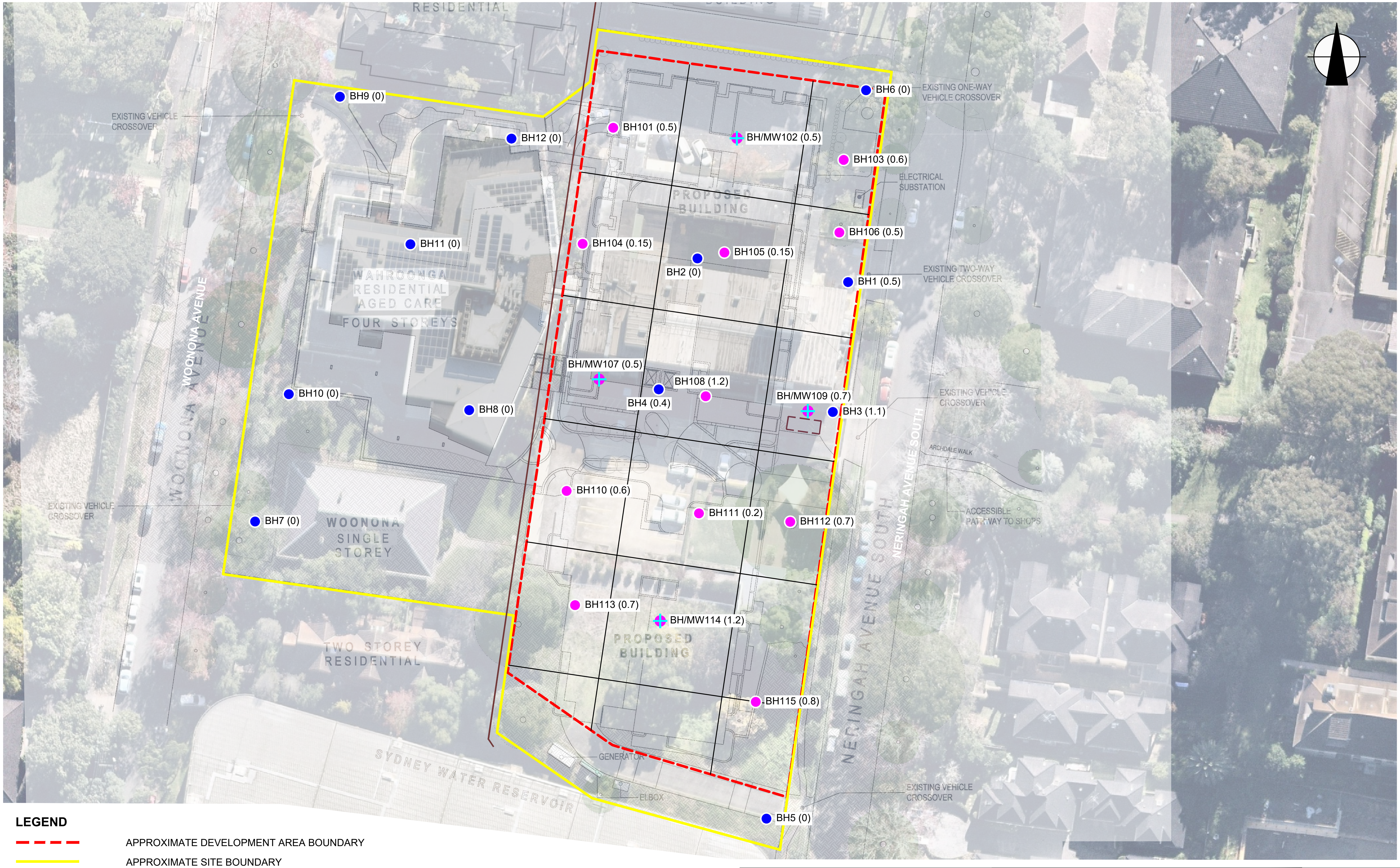

LEGEND

(red dashed line)	APPROXIMATE DEVELOPMENT AREA BOUNDARY
(yellow line)	APPROXIMATE SITE BOUNDARY
BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, 2022)
BH/MW(Fill Depth)	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, 2022)
BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (EIS, 2010)
	APPROXIMATE LOCATION OF SUSPECTED UNDERGROUND STORAGE TANK (UST)
	APPROXIMATE ALIGNMENT OF SEWER

