REPORT TO

NSW HEALTH INFRASTRUCTURE

ON

SAMPLING ANALYSIS AND QUALITY PLAN FOR DATA GAP INVESTIGATION (DGI)

FOR

ROUSE HILL HOSPITAL

AT

CORNER OF COMMERCIAL & WINDSOR ROADS, ROUSE HILL, NSW

Date: 1 September 2025
Ref: E35128Brpt5-Rev2-SAQP

JKEnvironments
www.jkenvironments.com.au

T: +61 2 9888 5000
JK Environments Pty Ltd
ABN 90 633 911 403

Report prepared by:

Vittal Boggaram
Principal Associate | Hydrologist | Environmental Engineer

Report prepared by:

Owen Fraser
Senior Associate | Geotechnical Engineer

For and on behalf of
JKE,
PO BOX 976, NORTH RYDE BC NSW 1670

DOCUMENT REVISION RECORD

Report Reference	Report Status	Report Date
E35128Brpt5-SAQP	Final Report	19 March 2025
E35128Brpt5-Rev1-SAQP	Revised Report – update with reference to SEARs	11 July 2025
E35128Brpt5-Rev2-SAQP	Revised Report – incorporating client comments	1 September 2025

This Report (which includes all attachments and annexures) has been prepared by JKE for the Client, and is intended for the use only by that Client.

This Report has been prepared pursuant to a contract between JKE and the Client and is therefore subject to:
a) JKE's proposal in respect of the work covered by the Report;
b) The limitations defined in the client's brief to JKE; and
c) The terms of contract between JKE and the Client, including terms limiting the liability of JKE.

If the Client, or any person, provides a copy of this Report to any third party, such third party must not rely on this Report, except with the express written consent of JKE which, if given, will be deemed to be upon the same terms, conditions, restrictions and limitations as apply by virtue of (a), (b), and (c) above.

Any third party who seeks to rely on this Report without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

Table of Contents

List of Tables

Attachments

Abbreviations

Asbestos Fines/Fibrous Asbestos	**AF/FA**
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**
Acid Sulfate Soil	**ASS**
Above-Ground Storage Tank	**AST**
Before You Dig Australia	**BYDA**
Below Ground Level	**BGL**
Benzo(a)pyrene Toxicity Equivalent Factor	**BaP TEQ**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Cis-1,2-dichloroethene	**cis-DCE**
Conceptual Site Model	**CSM**
Development Application	**DA**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environment Protection Authority	**EPA**
Environmental Site Assessment	**ESA**
Fibre Cement Fragment(s)	**FCF**
Finished Floor Level	**FFL**
General Approval of Immobilisation	**GAI**
Health Investigation Level	**HIL**
Health Screening Level	**HSL**
Health Screening Level-Site Specific Assessment	**HSL-SSA**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
JK Geotechnics	**JKG**
Lab 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**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Perchloroethylene (also known as tetrachloroethene)	**PCE**
Polycyclic Aromatic Hydrocarbons	**PAH**
Potential ASS	**PASS**
Polychlorinated Biphenyls	**PCB**
Per-and Polyfluoroalkyl Substances	**PFAS**
Perfluorooctanoic Acid	**PFOA**
Perfluorooctanesulfonic Acid	**PFOS**

Perfluorohexane Sulfonate	**PFHxS**
Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Quality Assurance	**QA**
Quality Control	**QC**
Remediation Action Plan	**RAP**
Reduced/Relative Level	**RL**
Relative Percentage Difference	**RPD**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Site Audit Statement	**SAS**
Site Audit Report	**SAR**
State Environmental Planning Policy	**SEPP**
Site Specific Assessment	**SSA**
Source, Pathway, Receptor	**SPR**
Specific Contamination Concentration	**SCC**
Standard Penetration Test	**SPT**
Standing Water Level	**SWL**
Trichloroethene	**TCE**
Trip Blank	**TB**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Recoverable Hydrocarbons	**TRH**
Trip Spike	**TS**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Underground Storage Tank	**UST**
Virgin Excavated Natural Material	**VENM**
Volatile Organic Compounds	**VOC**
Vinyl Chloride	**VC**
World Health Organisation	**WHO**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millivolts	**mV**
Millilitres	**ml or mL**
Milliequivalents	**meq**
micro Siemens per Centimetre	**µS/cm**
Micrograms per Litre	**µg/L**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Parts Per Million	**ppm**
Percentage	**%**
Percentage weight for weight	**%w/w**

1 INTRODUCTION

NSW Health Infrastructure ('the client') commissioned JKE to prepare a SAQP for the data gap investigation (DGI) for the proposed Rouse Hill Hospital development at the corner of Windsor Road and Commercial Road, Rouse Hill, NSW ('the site'). The wider investigation area is shown on Figure 1 and the SAQP site boundaries as shown on Figure 2 attached in the appendices.

Relevant information presented in previous JKE and JKG reports has been summarised in Section 2. This report should be read in conjunction with previous investigation reports.

A review of the provided project information indicates that the proposed Bulk Excavation Level (BEL) for the main building will be at RL55.2m, which is assumed to be 0.3m below the proposed Finished Floor Level (FFL) of RL55.5m. We note the southern end of the main building will comprise a loading dock with a FFL at RL49.8m which will connect into the externally paved areas. The proposed car park will have a BEL at approximately RL55.2m and RL56.55m, which is assumed to be 0.3m below the FFL, and will require a step in the ground floor level. Based on these levels we expect up to about 2m of filling and 1m of cut to achieve the design levels.

Works will also be carried out along Commercial Road comprising of new concrete islands and road widening to facilitate the site entry in the north-eastern corner of the site. A shared pathway will also be constructed in the south-western corner of the site connecting the site to the corner of Windsor Road and Rouse Hill Drive. Lastly, a temporary works area is to be set up adjacent to the hospital site (land owned by DPHI), for use during construction and we expect any structures to be installed approximately at existing grade. These future main works are proposed under a separate planning pathway and future investigations will be completed for these works.

1.1 Aims and Objectives

The primary aims of the DGI is to undertake additional environmental and geotechnical investigations in areas which were previously not addressed during the investigations outlined in Table 1-1. The investigations will include the following:

- Additional soil and groundwater contamination investigation to inform the DSI;
- Additional dryland salinity and ASS investigation to inform the SMP;
- Additional surface and groundwater investigation to inform the SGIA; and
- Additional geotechnical investigation to inform the GI and HA reports.

The DGI 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, salinity and ASS conditions via implementation of a sampling and analysis program;
- Document an iteration and review of the conceptual site model (CSM);

- Assess the potential risks posed by contamination to the receptors identified in the CSM (Tier 1 assessment);
- Assess whether the site is suitable or can be made suitable for the proposed development (from a contamination viewpoint); and
- Assess whether further intrusive investigation and/or remediation is required.

1.2 Scope of Work

The SAQP has been prepared generally in accordance with a JKE variation proposal to Contract No. HI22139 (Ref: EP70854B) of 10 December 2024 and written approval of variation from HI of 21 February 2025.

The scope of work included review of the previous JKE and JKG reports and preparation of an SAQP with regards to 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], the National Acid Sulfate Soil Guidance (2018) documents and the Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (1998)[3]

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

[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] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)

2 SITE INFORMATION

2.1 Summary of Previous Investigations

2.1.1 Preliminary Geotechnical Investigation (JKG)

JKG have previously undertaken a preliminary geotechnical investigation at the site for the proposed development. The geotechnical investigation included drilling of six boreholes (BH1 to BH6 inclusive), including the installation of three groundwater monitoring wells (BH/MW1, BH/MW4 and BH/MW6). The monitoring well locations are shown on Figure 2.

The investigation encountered clayey fill in all boreholes, extending to depths of approximately 0.2m and 0.9mBGL, with inclusions of ash and root fibres. Residual silty clay was encountered in all boreholes beneath the fill and was assessed to be of high plasticity and of hard strength. Weathered siltstone bedrock was encountered in all boreholes beneath the residual clay at depths ranging from approximately 0.6m to 1.8mBGL. The boreholes did not encounter groundwater during auger drilling.

2.1.2 Supplementary DSI (JKE)

JKE have previously prepared a supplementary DSI at the site for the proposed development. The primary aims of the investigation were to review previously identified potentially contaminating activities at the site, identify the potential for site contamination, and make an assessment of the soil and groundwater contamination conditions. The DSI included review of previous investigations completed at the site, a walkover site inspection, soil sampling from 32 locations and groundwater sampling from three monitoring wells installed by JKG.

Fill was encountered at the surface in all testpits, except TP11, and extended to depths of approximately 0.1m to 1.2mBGL. The fill typically comprised silty clay with inclusions of ironstone, sandstone and siltstone gravel, ash and root fibres. Concentrations of nickel and zinc were encountered in the groundwater samples that exceeded the ecological based site assessment criteria (SAC).

Based on the findings of the investigation, JKE noted that the site was suitable for the proposed development without the need for remediation. There was considered to be a relatively low potential for contamination-related unexpected finds to occur at the site during the proposed development works.

The report recommended:

- A Detailed Site Investigation (DSI) for the works to be carried out along Commercial Road, shared pathway and DPHI sites. Based on the results of the DSI, consideration should be made for the requirements of prepared a Remediation Action Plan (RAP) and any long-term Environmental Management Plan (EMP) for the proposed development at the sites; and
- Prepare an Unexpected Finds Procedure (UFP) as part of the RAP so that this procedure can be implemented during any future site works. We also recommend that the site remain secured and that the client organise regular inspections to ensure that unauthorised access and fly tipping does not occur.

The report also recommended that the site remain secured and that the client organise regular inspections to ensure that unauthorised access and fly tipping does not occur.

2.1.3 Hydrogeological Analysis (JKG)

A hydrogeological analysis report was prepared for the site by JKG. The purpose of the analysis was to prepare a geotechnical model of the site, based on previous geotechnical investigations undertaken by JKG, and to assess the potential seepage volumes into the ground floor excavation during construction and on-going use of the hospital.

The report indicated that the groundwater on site is within the siltstone bedrock profile and is relatively non-responsive to rainfall. Based on measured groundwater levels, it was inferred that the hydraulic gradient flows generally towards the south-east. The standing water level (SWL) recorded in the monitoring wells ranged from approximately 45.2mAHD to 50mAHD.

2.1.4 Preliminary Groundwater Quality Screening (JKE)

JKE undertook a preliminary groundwater quality screening for the proposed development. The screening included groundwater sampling from the 3 monitoring wells installed by JKG.

Based on the results of the screening, the groundwater samples identified concentrations of copper, zinc and aluminium above the ecological screening criteria adopted for potential disposal to stormwater. Groundwater samples MW1 and MW4 also encountered detections of Faecal Coliforms and E. Coli. The report recommended treatment of groundwater prior to disposal to stormwater.

Council approval should be obtained prior to discharge to stormwater and conditions imposed by Council on the discharge should be complied with.

2.1.5 Dryland Salinity and ASS Assessment (JKE)

JKE undertook a dryland salinity and ASS assessment for the proposed development. The screening included groundwater sampling from the 3 monitoring wells installed by JKG. The assessment included soil sampling from nine boreholes (BH101 to BH109) placed on a regular grid pattern as shown on Figure 2 attached in the appendices.

The assessment also included the installation of three groundwater monitoring wells (MW102, MW103 and MW109) and sampling from three existing groundwater monitoring wells (MW1, MW4 and MW6) spread across the site as shown on Figure 2 attached in the appendices. The wells were positioned for site coverage to establish baseline salinity conditions.

The assessment identified the following salinity conditions at the site:

- The soils are classed as very strongly acidic to very strongly alkaline;
- The soils are generally classed as non-saline to slightly saline;
- The soils are generally sodic to highly sodic;
- The soils are generally mildly aggressive towards buried concrete;

- The soils were non-aggressive towards buried steel;
- The groundwater is classed as saline;
- The groundwater is mildly aggressive towards buried concrete; and
- The groundwater is non-aggressive towards buried steel.

Based on the results, the report concluded that a salinity management plan (SMP) is required for the proposed development. A site specific SMP should be prepared when development plans have been finalised for the proposed development.

The assessment did not identify any risks from potential ASS (PASS) and concluded that an ASS management plan (ASSMP) was not considered necessary for the proposed development.

2.2 Site Identification

Table 2-1: Site Identification

Site Address:	Commercial Road, Rouse Hill
Lot & Deposited Plan:	Lots 311 and 312 DP 1274392
Current Land Use:	Vacant
Proposed Land Use:	Hospital
Local Government Authority:	The Hills Shire Council
Current Zoning:	B4 Mixed Use
Site Area (m^2) (approx.):	22,000
RL (AHD in m) (approx.):	50
Geographical Location (decimal degrees) (approx.):	Latitude: -33.688149 Longitude: 150.921881
Site Location Plan:	Figure 1
Proposed Sample Location Plan:	Figure 2

2.3 Site Location and Regional Setting

The site is located in a predominantly commercial area of Rouse Hill, with some remnants of former residential/rural land use to the west, on the south-east side of the intersection of Windsor and Commercial Roads. The site is located approximately 500m to the west of Caddies Creek.

2.4 Topography

The regional topography is characterised by gently undulating areas that typically falls towards local creeks and gullies. The site itself generally falls gently towards the south and south-east.

2.5 Site Inspection

A walkover inspection of the site was undertaken by JKE on 8 July 2024. A summary of the inspection findings is outlined in the following subsections.

2.5.1 Current Site Use and/or Indicators of Former Site Use

At the time of the inspection, the site was vacant and covered by grass with small areas of exposed soil present. An asphalt concrete (AC) paved path ran along the west, south, east and parts of the north boundaries of the site and parts of the AC driveway led to a gravelled area in the north-eastern portion of the site.

2.5.2 Buildings, Structures and Roads

An Asphaltic Concrete (AC) paved driveway was located in the north-east section of the site, that extended onto the site from Commercial Road. A gravel surfaced pathway extended along the east, south, west and part of the north site boundaries.

2.5.3 Boundary Conditions, Soil Stability and Erosion

The site was fenced with chain link fencing on all boundaries. A small gully feature was observed in the south section of the site, the base and banks of which were heavily vegetated. No obvious signs of erosion were observed.

2.5.4 Presence of Drums/Chemical Storage and Waste

No obvious signs of chemical or waste storage were observed at the site.

2.5.5 Evidence of Cut and Fill

Fill was observed on the ground surface in small areas across the site. No obvious stockpiles or mounds were observed and it did not appear that extensive earthworks had occurred since the previous investigations documented in Section 2.1 of this report.

2.5.6 Visible or Olfactory Indicators of Contamination (odours, spills etc)

No obvious indicators of contamination were observed at the site.

2.5.7 Drainage and Services

Surface water would be expected to flow to the small gully in the south section of the site before moving east towards Caddies Creek.

2.5.8 Sensitive Environments

Sensitive environments such as wetlands, ponds, creeks or extensive areas of natural vegetation were not identified on site or in the immediate surrounds.

2.5.9 Ecological Sensitive Areas

A review of the ecological sensitivity areas indicates the presence of native vegetation on the site. The information indicates that Cumberland Shale Plains Woodland of the Coastal Valley Grassy Woodlands is located in some sections of the site. JKE recommend engaging an ecologist to review any potential for impact on the native vegetation associated with the proposed development.

2.6 Surrounding Land Use

During the site inspection, JKE observed the following land uses in the immediate surrounds:

- North – a substation facility was located immediately north of the site. The site formed an approximate 'U' shape around the substation. We note that the substation was not present on the site in 2006 and had been constructed prior to the JBS&G DSI in 2020. Commercial Road was located north of the site and substation with a hotel, fast food restaurant and shopping centre further north;
- South – vacant land in similar condition to the site, with Rouse Hill Drive and Rouse Hill Town Centre (shopping centre) beyond;
- East – predominantly vacant land in similar condition to the site, with an on-grade car park approximately 140m to the east of the site; and
- West – a bus terminal with Windsor Road beyond and a railway overpass to the south-west.

JKE did not observe any land uses in the immediate surrounds that were identified as potential contamination sources for the site. We note that the substation appears to have been recently constructed and is unlikely to represent a potential contamination source.

2.7 Underground Services

The 'Before You Dig Australia' (BYDA) plans were reviewed for the investigation 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. Major services were not identified that would be expected to act as preferential pathways for contamination migration.

2.8 Summary of Regional Geology and Hydrogeology

2.8.1 Regional Geology and Soil Landscape

A review of the geological map of Penrith (1991)[4] indicates that the site is underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey claystone-siltstone and fine sandstone-siltstone laminite.

Soil landscape information sourced from the Soil Landscape – Central and Eastern NSW Map indicates that the site is located within the Blacktown soil landscape. Blacktown soils are characterised by moderate erodibility with some higher local occurrences, low dispersivity and localised areas of moderate salinity.

2.8.2 Dryland Salinity Potential of Western Sydney

The site is located within the area of Western Sydney included in the Salinity Potential Map prepared by the Department of Infrastructure, Planning and Natural Resources (DIPNR). Based upon interpretation from the geological formations and soil groups presented on the map, the site is located in a region of moderate salinity potential.

The moderate classification is attributed to scattered areas of scalding and indicator vegetation, in areas where concentrations have not been mapped. Saline areas may occur in this zone, which have not been identified or may occur if risk factors change adversely.

Reference should be made to the JKE dryland salinity and ASS report for further information (see Section 2.1.5).

2.8.3 Acid Sulfate Soil (ASS) Risk and Management

The site is not located in an ASS risk area according to the risk maps prepared by the Department of Land and Water Conservation.

Reference should be made to the JKE dryland salinity and ASS report for further information (see Section 2.1.5).

2.8.4 Summary of Site History

A review of historical information presented in the provided reports (discussed in Section 2.1) and the historical aerial photographs presented in the Lotsearch report was undertaken for the assessment. The review identified the following:

- Prior to the 1970s, the site was predominantly vacant and grassed. The site was likely used for agricultural (grazing) purposes;
- The site was utilised as a golf course from at least 1970 to circa 1994; and
- The site has remained vacant.

[4] Department of Mineral Resources, (1991). *1:100,000 Geological Map of Penrith (Series 9030)*

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 background/site history site history information. Reference should also be made to the figures attached in the appendices.

3.1 Potential Contamination Sources/AEC and CoPC

The JBS&G DSI CSM identified the following potential contamination sources:

- Historical pesticides/herbicide use and nutrient loading during historical golf course operation;
- Stockpiles of unknown origin;
- Fly tipping/dumped materials;
- Hazardous building materials associated with former built structures (including ACM pipes); and
- Offsite substation.

Based on a review of the works completed to date and the condition of the site during the JKE inspection for the SDSI, JKE provided the following comments/review regarding the above:

- Pesticide concentrations in samples obtained from previous JKE investigations between 2003 and 2006 and the subsequent JBS&G DSI were all very low (generally below the laboratory limits of detection) and were less than relevant assessment criteria;
- No stockpiles were observed on the site in 2024;
- No Fly tipping or dumped materials were observed on the site in 2024;
- The former asbestos pipe was removed and the removal was validated in 2006; and
- The offsite substation was constructed recently and was not considered to represent a potential contamination source.

Based on review of the JBS&G CSM and results of JKE and JBS&G investigations, the remaining potential contamination source and CoPC is unidentified asbestos associated with former structures and/or fill at the site.

JKE note that the risk to groundwater is considered to be low, however, groundwater assessment was not undertaken as part of the JBS&G DSI. The most likely potential contamination sources for groundwater include contaminated imported fill and localised spills. CoPC in groundwater include Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, BTEX and PAHs. A more comprehensive suite of Volatile Organic Compounds (VOCs) was also considered for the SDIS.

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

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

Table 3-1: CSM

Potential mechanism for contamination	The potential mechanisms for contamination are most likely to include 'top-down' impacts and spills. There is a potential for sub-surface releases to have occurred if deep fill (or other buried industrial infrastructure) is present, although this is considered to be the least likely mechanism for contamination.
Affected media	Soil and groundwater have been identified as potentially affected media. The potential for soil vapour impact will be assessed based on the results of the groundwater assessment. The available soil data indicates there is a negligible soil vapour risk from the occurrence of volatile TRH/BTEX in soil.
Receptor identification	Human receptors include site occupants/users (including adults and children), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas) and, as a conservative measure, freshwater ecology in Caddies Creek.
Potential exposure pathways	Potential exposure pathways relevant to the human receptors inhalation of dust (asbestos) and inhalation of vapours volatilising from groundwater into soil vapour then into proposed buildings. The potential for exposure would typically be associated with the construction and excavation works, and future use of the site.
Potential exposure mechanisms	The following have been identified as potential exposure mechanisms for site contamination: • Inhalation of asbestos fibres following disturbance of exposed soils during construction, or in proposed landscaped areas and/or unpaved areas; • Migration of groundwater off-site and into nearby water bodies, including aquatic ecosystems; and • Vapour intrusion into the proposed basement and/or building (volatilisation of contaminants from groundwater).
Presence of preferential pathways for contaminant movement	No obvious preferential pathways for contaminant migration were identified at the site.

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 1.1. 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.

The DQO process is validated in part by the Data Quality Assurance/Quality Control (QA/QC) Evaluation. The Data (QA/QC) Evaluation will be summarised in the DGI report.

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 assess the contamination status of the site, assess the 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 consent authority in exercising its planning functions in relation to the development proposal.

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

The information obtained for the DGI will also be used to update the SGIA report prepared by JKE and the geotechnical report prepared by JKG for the SSDA.

4.1.2 Step 2 - Identify the Decisions of the Study

The objectives of the DGI are outlined in Section 1.1. The decisions to be made reflect these objectives and are as follows:

- Are any results above the SAC?
- Do potential risks associated with contamination exist, and if so, what are they?
- Is remediation required?
- Is the site 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 additional dryland salinity management measures?

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;
- Site information, including site observations and site history documentation;
- Sampling of potentially affected media, including soil and groundwater;

- 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, fibre cement (if encountered), and groundwater samples 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 will be confined to the additional site boundaries to the north and south of the site as shown in Figure 2. The investigation will be limited vertically to a maximum nominated depth of approximately 8m below ground level (BGL) for the installation of groundwater monitoring wells. The final depth could depend on site conditions and will be noted in the DGI.

At this stage, the sampling is scheduled to be completed between April and May 2025 (temporal boundary). Areas not accessible for sampling will be noted in the DGI as data gaps.

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

4.1.5.1 Tier 1 Screening Criteria

The laboratory data will be assessed against relevant Tier 1 screening criteria (referred to as SAC), as outlined in Section 5. Exceedances of the SAC do not necessarily indicate a requirement for remediation or a risk to human health and/or the environment. Exceedances are considered in the context of the CSM and valid SPR-linkages.

Where appropriate, data will be assessed against valid statistical parameters to characterise the data population. This will 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.

For the DSI, the following decision rules will be considered:

- If all CoPC (with the exception of asbestos) concentrations are below the SAC, then the data will be compared directly to the SAC without statistical analysis;
- For soil data, if any individual CoPC (with the exception of asbestos) concentration is above the SAC, then statistical analysis will be considered based on the sampling plan. This will include calculation of the 95% upper confidence limit (UCL) value for the data set, with regards to the NEPM (2013) framework and other relevant guidelines made under the CLM Act 1997. The UCL will be 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;
- If asbestos concentrations are encountered above the SAC or in the top 100mm of soil, then asbestos will be deemed a contaminant of concern for remediation purposes; and
- Groundwater data will be compared directly to the SAC and evaluated with regards to valid/complete SPR-linkages.

4.1.5.2 Field and Laboratory 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).

Further details regarding the sampling and analysis undertaken, and the acceptable limits adopted, will be included in the Data Quality (QA/QC) Evaluation presented in the DGI report.

The suitability of the laboratory data is 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 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 is 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 is 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 this investigation, the null hypothesis (H_0) is that the 95% UCL for the CoPC is greater than the SAC. The alternative hypothesis (H_A) is that the 95% UCL for the CoPC is less than the SAC. Alternative considerations are made regarding asbestos based on an assessment of multiple lines of evidence.

Potential outcomes include Type I and Type II errors as follows:

- Type I error of determining that the soil is acceptable for the proposed land use when it is not (wrongly rejects true H_0), includes an alpha (α) risk of 0.05; and
- Type II error of determining that the soil is unacceptable for the proposed land use when it is (wrongly accepts false H_0), includes beta (β) risk of 0.2.

UCLs will be 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. However, where statistical analysis is applied in accordance with Step 5 via the calculation of UCL values, the potential for decision errors to occur will also be evaluated using the Combined Risk Value (CRV) method as outlined in Appendix E of the NSW EPA Sampling Design Part 1 – Application (2022)[5] contaminated land guidelines. The CRV method will be used retrospectively to establish whether there is sufficient statistical power in the UCL.

Statistical analysis will not apply to asbestos or groundwater data, therefore these data will be assessed based on a multiple lines of evidence and risk-based approach.

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.

[5] NSW EPA, (2022). *Sampling design part 1 - application.* (referred to as EPA Sampling Design Guidelines 2022)

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 investigation objectives. Adjustment of the investigation design can occur following consultation or feedback from project stakeholders. For this investigation, the design was 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 proposed for the DGI is outlined in the table below:

Table 4-1: Proposed DGI Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	Samples for the DGI will be collected from the following locations as shown on Figure 2: • North section along Commercial Road – sampling from 15 boreholes (BH401 to BH415); and • South section along transport corridor – sampling from 8 boreholes (BH301 to BH308). The above number of locations meets the minimum sampling density for hotspot identification, as outlined in the NSW EPA Sampling Design Part 1 – Application (2022)[6] contaminated land guidelines. Samples will be collected from eight selected locations (four in each area) for ASS and salinity analysis. The number of locations will meet 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 site area.
Sampling Plan	The sampling locations will be placed on a systematic plan with a grid spacing of approximately 15m to 20m between sampling location as shown on Figure 2. A systematic plan is considered suitable to identify hotspots to a 95% confidence level and calculate UCLs for specific data populations (UCLs will only be applied where appropriate and in accordance with the DQOs).

[6] NSW EPA, (2022). *Sampling design part 1 - application.* (referred to as EPA Sampling Design Guidelines 2022)

Aspect	Input
Set-out and Sampling Equipment	Sampling locations will be set out using an electronic rangefinder/tape measure/hand held GPS unit (with an accuracy of ±5m). In-situ sampling locations will be checked for underground services by an external contractor prior to sampling. Samples will be collected using a drill rig equipped with spiral flight augers. Soil samples will be obtained from a Standard Penetration Test (SPT) split-spoon sampler, and/or directly from the auger.
Sample Collection and Field QA/QC	Soil samples will be obtained in accordance with our standard field procedures. Soil samples will be collected from the fill and natural profiles based on field observations. The sample depths will be shown on the logs included in the DGI report. Soil samples for contamination testing will be placed in glass jars with plastic caps and Teflon seals with minimal headspace. Samples for asbestos analysis will placed in zip-lock plastic bags. ASS 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 field splitting procedure includes alternate filling of the sampling containers to obtain a representative split sample. Homogenisation of duplicate samples will not occur to minimise the potential for the release of volatile organic compounds.
Field Screening	A portable Photoionisation Detector (PID) fitted with a 10.6mV lamp will be used to screen the samples for the presence of volatile organic compounds (VOCs). PID screening for VOCs will be undertaken on soil samples using the soil sample headspace method. VOC data will be obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. PID calibration records will be maintained for the project. The field screening for asbestos quantification will include the following: • A representative bulk sample (approximately 10L sample, to the extent achievable based on sample return) is to be collected from fill at 1m intervals, or from each distinct fill profile. The quantity of material for each sample may vary based on the return achieved using the auger. The bulk sample intervals will be shown on the borehole logs; • Each 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 fibre cement. If the soil are cohesive in nature, the samples will be subsequently placed on a contrasting support (blue tarpaulin) and inspected for the presence of fibre cement. Any soil clumps/nodules will be disaggregated; • The condition of fibre cement or any other suspected asbestos materials will be noted on the field records; and • If observed, any fragments of fibre cement in the bulk sample will be 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), as summarised in Section 5.1. Bulk samples in unpaved areas will be taken from the top 100mm, then each distinct fill profile thereafter, with a minimum of one sample per 1m depth of each fill profile.

Aspect	Input
	A calibration/check of the accuracy of the scale used for weighing the fibre cement fragments will be undertaken using a set of calibration weights. Calibration/check records are maintained on file by JKE. The scale used to weigh the 10L samples will not be calibrated, however this is not considered significant as this method of providing a weight for the bulk sample is considered to be considerably more accurate than applying a nominal soil density conversion.
Decontamination and Sample Preservation	Sampling personnel will use disposable nitrile gloves during sampling activities. Re-usable sampling equipment will be decontaminated between sampling events using a Decon and potable water solution, followed by a rinse in potable water. 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 proposed for the DGI is outlined in the table below:

Table 4-2: Proposed Groundwater Sampling Plan and Methodology

Aspect	Input
Sampling Plan	Groundwater monitoring wells will be installed in four selected boreholes drilled for the DGI. Two boreholes per area will be targeted based on site access constraints associated with Commercial Road. The wells will be positioned to establish background groundwater conditions at the site.
Monitoring Well Installation Procedure	The monitoring well construction details will be documented on the appropriate borehole logs. The monitoring wells will be installed to depths of approximately 8mBGL. The wells will generally be 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 used around the screen section for groundwater infiltration; • A hydrated bentonite seal/plug used 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 monitoring well installation, including the screen lengths, is considered suitable for assessment of general groundwater quality with regards to Table 5 in Schedule B2 of NEPM 2013.
Monitoring Well Development	The monitoring wells will be developed after installation using a submersible electrical pump/dedicated disposable plastic bailer. During development, the following parameters will be monitored using calibrated field instruments: • Standing water level (SWL) using an electronic dip meter; and • pH, temperature, electrical conductivity (EC), dissolved oxygen (DO) and redox potential (Eh) using a YSI Multi-probe water quality meter.

Aspect	Input
	Steady state conditions are considered to have been achieved when the difference in the pH measurements is less than 0.2 units, the difference in conductivity is less than 10%, and when the SWL is not in drawdown. In the event that groundwater in-flow is relatively slow, the development will continue until the wells are effectively dry. The field monitoring records and calibration data will be included in the DGI report.
Groundwater Sampling	The monitoring wells will be allowed to recharge for approximately five to seven days after development. Prior to sampling, the monitoring wells will be checked for the presence of Light Non-Aqueous Phase Liquids (LNAPL) using an inter-phase probe electronic dip meter. The monitoring well head space will be checked for VOCs using a calibrated PID unit. The samples will be obtained using a peristaltic pump/disposable plastic bailer. During sampling, the following parameters will be monitored using calibrated field instruments: • SWL using an electronic dip meter; and • pH, temperature, EC, DO and Eh using a YSI Multi-probe water quality meter. Steady state conditions is considered to have been achieved when the difference in the pH measurements is less than 0.2 units, the difference in conductivity is less than 10%, and when the SWL was not in drawdown. Groundwater samples will be obtained directly from the single use PVC tubing and placed in the sample containers. Duplicate samples are to be obtained by alternate filling of sample containers. This technique is 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 waste water contractor for off-site disposal. The field monitoring record and calibration data will be included in the DGI report.
Decontaminant and Sample Preservation	During development, the development pump and hose will be flushed between monitoring wells with a potable water and Decon solution, followed by a pulse of potable water (single-use tubing will be used for each well). This will also occur for the inter-phase probe electronic dip meter during development and sampling. The groundwater sampling process utilises a peristaltic pump and single-use tubing, therefore no decontamination procedure for the sampling is considered necessary. Rinsate samples will be be obtained during the decontamination process as part of the field QA/QC. The samples will be preserved with reference to the analytical requirements and placed in an insulated container with ice or ice bricks. 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 Additional Geotechnical Investigation (JKG)

Additional geotechnical data is required to inform detailed pavement design for the portions of the site that have been proposed to be investigated as shown over the areas of the '300' and '400 borehole series, as shown on the attached Sample Location Plan (Figure 2). The works will be required to inform pavement design and we therefore recommend the following scope of work as a minimum.

- 10 boreholes will be auger drilled to at least minimum 1m below proposed subgrade level. Bedrock, if encountered, will be drilled with the auger. Four boreholes should comprise the proposed '300' borehole series and six boreholes should comprise the proposed '400' series, per the attached Figure 2 Sample Location Plan. The boreholes should be spread across the investigation areas to provide adequate site coverage. Additional boreholes may be required should the subsurface conditions be highly variable;
- Dynamic Cone Penetrometer (DCP) tests will be carried out at each borehole location to a maximum depth of at least 1m below proposed subgrade level, or prior refusal, to assist with assessment of soil strength and relative density;
- An experienced geotechnical engineer or engineering geologist must be present on site for the investigation to set out the boreholes, direct the sampling and testing, and compile the borehole logs;
- 10 standard compaction and 10 day soaked CBR tests carried out on subgrade samples to assess pavement design parameters. Four CBR tests should comprise of samples obtained from the proposed '300' borehole series and six CBR tests should comprise of samples obtained from the proposed '400' series, per the attached Figure 2 Sample Location Plan; and
- A report should be submitted detailing the encountered subsurface conditions and recommendations on subgrade preparation, engineered fill, pavement design parameters and any other relevant geotechnical aspects.

4.5 Laboratory Analysis and Proposed Analytical Schedule

Samples will 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, field rinsate and shroud samples	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 DGI, an allowance has been made for the following analysis:

- Up to 23 selected soil samples for: heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); PAHs; TRH; BTEX; OCP; OPP; PCBs; and asbestos (500ml);
- Up to 12 selected deeper soil samples for: heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc); PAHs; TRH; BTEX;
- Up to four selected FCF, if found on or in soil, analysed for asbestos;

- Up to 24 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 eight selected soil samples will be analysed for cation exchange capacity (CEC);
- Up to four 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 and PAHs for waste classification purposes;
- Up to 24 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:
    - Alkalinity (bicarbonate, carbonate, hydroxide and total), electrical conductivity (EC), pH, redox potential (Eh) and dissolved oxygen (DO);
    - Turbidity, total dissolved solids (TDS), total suspended solids (TSS), total organic carbon (TOC) and sodium absorption ratio (SAR);
    - Ionic balance, which includes major anions and the cation suite (including hardness);
    - Metals including Aluminium (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), lithium (Li), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silica (dissolved SiO2), silver (Ag), strontium (Sr), uranium (U), vanadium (V), zinc (Zn);
    - Nutrient suite, including Ammonia (NH3), nitrate (NO3), total nitrogen (N), oxidised nitrogen (N), total phosphorus (P) and reactive phosphorus (P);
    - Faecal coliforms and Escherichia (E) coli;
    - Low level PAHs; TRH; and BTEX; and
    - 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 8mBGL.

5 SITE ASSESSMENT CRITERIA (SAC)

The following SAC derived from the NEPM 2013 and other guidelines, as discussed in the following sub-sections, will be adopted for the DGI.

5.1 Soil

Soil data will be compared to relevant Tier 1 screening criteria in accordance with NEPM (2013) as outlined below.

5.1.1 Human Health

- Health Investigation Levels (HILs) for a 'commercial/industrial' exposure scenario (HIL-D);
- Health Screening Levels (HSLs) for a 'commercial/industrial' exposure scenario (HSL-D). HSLs will be calculated based on conservative assumptions including a 'sand' type and a depth interval of 0m to 1m;
- HSLs for direct contact presented in the CRC Care Technical Report No. 10 – Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document (2011)[7]; and
- Asbestos will be assessed against the HSL-D criteria. A summary of the asbestos criteria is provided in the table below:

Table 5-1: Details for Asbestos SAC

Guideline	Applicability
Asbestos in Soil	The HSL-D criteria will be adopted for the assessment of asbestos in soil. The SAC adopted for asbestos are derived from the NEPM 2013 and based on the Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (2021)[8]. The SAC include the following: • No visible asbestos at the surface/in the top 10cm of soil; • <0.05% w/w bonded asbestos containing material (ACM) in soil; and • <0.001% w/w asbestos fines/fibrous asbestos (AF/FA) in soil. Concentrations for bonded ACM concentrations in soil are based on the following equation which is presented in Schedule B1 of NEPM (2013): $\textbf{\% w/w asbestos in soil} = \dfrac{\textbf{\% asbestos content x bonded ACM (kg)}}{\text{Soil volume (L) x soil density (kg/L)}}$ However, we are of the opinion that the actual soil volume in a 10L bucket varies considerably due to the presence of voids, particularly when assessing cohesive soils. Therefore, each bucket sample was weighed using electronic scales and the above equation was adjusted as follows (we note that the units have also converted to grams): $\textbf{\% w/w asbestos in soil} = \dfrac{\textbf{\% asbestos content x bonded ACM (g)}}{\text{Soil weight (g)}}$

[7] 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*

[8] Western Australian (WA) Department of Health (DoH), (2021). *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*. (referred to as WA DoH 2021)

5.1.2 Environment (Ecological – terrestrial ecosystems)

- Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for an 'urban residential and public open space' (URPOS) exposure scenario. The EILs will only be applied to the top 2m of soil as outlined in NEPM (2013). The criterion for benzo(a)pyrene will be increased from the value presented in NEPM (2013) based on the Canadian Soil Quality Guidelines[9];
- ESLs will be adopted based on the soil type; and
- EILs for selected metals will be calculated using site specific soil parameters for pH, cation exchange capacity and clay content. The data used to select the added contaminant limit (ACL) values presented in Schedule B(1) of NEPM (2013), and published ambient background concentration (ABC) presented in the document titled Trace Element Concentrations in Soils from Rural and Urban Areas of Australia (1995)[10]. This method is considered to be adequate for the Tier 1 screening.

5.1.3 Management Limits for Petroleum Hydrocarbons

Management limits for petroleum hydrocarbons (as presented in Schedule B1 of NEPM 2013) will be considered.

5.1.4 Waste Classification

Data for the waste classification assessment will be assessed in accordance with the Waste Classification Guidelines, Part 1: Classifying Waste (2014)[11] as outlined in the following table:

Table 5-2: Waste Categories

Category	Description
General Solid Waste (non-putrescible)	• If Specific Contaminant Concentration (SCC) ≤ Contaminant Threshold (CT1) then Toxicity Characteristics Leaching Procedure (TCLP) not needed to classify the soil as general solid waste; and • If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as general solid waste.
Restricted Solid Waste (non-putrescible)	• If SCC ≤ CT2 then TCLP not needed to classify the soil as restricted solid waste; and • If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as restricted solid waste.
Hazardous Waste	• If SCC > CT2 then TCLP must be undertaken to classify the soil as hazardous waste; and • If TCLP > TCLP2 and/or SCC > SCC2 then treat as hazardous waste.
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that meet the following: • That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • That does not contain sulfidic ores or other waste; and • Includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette.

[9] Canadian Council of Ministers of the Environment, (1999). *Canadian soil quality guidelines for the protection of environmental and human health: Benzo(a)Pyrene (1997)* (referred to as the Canadian Soil Quality Guidelines)

[10] 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.

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

5.1.5 Acid Sulfate Soil

The action criteria presented in the National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual (2018)[12] are summarised in the following table. The action criteria for 'coarse textured soils' will be adopted.

Table 5-3: ASS Action Criteria

Type of material		**Net Acidity**			
Texture range* (NCST 2009)	Approximate clay content (%)	1–1000 t materials disturbed		> 1000 t materials disturbed	
		% S-equiv. (oven-dried basis)	mol H^+/t (oven-dried basis)	% S-equiv. (oven-dried basis)	mol H^+/t (oven-dried basis)
Fine - light medium to heavy clays	>40	≥0.10	≥62	≥0.03	≥18
Medium - clayey sand to light clays	5–40	≥0.06	≥36	≥0.03	≥18
Coarse and Peats - sands to loamy sands	<5	≥0.03	≥18	≥0.03	≥18

* If bulk density values are not available for the conversion of cubic meters to tonnes of soil, then default bulk densities, based on the soil texture, may be used.

5.2 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 for the DGI include aquatic ecosystems, human uses (incidental contact and recreational water use), and human-health risks in non-use scenarios (vapour intrusion).

5.2.1 Human Health

- HSLs for a 'commercial/industrial' exposure scenario (HSL-D). HSLs will be calculated based on the soil type and the observed depth to groundwater;
- In the event the proposed earthworks for the development will intersect groundwater or in the event the groundwater is recorded at depths shallower than 2m, JKE will undertake a site-specific assessment (SSA) for the Tier 1 screening of human health risks posed by volatile contaminants in groundwater. The assessment included selection of alternative Tier 1 criteria that are considered suitably protective of human health. These criteria are based on drinking water guidelines and have been referred to as HSL-SSA. The criteria are based on the following:

[12] Water Quality Australia, (2018). *National Acid Sulfate Soils Guidance, National acid sulfate soils sampling and identification methods manual.*

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

- Australian Drinking Water Guidelines 2011 (updated 2021)[14] for BTEX compounds and selected VOCs;
- World Health Organisation (WHO) document titled Petroleum Products in Drinking-water, Background document for the development of WHO Guidelines for Drinking Water Quality (2008)[15] for petroleum hydrocarbons. We have conservatively adopted the value of 100µg/L for TRH F1 and F2;
- USEPA Region 9 screening levels for naphthalene (threshold value for tap water); and
- The use of the laboratory PQLs for other contaminants where there are no Australian guidelines.

- The Australian Drinking Water Guidelines 2011 (updated 2021)[16] will 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 or with seepage water in excavations/basements). These have been deemed as 'recreational' SAC.

5.2.2 Environment (Ecological - aquatic ecosystems)

Groundwater Investigation Levels (GILs) for 95% protection of freshwater species will be adopted based on the Default Guideline Values in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)[17]. The 99% trigger values will be adopted where required to account for bioaccumulation. Low and moderate reliability trigger values will also be adopted for some contaminants where high-reliability trigger values don't exist.

---

[14] National Health and Medical Research Council (NHMRC), (2021). *National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011* (referred to as ADWG 2011)

[15] World Health Organisation (WHO), (2008). *Petroleum Products in Drinking-water, Background document for the development of WHO Guidelines for Drinking Water Quality* (referred to as WHO 2008)

[16] National Health and Medical Research Council (NHMRC), (2021). *National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011* (referred to as ADWG 2011)

[17] 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)

6 DGI REPORTING REQUIREMENTS

A DGI 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]. The ASS and dryland salinity assessment will be incorporated into the DGI report.

JKG will prepare and issue a separate report for the additional geotechnical investigation outlined in Section 4.4.

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

7 LIMITATIONS

The report limitations are outlined below:

- This SAQP was developed based on the information available, as documented in this plan. There is always a potential that the proposed investigation will identify contamination impacts (actual or potential) that trigger a need for further investigation;
- 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 investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The plan is based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- 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 preparation of this report has 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 landuse. 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 investigation. If the subject site is sold, ownership of the investigation report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the investigation was undertaken. No person should apply an investigation 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 investigation 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 investigations 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 investigation 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.

Investigation Limitations
Although information provided by a site investigation can reduce exposure to the risk of the presence of contamination, no environmental site investigation can eliminate the risk. Even a rigorous professional investigation 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 Investigations by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an investigation 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 Investigation Report

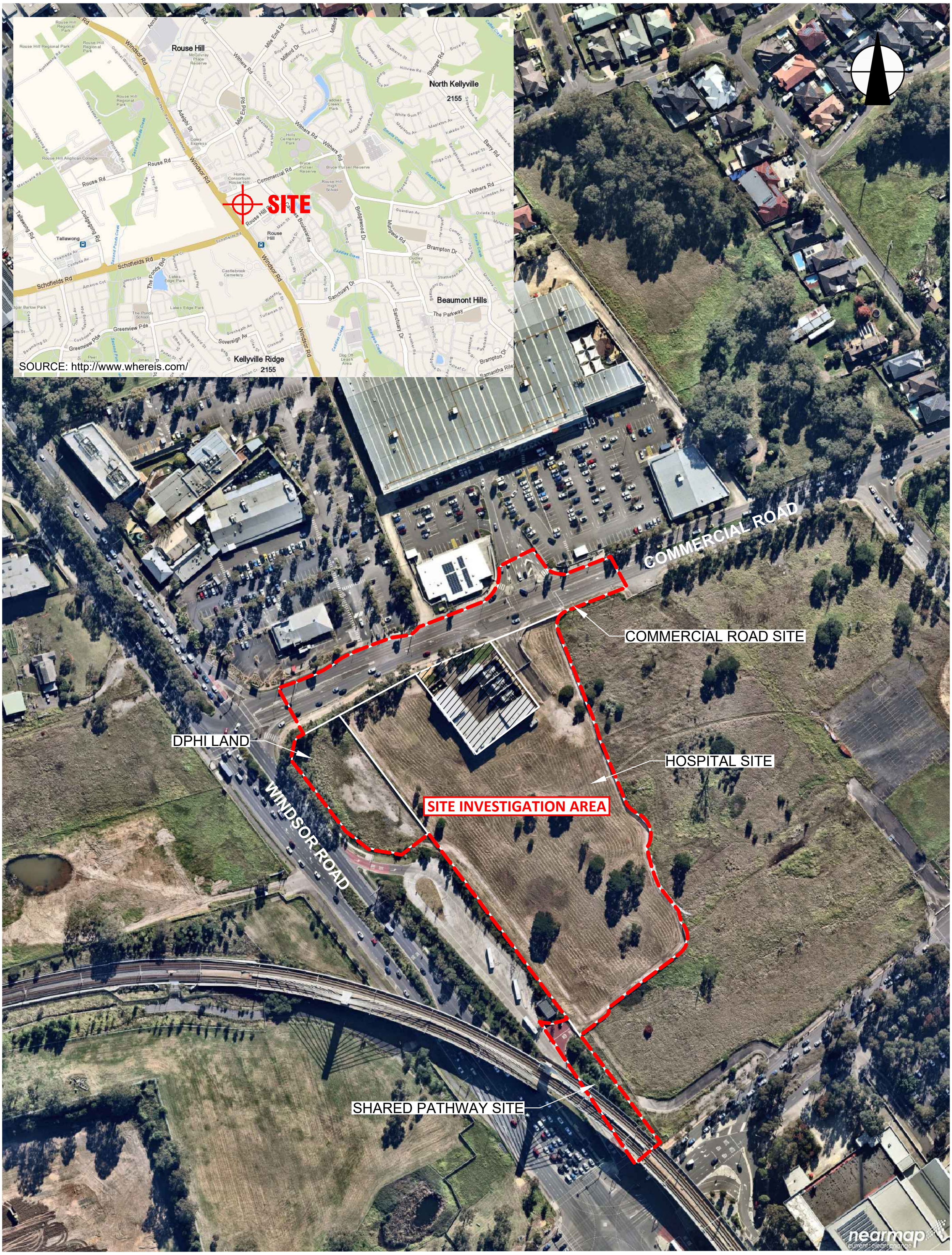
Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other 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 investigation. 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 investigation. 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 investigation 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 investigation 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 investigation, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Report Figures



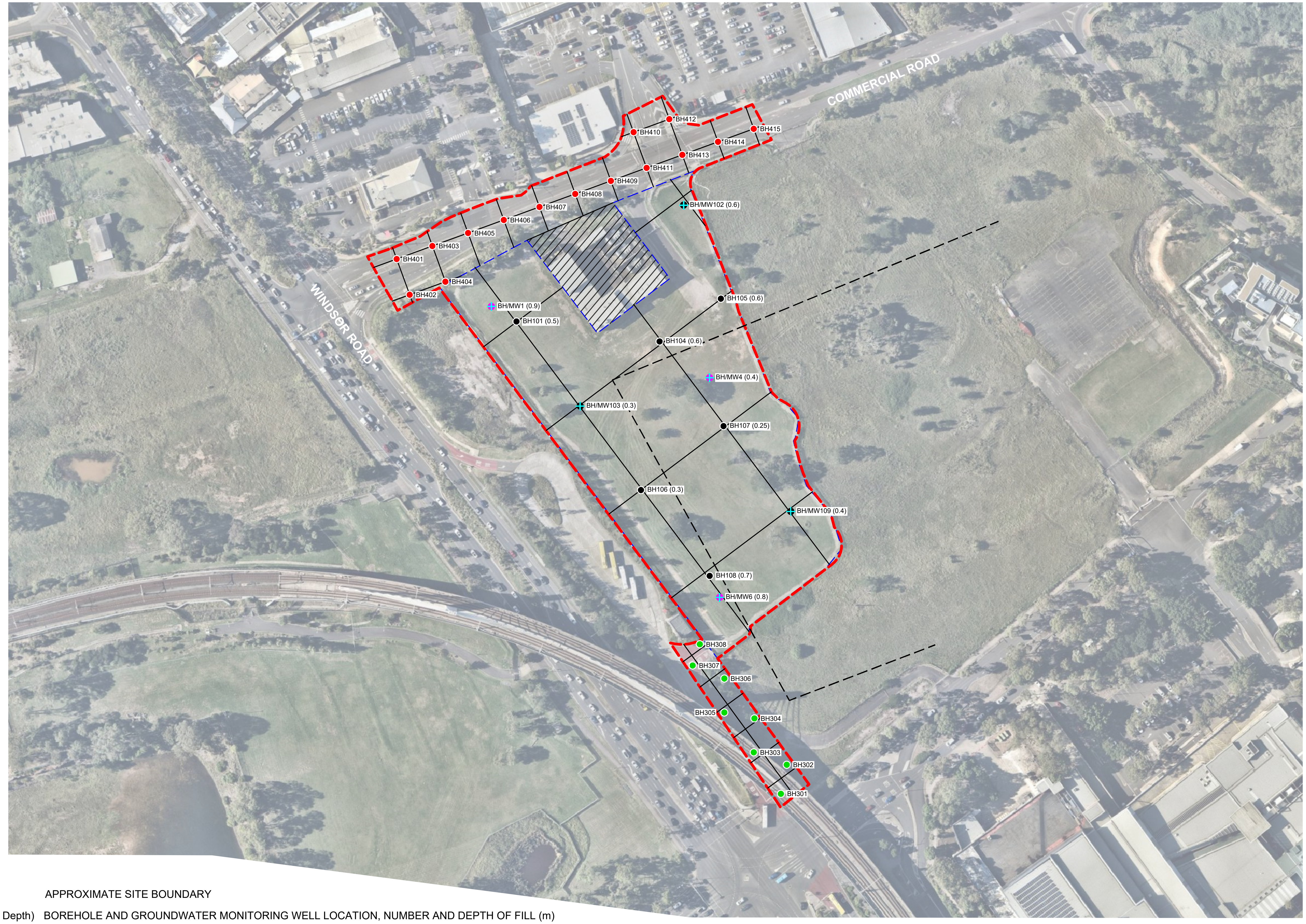
AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	SITE INVESTIGATION AREA
Location:	CNR WINDSOR AND COMMERCIAL ROAD, ROUSE HILL, NSW
Project No:	E35128B
Figure No:	1

JKEnvironments

PLOT DATE: 29/08/2025 4:07:40 PM DWG FILE: K:\5C EIS JOBS\37000'S\E37757B ROUSE HILL HOSPITAL\CAD\E37757B.DWG



LEGEND

	APPROXIMATE SITE BOUNDARY
BH/MW(Fill Depth)	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
BH101	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
BH/MW102	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
	FORMER ASBESTOS PIPELINE
BH301	PROPOSED SAMPLE LOCATION AND NUMBER (AREA B)
BH401	PROPOSED SAMPLE LOCATION AND NUMBER (AREA C)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 20 40 60 80 100

SCALE 1:2000 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: CNR WINDSOR AND COMMERCIAL ROAD, ROUSE HILL, NSW

Project No: E35128B

Figure No: 2

JKEnvironments

PLOT DATE: 13/03/2025 3:35:57 PM DWG FILE: K:\5C EIS JOBS\35000'S\E35128PH ROUSE HILL\CAD\E35128B.DWG

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)[26] methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (1991)[27]. The NEPM (2013) is consistent with these documents.

A. <u>Practical Quantitation Limit (PQL), Limit of Reporting (LOR) & Estimated Quantitation Limit (EQL)</u>

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. <u>Precision</u>

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. <u>Accuracy</u>

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. <u>Representativeness</u>

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. <u>Completeness</u>

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;

[26] US EPA, (1994). *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* (US EPA SW-846)
[27] 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

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

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

National Health and Medical Research Council (NHMRC), (2021). 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, (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)

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, (2021). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia