Proposed Redevelopment of Cessnock Hospital 24 View St, Cessnock NSW 2325

Remediation Action Plan

Health Infrastructure c/o Turner & Townsend

Reference: 754-NTLEN347071-2

30 October 2024

PROPOSED REDEVELOPMENT OF CESSNOCK HOSPITAL 24 VIEW ST, CESSNOCK NSW 2325

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PREPARED FOR

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EXECUTIVE SUMMARY[1]

Tetra Tech Coffey Pty Ltd (Tetra Tech) was engaged by Turner & Townsend Pty Ltd (Turner Townsend) on behalf of NSW Health Infrastructure to prepare a Remediation Action Plan (RAP) to support the proposed redevelopment at Cessnock Hospital, located at 24 View Street, Cessnock New South Wales (NSW) 2325 within part of Lot 2 DP1173784 and part of Lot 11 SP 882585 (the Site).

Tetra Tech previously completed a preliminary site investigation (PSI) with limited sampling (report issued 9 July 2024 with reference: 754-NTLEN347071 R01). The potential risk of contamination to human health for the current and ongoing land uses was assessed as low to moderate and the potential risk to ecological receptors as low based on the findings of the PSI. However, data gaps were identified related to suspected asbestos in fill and reported polyaromatic hydrocarbon (PAH) and petroleum hydrocarbon (as TRH) impacts in the vicinity of the incinerator and workshop buildings and potential petroleum hydrocarbon impacts associated with the hoist in the yard maintenance shed.

Tetra Tech subsequently completed a Detailed Site Investigation (DSI) (report issued 11 October 2024 with reference: 754-NTLEN347071 R02 Rev1) including additional assessment of soil to meet the sampling density requirements of NSW EPA contaminated land sampling guidelines and close out the identified data gaps. Fill soil was encountered across the site during the investigations between approximately 0.5 to 1.6m below ground level (BGL). A fill mound present in the grassed area behind the workshops and yard maintenance shed (that is, away from the hospital buildings), sloped downward to the north, and the depth of the fill was observed to decrease to the west. A fill mound was also observed behind the pathology building and also sloped downward to the north.

These fill mounds were observed to include anthropogenic materials including plastic, tile, brick, nails and bonded asbestos containing material (ACM). ACM which was also observed in the surface soils would not meet the HSL requirement for no visible forms of asbestos (applicable to the top 10cm of soil). The potential for ACM debris also exists beneath the footprints of these buildings.

Soil analytical results reported individual exceedances of ecological assessment criteria for Zinc, TRH F2 (C_{10}-C_{16}) and TRH F3 (C_{16} - C_{34}) and human health criteria for carcinogenic PAHs (reported as benzo(a)pyrene TEQ). No contaminants with individual exceedances of criteria reported 95% $UCL_{AVERAGE}$ above criteria. Two samples for Zinc were above EIL criteria (BH2A_1.0-1.1 adjacent the yard maintenance shed and BH4A_0.1-0.2 near the former incinerator). Additional samples analysed from the boreholes were below criteria. Carcinogenic PAHs was reported above 250% of the HIL criterion in a sample collected immediately below the asphalt (0.1-0.2m) in front of the former incinerator. The concentration of carcinogenic PAHs reported in the sample from lower in the borehole (1.0-1.1m) was below the HIL criterion.

Groundwater was encountered at more than 6m below ground level (bgl) and the concentrations of COPCs (contaminants of potential concern) were below the laboratory limit of reporting (LOR), except for Arsenic and Copper which were detected at the LOR and Nickel and Zinc were reported at 15 and 60 µg/L respectively, above the freshwater ANZG Freshwater Water 95% protection level. Groundwater was considered to be unlikely to be impacted by top-down contamination.

The objectives of the RAP are to provide guidance for the remediation of the Site including remedial options assessment and identification of a preferred remedial strategy so that the Site can be suitable for the proposed use. The RAP also outlines the minimum controls necessary to complete the proposed remedial works in a manner that minimises negative impacts upon worker health and safety (WHS) and the environment.

A remediation options assessment was undertaken for the contamination identified at the Site based on the Conceptual Site Model (CSM) and the proposed final land use and concept plan for the proposed Cessnock

[1] This executive summary must be read in the context of the full report and the attached limitations.

Hospital Redevelopment. Factors considered during the options assessment included the location and volumes of impacted soils and the management of fill that will be disturbed as part of the redevelopment.

Based on consideration of potential remedial options the preferred remedial strategy for the Site is a combination of Option 2 - Excavation and onsite consolidation in a 'borrow pit' below building footprint or hardstand areas and Option 3 - Onsite capping of material below a suitable barrier layer (e.g. hardstand pavement, asphalt, landscaping and/ or similar cover). The concept plan for the redevelopment includes a new, clinical services building and associated hardstand and landscaped areas and car park in the western portion of the Site, which corresponds to the existing car park.

Impacted fill material would be excavated and consolidated in a containment area ('borrow pit) below the building footprint or hardstand (Option 2) as required or be covered in place by a suitable barrier (hardstand, landscaping) (Option 3). These would act as the primary control for the elimination of exposure pathways to environmental receptors and will mitigate the potential risks associated with the contaminated fill material.

Excavation and off-site disposal (Option 1) is considered an acceptable contingency or supplementary option in the event that the preferred strategy cannot be applied.

The Site will be considered to be adequately remediated once the contaminated material is consolidated and isolated (or appropriately disposed offsite) and the final barrier layer(s) are constructed (i.e. building footprints, hardstand surfaces or landscaping.

It is considered that the Site can be made suitable for the proposed development by successful implementation of the remediation measures and validation measures described in the RAP.

At the completion of the remediation process a Long-Term Environmental Management Plan (LTEMP) must be prepared by an appropriately experienced and accredited contaminated land consultant. The LTEMP will provide a summary of the remedial works and residual contamination as well as guidance for the management of the isolated impacted material during the lifetime of the Site.

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ACRONYMS/ABBREVIATIONS

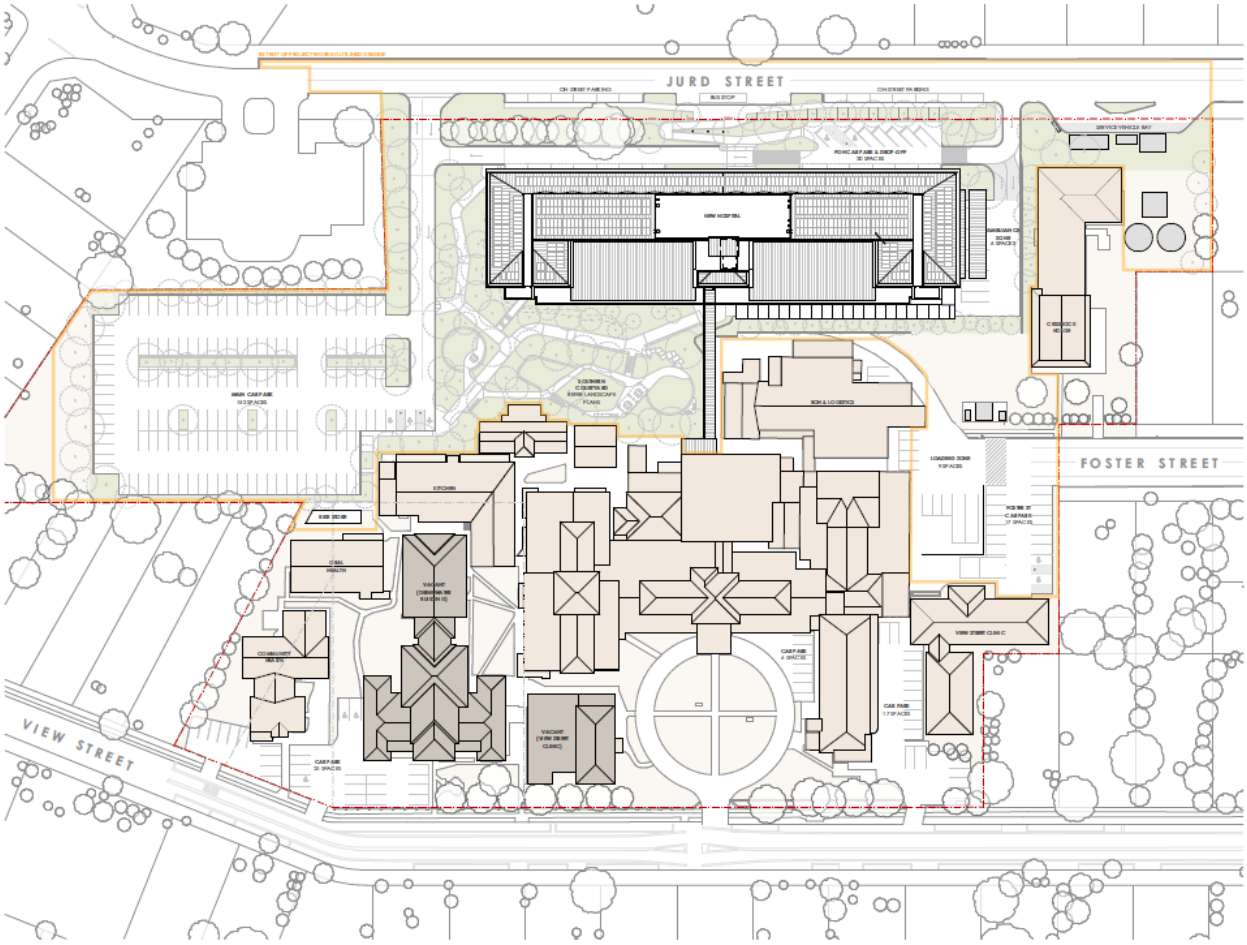
Acronyms/Abbreviations	Definition
ACM	Asbestos Containing Material
AEC	Areas of Environmental Concern
AHD	Australian Height Datum
AHIP	Aboriginal Heritage Impact Permit
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
BGL	Below Ground Level
BTEX	Benzene Toluene Ethylbenzene and Xylene
CLMP	Contaminated Land Management Plan
CN	City of Newcastle
COPC	Chemicals/Contaminants of Potential Concern
CSM	Conceptual Site Model
DECC	Department of Environment and Climate Change
DNAPL	Dense Non-Aqueous Phase Liquid
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
ESL	Ecological Screening Level
HIL	Health Investigation Level
HCCD	Honeysuckle City Campus Development
HDPE	High-Density Polyethylene
HSE	Health, Safety and Environmental
HSSE	Health, Safety, Security and Environmental
HSL	Health Screening Level
LNAPL	Light Non-Aqueous Phase Liquid
LTEMP	Long-Term Environmental Management Plan
NEPC	National Environment Planning Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
NSW	New South Wales

NSW EPA	New South Wales Environmental Protection Authority
NSW Health	NSW Health Administration Corporation
PAH	Polycyclic Aromatic Hydrocarbon
PSI	Preliminary Site Investigation
QA	Quality Assurance
QC	Quality Control
RAP	Remediation Action Plan
SAC	Site Assessment Criteria
SEPP	State Environmental Protection Policy
SWMS	Safe Work Method Statement
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbon
UCL	Upper Confidence Limit
UFP	Unexpected Finds Protocol
VENM	Virgin Excavated Natural Material

1. INTRODUCTION

Tetra Tech Coffey Pty Ltd (Tetra Tech) was engaged by Turner & Townsend Pty Ltd (Turner Townsend) on behalf of NSW Health Infrastructure to prepare a Remediation Action Plan (RAP) to support the proposed redevelopment at Cessnock Hospital, located at 24 View Street, Cessnock New South Wales (NSW) 2325 within part of Lot 2 DP1173784 and part of Lot 11 SP 882585 (the Site). Refer to Figure 1 of Appendix A for the Site locality plan. The proposed redevelopment concept is for a new, clinical services building on the northern portion of the Site (Figure 1-1, within the orange outline). A site plan is presented in Figure 2 of Appendix A.

Figure 1-1: Proposed Cessnock Hospital Redevelopment Concept Design



1.1 BACKGROUND

Tetra Tech previously completed a preliminary site investigation (PSI) with limited sampling *('Preliminary Site Investigation (Limited Sampling), Proposed Redevelopment of Cessnock Hospital'* 24 View St, Cessnock NSW 2325, 9 July 2024 (Tetra Tech report reference: 754-NTLEN347071 R01) (Tetra Tech 2024a). The potential risk of contamination to human health for the current and ongoing land uses was assessed as low to moderate and the potential risk to ecological receptors as low based on the findings of the PSI. However, data gaps were identified related to suspected asbestos in fill and reported polyaromatic hydrocarbon (PAH) and petroleum hydrocarbon (as TRH) impacts in the vicinity of the incinerator and workshop buildings and potential TRH impacts associated with the hydraulic hoist in the yard maintenance shed.

Tetra Tech subsequently completed a Detailed Site Investigation (DSI) (*Detailed Site Investigation, Proposed Redevelopment of Cessnock Hospital'* 24 View St, Cessnock NSW 2325, 11 October 2024 (Tetra Tech report

reference: 754-NTLEN347071 R02 Rev 1) (Tetra Tech 2024b) including additional assessment of soil to meet the sampling density requirements of NSW EPA contaminated land guidelines and close out the identified data gaps pertaining to chemical characterisation of soils / asbestos on-site and installation and sampling of a groundwater monitoring well downgradient of the yard maintenance shed to assess groundwater.

Fill soil was observed to be present across the site during the PSI and encountered to depths between approximately 0.5 and 1.6m above natural ground during the PSI and DSI investigations. A fill mound present in the grassed area behind (northwest of) the workshops and yard maintenance shed, sloped downward to the north, and the depth of the fill mound was observed to decrease to the west. A fill mound was also observed behind the pathology building and also sloped downward to the north. The fill was observed to include anthropogenic materials such as plastic, tile, brick, nails and bonded asbestos containing material (ACM). ACM was observed in the surface soils and would not meet the HSL requirement for no visible forms of asbestos (applicable to the top 10cm of soil). The potential for asbestos debris also exists beneath the footprints of these buildings.

Soil analytical results reported individual exceedances of ecological assessment criteria for Zinc, TRH F2 ($>C_{10}$-C_{16}) and TRH F3 ($>C_{16}$ - C_{34}) and human health criterion for carcinogenic PAHs (reported as benzo(a)pyrene TEQ). No contaminant with individual exceedances of criterion reported 95% $UCL_{AVERAGE}$ above criterion. Two samples for Zinc were above EIL criteria (BH2A_1.0-1.1 adjacent the yard maintenance shed and BH4A_0.1-0.2 near the former incinerator), however additional samples analysed from the boreholes were below EIL criteria. Carcinogenic PAHs were reported above 250% of the HIL criterion in a duplicate sample (QC1A) collected immediately below the asphalt (0.1-0.2m) in front of the former incinerator. The reported concentration likely reflected influence from traces of asphalt in the QC analysed sample. The concentration reported in the sample from lower in the borehole (1.0-1.1m) was below criterion.

Based on the in-situ investigation, the historical fill soil was assessed with a preliminary classification of General Solid Waste should it be required to be managed offsite, except for fill mounds in the grassed area where ACM impact was reported which was classified as Special Waste –Asbestos (otherwise managed as General Solid Waste).

Groundwater was encountered at greater than 6mbgl and the concentrations of potential organic contaminants were below the laboratory limit of reporting (LOR). Arsenic and Copper were detected at the LOR and Nickel and Zinc were reported at 15 and 60 µg/L respectively, above the freshwater ANZG Freshwater Water 95% protection level.

Exceedances of assessment criteria for the site were isolated and considered to be generally related to uncontrolled fill and buried waste materials. The potential risk of contamination to human health and ecological receptors for the current and proposed ongoing land uses arising from chemical contaminants of concern has been assessed as low based on the findings of the PSI and this DSI. However, asbestos in the form of bonded ACM fragments was identified in the fill which represents a potential risk to human health, particularly maintenance and construction workers conducting excavations. Groundwater was not indicated to be impacted by top-down contamination from the site.

On the basis of these findings, Tetra Tech recommended a RAP be developed for management of bonded asbestos impacted fill in order for the Site to be made suitable for the proposed redevelopment works and the intended future use afterwards.

1.2 OBJECTIVES

The objectives of this RAP were to:

- Provide guidance for the remediation of the Site fill identified to be impacted by bonded asbestos, so that potentially unacceptable risk to human health are mitigated in light of the proposed redevelopment.
- Consider remedial options and identify a preferred remedial strategy such that the Site can be made suitable for redevelopment and the proposed future use.

These objectives would be achieved through:

- Stating the remediation and validation strategy required which if implemented can make the Site suitable for the proposed use.
- Providing suitable management options for excavated and potentially contaminated material.
- Providing guidance for the establishment of landscaping within the Site.

Outlining minimum controls necessary to complete the proposed remedial works in a manner that mitigates negative impacts upon worker health and safety (WHS) and the surrounding environment.

1.3 SCOPE OF WORKS

In preparing this RAP, Tetra Tech completed the following scope of works:

- Reviewed and summarised findings of past investigations with regards to contamination.
- Reviewed proposed development plans.
- Carried out a remedial options appraisal. Outlined a remediation/management approach to be implemented during redevelopment.
- This RAP has been developed with reference to the following legislation, industry standards, codes of practice, and guidance documents, where applicable:
  - NSW Work Health and Safety (WHS) Act 2011 (WHS Act 2011)
  - NSW WHS Regulation 2017 (WHS Regulation 2017)
  - NSW Contaminated Land Management Act 1997 (CLM Act)
  - Protection of the Environment Operations (POEO) Act 1997 (POEO Act 1997)
  - POEO (Waste) Regulation 2014 (POEO Waste Regulation 2014).
  - Chapter 4, State Environmental Planning Policy (Resilience and Hazards) 2021 (SEPP RH)
  - Cessnock Local Environmental Plan 2011
  - National Environment Protection Council, National Environment Protection (Assessment of Site
  - Contamination) Measure, 1999 (amended April 2013) (ASC NEPM 2013).
  - NSW EPA Contaminated Land Guidelines: Consultants reporting on contaminated land, 2020 (NSW EPA 2020).
  - NSW EPA Waste Classification Guidelines: Part 1 – Classifying Waste, 2014 (NSW EPA Waste Classification Guidelines 2014).
  - NSW EPA 2022, Sampling Design Part 1 – Application (SDG)
  - Western Australia Department of Health 2009, Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (WA Guidelines)

2. SITE INFORMATION

2.1 SITE IDENTIFICATION

Site identification and details including adjacent land use are summarised in Table 2-1.

Table 2-1: Summary of Site Details

Street Address	24 View Street Cessnock NSW 2325
Site Area	Approximately 1.38 hectares
Cadastre	Part of Lot 2 DP1173784 and Part of Lot 11 SP 882585
Current Zoning	SP2: Infrastructure under the Cessnock Local Environmental Plan 2011
Proposed Site Use	Continued use as a Health Services Facility
Local Government Area	Cessnock Council
Local Aboriginal Land Council	Mindaribba
Site co-ordinates (UTM56S)	345276 m E 6366667 m N (north-western corner)
Adjacent Land Use	The majority of Cessnock Hospital occupies adjacent land to the south, east and west of the Site with medium density residential properties surrounding the Hospital. A commercial property (Mountain View Lodge Hostel) is present to the north of the Site, over Jurd Street, followed by medium density residential properties beyond.

2.2 DESKTOP REVIEW

A desktop review was undertaken as part of a PSI for the Site (Tetra Tech 2024a). A summary is presented in this section.

2.2.1 Site History

Historical title search indicated the Site lots were acquired for use as a hospital in 1941 (Lot 1 and part Lot 2 DP1173784) and 1954 (part Lot 2 DP1173784 and Lot 11 DP 882585). Prior to this the Site lots were privately owned.

The Site has been used as a hospital with aerial imagery reviewed from 1963 showing the main hospital building associated clinics and main workshop buildings were present to the south of the Site. The Site was largely grassed with structures in the north-eastern and southern-central portion. Development of hospital outbuildings expanded on the Site in the 1970s and 1980s, including the incinerator building and workshops along the southern edge of the grassed aera. The current yard maintenance shed with hoist was present on the Site by 1993. Structures in the western portion of the Site were removed between 2017 and 2022 and the area is used for car parking.

Anecdotal information indicated that incinerator waste and asbestos were buried within fill materials in the grassed area of the Site.

2.2.2 Environmental Setting

Relevant information on the Site environmental setting in Tetra Tech 2024a is supplemented with information from Tetra Tech 2024b and summarised in Table 2-2.

Table 2-2: Environmental Setting Summary

Item	Discussion
Topography	The Site is situated at approximately 85 – 87m Australian Height Datum (AHD) and features a gradual slope downwards from south to north.
Geology	The Site is underlain by Permian sedimentary rock including Sandstone, siltstone and mudstone and the Greta Coal Measures
Soil Landscape	Regional soils encompassing the Site are of the Branxton soil landscape (reviewed from eSpade), mainly comprised of Yellow Podzolic Soils on midslopes with Red Podzolic Soils on crests and Yellow Soloths on lower slopes and in drainage lines.
Acid Sulfate Soils	The Site is an area of no known occurrence for acid sulfate soils.
Surface Water Hydrology	• No surface water body is present on the Site. • Rain fall runoff is expected to follow topography to the north and enter site stormwater drains • An unnamed ephemeral creek line is present across Jurd Street to the north, that appears to drain to a wetlands system approximately 470 m north of the Site.
Hydrogeology	• Groundwater was encountered beneath the Site in Sandstone at a depth of approximately 6.3 m BGL. • Regional or perched groundwater at the Site is anticipated to flow in a north-easterly direction based on the local topography and flow direction of the surrounding surface waters.
Ecology	An area along the northern boundary of the Site corresponding to the tree line was identified on the NSW Government Biodiversity Values Map as "Threatened species or communities with potential for serious and irreversible impacts". This area and was suspected to be connected to the northern ephemeral creek and wetlands system.

2.3 SITE CONDITION

During the site walkover and assessment works as part of the PSI and DSI the Site was observed to be an operational hospital. A site plan is presented in Figure 2 of Appendix A.

The Site consists of a grassed area with helicopter pad and old mortuary building in the northern portion of site. To the immediate south of the grassed area were old workshop buildings, a building which formerly housed an incinerator is now used for waste storage (in lined waste bins) and a yard maintenance shed. The yard maintenance shed contained a hoist for maintenance of ride on mowers and small amounts of chemicals (fuel, herbicides). The yard maintenance shed had only moderate staining on the concrete slab and not deterioration of the surface (cracks etc) was evident.

To the east is the pathology clinic building and in the central southern portion of the Site a workshop and services building and adjacent supply building, dangerous goods store and old bunded fuel above ground storage tank (AST). The old buildings were noted to contain hazardous materials including asbestos fibre sheeting and lead paint.

A fill mound was present in the grassed area behind the workshops, which sloped downward to the north, and the depth of the fill mound was observed to decrease to the west. A fill mound was also observed behind the pathology building and also sloped downward to the north.

Asphalt sealed roads enter the site from Jurd Street and Foster Street and run through the centre of the Site. A large asphalt sealed car park area is present in the southwestern portion of Site.

To the south of the Site is the main hospital building and auxiliary buildings.

2.4 PREVIOUS REPORTS

The following previous contamination reports were available for review for this RAP. Assessment sample locations are presented in Figure 3 of Appendix A.

- '*Preliminary Site Investigation with limited sampling. Proposed Redevelopment of Cessnock Hospital*'. 24 View St, Cessnock NSW 2325, 9 July 2024 (Tetra Tech report reference: 754-NTLEN347071 R01)).
- '*Detailed Site Investigation. Proposed Redevelopment of Cessnock Hospital*'. 24 View St, Cessnock NSW 2325, 11 October 2024 (Tetra Tech report reference: 754-NTLEN347071-2 R02 Rev1)).
- 'Asbestos and Hazardous Materials Pre-Demolition Assessment', Cessnock Hospital, 24 View Street, 23 August 2024) Tetra Tech report reference: 754-NTLEN347071-1 R01)

2.4.1 Tetra Tech 2024a Preliminary Site Investigation

The primary objective of the PSI was to assess the Site with respect to potential contamination, in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines and legislation.

The objectives of the PSI included:

- Examine potential contamination from previous land uses, identifying known or possible sources and contaminants of concern.
- Assess potential risks to human and ecological health based on current and proposed land use.
- Provide recommendations for further investigation, remediation, and management if needed.

Determine if the Site is suitable for continued use as a Health Facility, considering the planned redevelopment.

The activities undertaken for the PSI included:

- A desktop review of:
    - Site environmental setting
    - A search of NSW EPA regulatory databases under the Contaminated Land Management Act 1997 or the Protection of the Environment Operations (POEO) Act 1997 for the Site and nearby properties.
    - Historical aerial photographs for the Site and surrounds.
    - Section 10.7 ((2) and (5)) planning certificate.
    - Safework NSW Schedule 11 Hazardous chemicals on premises search.
    - Historical land titles for the Site.
- A site walkover to observe site conditions and visually inspect evidence of potential contamination.
- Anecdotal evidence of potential historical contamination from the Site facilities manager
- The intrusive fieldworks comprising:
    - Boreholes advanced using solid-flight augers on a track-mounted mini loader, at 19 locations and hand auger at one location (BH01) to a maximum depth of about 1.5 metres.
    - Screening soil for volatile organic compounds (VOCs) using a photo-ionisation detector (PID).
    - Soil sampling from both fill and natural soil profiles,
    - Submission of samples to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of identified contaminants of potential concern (COPCs): Total recoverable hydrocarbons (TRH), Benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN) Polycyclic aromatic hydrocarbons (PAHs), Metals (arsenic, cadmium, chromium, copper, lead, nickel and zinc), Polychlorinated biphenyls (PCBs), Organochlorine pesticides (OCPs) and organophosphate pesticides (OPPs), Asbestos.

- Preparation of a PSI report documenting the findings of the scope of work including Development of a risk-based preliminary Conceptual Site Model (CSM), assessment of analytical results, and conclusion and recommendations based on the findings.

Analytical results from soil samples for COPCs were assessed against the adopted (commercial/industrial) site criteria from Schedule B1 in the ASC NEPM 2013

Key results reported were:

- The identification of asbestos fragments in fill material from two boreholes (BH06 and BH09)
- TRH was detected in samples collected from within the carpark at the Site.
  - The concentration of TRH F3 (C_{16} - C_{34}) in the BH13 sample from a depth of 0.0-0.2 mBGL of 3,000 mg/kg exceeded the adopted ESL criteria.
  - The concentration of TRH F2 C_{10} - C_{16} (minus Naphthalene) in BH15 sample of 350 mg/kg from a depth of 1.0-1.2 mBGL exceeded the adopted ESL criteria.
  - The criterion exceedance was isolated to this sample in the borehole
  - .
- Carcinogenic PAHs were also reported for sample BH13_0.0-0.2 at 92 mg/kg, above the HIL (40 mg/kg). However, it was below 250% of the HIL and considered to be a localised and possibly attributed to cross-contamination of the sample by asphalt from the carpark surface.

Samples were also assessed against the NSW EPA 2014 Waste Classification Thresholds for in-situ waste classification.

- The in-situ waste classification reported exceedance of the Tier 1 CT1 thresholds for the classification of general solid waste (non-putrescible) for:
  - Benzo(a) pyrene (BH02_0.0-0.2, BH03_0.0-0.2, BH09_0.0-0.2, BH13_0.0-0.2, BH13_1.0-1.2, BH15_0.0-0.2 and BH15_1.0-1.2.)
  - Total PAHs (BH13_0.0-0.2)
  - Lead (BH09_0.0-0.2, BH13_0.0-0.2 and BH07_0.5-0.7)
  - Nickel (BH07_0.5-0.7, BH17_0.0-0.2, BH18_0.0-0.2 and BH19_0.0-0.2)
- The samples with the highest reported concentrations of these contaminants were analysed for leachability (Toxicity Characteristic Leaching Procedure (TCLP) preparation) to assess the samples against the Tier 2 thresholds (SCC1 and TCLP1). The TCLP1 and SCC1 thresholds were not exceeded.

The fill was assessed as general solid waste (non-putrescible) with the locations of BH06 and BH09 being classed as Special Waste – asbestos, otherwise general solid waste (non-putrescible).

A preliminary Conceptual Site Model (CSM) was developed using findings of the PSI (including the available soil investigation).

- The potential risk of contamination to human health for the current and ongoing land uses was assessed as low to moderate.
- For ecological receptors, the exposure pathways were assessed as potentially incomplete and the potential risk from contamination for both the current and proposed land uses, was assessed as low to moderate.

Tetra Tech recommended a Detailed Site Investigation (DSI) to address:

- Data gaps related to the quantity and quality of fill of unknown origin across the Site.
- Groundwater conditions.
- Further assessment of the extent of asbestos impact and the reported PAH and petroleum hydrocarbon (as TRH) impacts in the vicinity of the incinerator and workshop buildings at BH13 and BH15 and the hoist (potential TRH/BTEXN impacts).

On the basis of the findings of the PSI, Tetra Tech concluded that the Site could be made suitable for the proposed redevelopment by undertaking a DSI and by removal of any asbestos impacted fill/ soil during redevelopment.

2.4.2 Tetra Tech 2024b Detailed Site Investigation

The primary objective of the DSI was to characterise the Site with respect to potential soil and groundwater contamination, in accordance with the relevant NSW EPA guidelines and legislation. More specifically, the objectives of the DSI were to:

- Undertake the additional investigations recommended in the PSI.
- Confirm the preliminary in situ waste classification of the assessed soils.
- Provide an opinion on the suitability of the Site from a contamination perspective for the proposed development based on a commercial/industrial-zoned land use.
- Provide recommendations for further assessment and / or remediation and management, as required.

The activities undertaken for the DSI included:

- Fieldworks consisting of:
  - Service clearance of proposed borehole locations, drilling using solid-flight augers (200mm) at six locations to the depth of natural material underlying fill (generally <2m BGL)
  - Screening soil for volatile organic compounds (VOCs) using a photo-ionisation detector (PID).
  - Soil sampling from depth intervals in the soil profile from the fill and underlying natural material including at the surface (0-0.1 mBGL), at approximately 0.5 mBGL, 1 mBGL and 1.5 – 2.0m.
  - Quantitative NEPM asbestos sampling. Including collection of 500ml soil samples and sieving of 10 L of fill/soil through a 7 mm sieve for sample locations in the grassed area.
  - Installation of a groundwater monitoring well to depth of 8m (bgl) at a downgradient location using slotted PVC pipe (screen interval 5 – 8m bgl) with a 2-3 mm sand annulus backfill, 0.5 m bentonite plug at the top of the sand pack and finished with a flush-mounted cover.
- Preparation of a DSI report in accordance with the NSW EPA Consultants reporting on contaminated land: Contaminated land guidelines (2020) including:
  - Summary of the PSI
  - Data quality objectives, data quality indicators and quality assurance and quality control.
  - Comparison of analytical results against the relevant health and ecological criteria from the ASC NEPM 2013 and the ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.
  - An updated preliminary in situ waste classification of the assessed soils.
  - A discussion of results and an updated conceptual site model using the risk-based source-pathway-receptor model with respect to potential sources of contamination
  - A clear statement on the suitability of the Site for the proposed development and recommendations for further assessment / remedial action / management as required

The report detailed site observations during fieldworks including:

- The nature of the fill including observations of anthropogenic materials was consistent with the PSI.
- Fragments of ACM were observed in fill in BH01A (near the pathology building) and in BH5A behind the workshops. Foreign materials included plastic, tile and nails were reported in fill in BH2A adjacent the yard maintenance shed. No stains or odours were observed.
- The yard maintenance shed had only moderate localised staining on the concrete slab and deterioration of the surface (cracks etc) was not evident.

Soil analytical results were compared with the adopted assessment criteria.

- Soil analytical results reported individual exceedances of ecological assessment criteria for Zinc, TRH F2 (C10-C16) and TRH F3 (C16 - C34) and human health criteria for carcinogenic PAHs.
- No COPCs with individual exceedances of criteria reported 95% $UCL_{AVERAGE}$ above criteria.
- Two samples for Zinc were above EIL criteria (BH2A_1.0-1.1 adjacent the yard maintenance shed and BH4A_0.1-0.2 near the former incinerator), however additional samples analysed from the boreholes were below EIL criteria.
- Carcinogenic PAHs in QC1A (BH4A_0.1-0.2) was above 250% of the HIL criterion. The reported concentration likely reflected potential influence from traces of asphalt in the analysed QC sample. The concentration reported in the sample from lower in the borehole (1.0-1.1m) was below criterion.
- Based on the in-situ investigation the soil was assessed with a preliminary classification of General Solid Waste should it be required to be managed offsite, except for fill mounds in the grassed area where asbestos was reported which was classified as Special Waste –Asbestos, otherwise managed as General Solid waste.
- Groundwater was encountered at greater than 6mbgl. Concentrations of organic compounds were below the laboratory limit of reporting (LOR). Arsenic and Copper were detected at the LOR and Nickel and Zinc were reported at 15 and 60 µg/L respectively, above the freshwater ANZG Freshwater Water 95% protection level.

Conclusions and recommendation based on the DSI investigation included:

- Exceedances of assessment criteria reported for the site were isolated and considered to be generally related to uncontrolled fill and buried waste materials.
- The risk of contamination to human health and ecological receptors for the current and proposed ongoing land uses arising from chemical contaminants of concern was assessed as low. However, asbestos in the form of bonded ACM was identified in the fill which represents a potential risk to human health, particularly maintenance and construction workers conducting subsurface excavations.
- Groundwater was not indicated to be impacted by top-down contamination from the site.
- Tetra Tech concluded that the Site could be made suitable for the proposed redevelopment works of the hospital subject to management of bonded ACM impacted fill. A remediation action plan (RAP) including an unexpected finds protocol was recommended for this.

2.4.3 Tetra Tech 2024c Hazardous Materials Assessment

A hazardous materials survey was conducted across the Cessnock Hospital Precinct. With respect to the Site, the survey identified the presence of hazardous materials in the former incinerator, workshop buildings, pathology Building and old mortuary. Hazardous materials identified included asbestos fibre cement sheeting and other forms of asbestos including friable asbestos (lagging), lead based paint, PCBs (in metal capacitors and refrigerants (Hydrochlorofluorocarbon (HCFC)).

2.4.4 Data gaps

Based on findings of the previous investigations bonded ACM has been reported impacting the fill mounds in the grassed area in vicinity of the former incinerator and workshop buildings, yard maintenance shed and Pathology building. The extent to which asbestos impacts the fill mounds has not been fully delineated, and the potential exists for waste materials including asbestos in the fill below the building footprints.

3. CONCEPTUAL SITE MODEL

Contamination, if not managed appropriately could pose a potential risk to human health and/or the environment during redevelopment and future use of the Site. For an ecological or human health risk from contamination to be present, there must be a plausible linkage between the source (pollutant) and a receptor by means of a transport mechanism (pathway). This source – pathway – receptor linkage is described as a Conceptual Site Model.

3.1 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) for the Site based on the findings of the PSI and DSI and objectives of this RAP is presented in Table 3-1.

Table 3-1: Summary Conceptual Site Model for the Site

Primary Sources	Impacted Media	Pathway	Receptor	Likelihood of Source-Pathway-Receptor Linkage
Uncontrolled Fill (general)	Fill impacted by TRH, Metals, PAHs. Concentrations of contaminants below site criteria except for isolated exceedance of the ESL for F2 >C_{10} - C_{16} (minus Naphthalene) below asphalt	Ingestion of, inhalation of and dermal contact with impacted soils	Maintenance and construction workers engaged in excavation on-site (bulk earthworks or shallow trench)	Low to Moderate
			Current and future Site users during routine activity (commercial/industrial)	Low
			Environmental – on-site flora and fauna, including transitory wildlife and soil microbiota	Low
		Ingestion of and dermal contact with surface water impacted from runoff	Environmental – ecology of the ephemeral creek to the north of the Site & downgradient wetlands	Low
		Leaching of contaminants from fill into groundwater	Groundwater – beneath the site (reported in sandstone at 6.3 m BGL)	Low
Fill mounds (potentially containing buried waste) in vicinity of the former incinerator/ workshop buildings / pathology Building	Fill impacted by TRH, Metals, PAHs and Asbestos (ACM). Concentrations of carcinogenic PAHs exceeding the HSLs were reported in the vicinity of the incinerator below asphalt. Isolated exceedances of EILs for Zinc were reported below asphalt Asbestos in Fill including near surface (0-10cm)	Ingestion of, inhalation of and dermal contact with impacted soils	Maintenance and construction workers engaged in excavation on-site (bulk earthworks or shallow trench)	High
			Current and future Site users during routine activity (commercial/industrial)	Low
			Environmental – on-site flora and fauna, including transitory wildlife and soil microbiota	Low
		Ingestion of and dermal contact with surface water impacted from runoff	Environmental – ecology of the ephemeral creek to the north of the Site & downgradient wetlands	Low

		Leaching of contaminants from fill into groundwater	Groundwater – beneath the site (reported in sandstone at 6.3 m BGL)	Low
Hazardous building materials **The former incinerator/ workshop buildings / Pathology Building, old mortuary**	Soil concentrations of Lead were below assessment criteria. PCB's in soil were reported below LORs No asbestos fines / friable asbestos was detected in soils	Ingestion of, inhalation of and dermal contact with impacted soils.	Maintenance and construction workers and excavation workers on-site (shallow trench)	Negligible - no complete exposure pathway
			Site users (commercial/industrial)	Negligible - no complete exposure pathway
			Environmental – on-site flora and fauna, including transitory wildlife and soil microbiota	Negligible - no complete exposure pathway
		Ingestion of and dermal contact with surface water impacted from runoff	Environmental – ecology of the ephemeral creek to the north of the Site	Negligible - no complete exposure pathway
Yard maintenance shed and Above-ground storage tank (AST) (fuel storage)	Soil in the vicinity was not indicated to be impacted by spills or leaks based on reported concentrations of TRH, PAH, BTEX	Ingestion of, inhalation of and dermal contact with impacted soils or vapours	Maintenance and construction workers and excavation workers on-site (shallow trench)	Negligible - no complete exposure pathway
			Current and future Site users (commercial/industrial)	Negligible - no complete exposure pathway
		Ingestion of and dermal contact with surface water impacted from runoff	Environmental – on-site flora and fauna, including transitory wildlife and soil microbiota	Negligible - no complete exposure pathway
		Leaching of contaminants from fill into groundwater	Environmental – ecology of the ephemeral creek to the north of the Site & downgradient wetlands	Negligible - no complete exposure pathway
Groundwater	Reported in sandstone at 6.3 m BGL. Metals (cadmium, copper, nickel and zinc) were reported above 95% freshwater criteria	Ingestion of, and dermal contact with impacted groundwater	Maintenance and construction workers and excavation workers on-site (shallow trench)	Negligible - no complete exposure pathway
			Current and future Site users (commercial/industrial)	Negligible - no complete exposure pathway
			Environmental – ecology of the ephemeral creek approximately 20m to the north of the Site & downgradient wetlands approximately 500m to the north	Low

4. VALIDATION CRITERIA

The current zoning is SP2: Infrastructure, and the development as proposed includes the ongoing use of the Site as a hospital. Assessment criteria was selected for relevance to the future use of the Site.

The criteria presented are intended to apply as Tier 1 risk assessment criteria based on certain site-specific characteristics.

4.1.1 Soil health-based and ecological investigation levels

The soil investigation levels are adopted from the National Environmental Protection (Assessment of Site Contamination) Measure 1999 (2013), (ASC NEPM).

Schedule B1, Guideline on Investigation Levels for Soil and Groundwater, of the ASC NEPM presents health-based investigation levels for different land uses (e.g. industrial / commercial, residential, recreational etc.) as well as ecological investigation levels.

Table 4 of the ASC NEPM Schedule B7, Guideline on Derivation of Health-Based Investigation Levels, shows the exposure pathways considered for these four generic land use categories. The content is re-produced in Table 4-1.

Table 4-1: Exposure Pathways for Generic Land Use Categories

Exposure pathways	Land use scenario			
	HIL A	HIL B	HIL C	HIL D
Indoor inhalation of dust	Y	Y	N	Y
Outdoor inhalation of dust	Y	Y	Y	Y
Dermal contact with shallow soil and dust	Y	Y	Y	Y
Incidental ingestion of shallow soil and dust	Y	Y	Y	Y
Ingestion of home-grown vegetables and fruit	Y	N	N	N
Ingestion of home-grown poultry and/or eggs	N	N	N	N
Ingestion of soil adhering to home-grown produce	Y	N	N	N
Y – indicates exposure pathway has been considered in the derivation of the HILs				
N – indicates exposure pathway has not been considered in the derivation of the HILs or interim soil vapour HILs				

The proposed development will comprise the clinical services building and associated hardstand, asphalt car park over the majority of the Site and landscaped areas. The “HIL D” exposure scenarios described in Schedule B7 of the ASC NEPM has been selected as most appropriate for the proposed development considered to fall in line with the proposed land use.

Health screening levels (HSLs) have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via inhalation after vapour intrusion into indoor air and direct contact with soil and groundwater. These HSLs depend on general soil type (sand, silt and clay mixture), building configurations and land use scenarios.

Section 3.2.5.2 of Schedule B7 of the ASC NEPM states the following about the sensitive populations applicable to the HIL D criteria values:

> *“Adults of working age are the population usually most sensitive to health risks associated with soil contamination within the generic commercial/industrial land use scenario. Although many commercial*

premises welcome children on an intermittent basis, it is unlikely that children visit the majority of workplaces frequently. Similarly, in commercial premises where children are regular visitors, such as shopping centres, both the duration and frequency of child exposures are generally lower than that of a full-time adult employee.

In accordance with the recommendations outlined in enHealth (2004), the adult employees addressed in the HIL D values have been considered to work within the same commercial/industrial premises for their full working life (30 years). The HILs developed for the commercial/industrial land use scenario are not applicable to a site used frequently by more sensitive groups such as children (within childcare centres, hospitals and hotels) and the elderly (within hospitals, aged care facilities and hospices).”

4.1.2 Health Investigation/ Screening Levels HIL/ HSLs

The relevant HIL/HSL values from the ASC NEPM for Commercial/Industrial land uses for the Site is listed in Table 4-2 and Table 4-3.

Table 4-2: HILs for Applicable Land Uses

Chemical	HIL – D Commercial/ Industrial (mg/kg)
Arsenic	3,000
Cadmium	900
Chromium (VI)	3,600
Copper	240,000
Lead	1,500
Mercury	730
Nickel	6,000
Zinc	400,000
Carcinogenic PAHs, reported as Benzo(a)pyrene TEQ	40
Total PAHs	4,000

Table 4-3: Health Screening Levels for Commercial/ Industrial (HSL D) Land Use

Chemical	HSL D – Commercial/ Industrial (Sand) (mg/kg)[1]			HSL-D Direct Contact[2] (mg/kg)	HSL – Intrusive Maintenance Worker (Shallow Trench) (Sand)[3]	
	0m to <1m	1m to <2m	2m to <4m		0m to <2m	2m to <4m
Benzene	3	3	3	430	77	160
Toluene	NL	NL	NL	99,000	NL	NL
Ethylbenzene	NL	NL	NL	27,000	NL	NL
Xylenes	230	NL	NL	81,000	NL	NL
Naphthalene	NL	NL	NL	11,000	NL	NL
F1 (TRH C_6-C_{10} – BTEX)	260	370	630	-	NL	NL
TRH C_6-C_{10}	-	-	-	26,000	-	-
F2 (TRH >C_{10}-C_{16} – Naphthalene)	NL	NL	NL	-	NL	NL
TRH C_{10}-C_{16}	-	-	-	20,000	-	-
TRH C_{16}-C_{34}	-	-	-	27,000	-	-
TRH C_{34}-C_{40}	-	-	-	38,000	-	-

NL: non-limiting (i.e. contaminant is not considered to pose a risk to human health through vapour inhalation regardless of concentration).
Soil type is sandy based on observations during the DSI.
1. *Table 1A(3) – Soil Health Screening Levels for Vapour Intrusion (ASC NEPM);*
2. *Table A4 - Soil Health Screening levels for Direct Contact for commercial/ industrial (CRC CARE, 2011);*
3. *Table A3 – Soil Health Screening Levels for Vapour Intrusion (Intrusive Maintenance Worker) (CRC CARE, 2011).*

4.1.3 Asbestos

In accordance with Section 4.8 of Schedule B1 of the ASC NEPM, consideration to HSLs for asbestos have been included where laboratory analysis is completed as part of additional assessment and/ or validation sampling. HSLs for asbestos in soils assess three forms of asbestos, which include:

- Asbestos Containing Material (ACM) – material that is 'bound in a matrix such as cement or resin (e.g. asbestos fencing and vinyl tiles). This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release'.
- Fibrous Asbestos (FA) – material that 'comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling)'.
- Asbestos Fines (AF) – material that 'includes free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substantial degree of damage which increases the potential for fibre release.)'.

No visible forms of asbestos relating to 'All forms of asbestos' relate to the top 0.1m of soil.

The criteria for HSLs for asbestos in soils is presented below in Table 4-4.

Table 4-4: Summary of Asbestos Health Screening Levels

Form of Asbestos	Recreational HSL-D %w/w
Bonded ACM	0.05%
FA and AF	0.001%
All forms of asbestos	No visible asbestos for surface soil (surface to a depth of 0.1m)

ACM: Asbestos Containing Material, FA: Fibrous Asbestos, AF: Asbestos Fines; No visible forms of asbestos related to the top 0.1m of soil.

5. REMEDIATION OPTIONS ASSESSMENT

5.1 GOALS OF REMEDIATION

The goal of remedial works is to implement remediation and/or management measures to mitigate or control potentially unacceptable risks to human health from asbestos impacted fill to ensure that the site is suitable from a contamination perspective for the proposed redevelopment.

5.2 REMEDIATION HIERARCHY

The ASC NEPM (2013) provides a preferred hierarchy of options for remediation and/or management which is outlined as follows:

- On-site remediation of soil contamination so that the risk of the contamination is reduced to an acceptable level.
- Off-site remediation of soil contamination so that the risk of the contamination is reduced to an acceptable level.

If the above is not practicable, then the following would be considered:

- Containment of the contamination either in-situ to reduce the risk to an acceptable level or appropriately designed and managed facility.
- Removal of the contaminated soil to an appropriately licensed facility and replace with suitable material.
- If practicable, adopting a less sensitive land use or implement controls on site activities that will negate the need for remedial works.

5.3 REMEDIATION OPTIONS ASSESSMENT

A preliminary qualitative assessment of remediation options was undertaken to identify options that could meet remediation objectives.

Based on the information presented in the contamination assessment reports, and the likely extent of remediation required, four remediation options were considered as applicable options for implementation at the Site, each with advantages and disadvantages. These are presented in Table 5-1, including an assessment of the feasibility of implementation of the remediation option at the Site.

The appropriateness of a particular remediation option varies depending on a combination of local factors including:

- Space available on-site during remediation.
- Air quality, noise, and traffic impact on adjacent site users.
- Nature and extent of contamination.
- Geological and hydrogeological conditions.
- Type(s) of contamination, including the impacted media.
- Human health and environmental risks (both during and post development).

The selection of a preferred remedial option would consider:

- Effectiveness of remediation – the ability to meet the remedial objectives.
- Contractor experience with remedial technology/approach.
- Sustainability (environmental, economic and social)) – waste generation, cost effectiveness, stakeholder acceptance of the remedial solution etc.
- Time required to complete remediation.

- Long-term liabilities and ongoing management requirements.

Remediation may comprise implementation of one or a combination of the remedial management options described in Table 5-1.

Table 5-1: Remediation Options Assessment

Option No.	Remediation Option	Assessment	Option Feasible?
1	Excavation and off-site disposal of impacted material	Contaminated material could be removed and disposed at an appropriately licensed facility following classification as waste in accordance with NSW EPA (2014) guidelines with excavations re-instated with appropriately certified material • The advantage of this option is the potential for minimising long-term management of the land, as well as minimising restrictions on future land use following remediation and validation. It also eliminates a risk during construction, where working under asbestos controls may require more time and cost. • The disadvantages of this option include potentially significant costs associated with waste transport and disposal, potentially unnecessary use of landfill capacity and importing replacement materials.	Yes – the option is suitable to effectively manage the impacted fill material. Feasibility from a sustainability perspective will depend on volumes of material requiring disposal and proximity of a suitably licensed facility to