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 6 12 18 24 30

SCALE 1:600 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **SAMPLE LOCATION PLAN**

Location: NERINGAH HOSPITAL, 4-12 NERINGAH AVENUE SOUTH, WAHROONGA, NSW

Project No: E35312BR

Figure No: 2

JKEnvironments

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Appendix B: Report Explanatory Notes

QA/QC Definitions

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994)[19] methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (1991)[20]. The NEPM (2013) is consistent with these documents.

A. Practical Quantitation Limit (PQL), Limit of Reporting (LOR) & Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection Limit for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations: *"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit*" (Keith, 1991).

B. Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD).

C. Accuracy

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured (i.e. the proximity of an averaged result to the true value, where all random errors have been statistically removed). The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes. Accuracy is typically reported as percent recovery.

D. Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handing and analysis protocols and use of proper chain-of-custody and documentation procedures.

E. Completeness

Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

- Chain-of-custody forms;
- Sample receipt form;
- All sample results reported;
- All blank data reported;

[19] US EPA, (1994). *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* (US EPA SW-846)
[20] Keith., H, (1991). *Environmental Sampling and Analysis, A Practical Guide*

- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

F. Comparability

Comparability is the evaluation of the similarity of conditions (e.g. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel; Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

G. Blanks

The purpose of laboratory and field blanks is to check for artefacts and interferences that may arise during sampling, transport and analysis.

H. Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

$$\frac{(\text{Spike Sample Result} - \text{Sample Result}) \times 100}{\text{Concentration of Spike Added}}$$

I. Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

J. Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2) \times 100}{\{(D1 + D2)/2\}}$$

Appendix C: Guidelines and Reference Documents

Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). Acid Sulfate Soils Manual

Australian and New Zealand Environment Conservation Council (ANZECC), (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Canadian Council of Ministers of the Environment, (1999). Canadian soil quality guidelines for the protection of environmental and human health: Benzo(a)Pyrene (1997)

CRC Care, (2011). Technical Report No. 10 – Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document

Contaminated Land Management Act 1997 (NSW)

Department of Land and Water Conservation, (1997). 1:25,000 Acid Sulfate Soil Risk Map Series

Department of Land and Water Conservation, (2002). Site Investigations for Urban Salinity

Heads of EPAs Australia and New Zealand, (2020). PFAS National Environmental Management Plan Version 2.0.

Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)

National Health and Medical Research Council (NHMRC), (2018). National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011

NSW Department of Environment and Conservation, (2007). Guidelines for the Assessment and Management of Groundwater Contamination

NSW EPA, (1995). Contaminated Sites Sampling Design Guidelines

NSW EPA, (2014). Waste Classification Guidelines - Part 1: Classifying Waste

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

NSW EPA, (2020). Consultants Reporting on Contaminated Land, Contaminated Land Guidelines

NSW EPA, (2022), Sampling design part 1 – application, Contaminated Land Guidelines

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

Olszowy, H., Torr, P., and Imray, P., (1995). Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission

Protection of the Environment Operations Act 1997 (NSW)

State Environmental Planning Policy Resilience and Hazards 2021 (NSW)

Sullivan. L, Ward. N, Toppler. N, and Lancaster. G, (2018). National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual, Department of Agriculture and Water Resources, Canberra ACT

World Health Organisation (WHO), (2008). Petroleum Products in Drinking-water, Background document for the development of WHO Guidelines for Drinking Water Quality

Western Australia Department of Health, (2009). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia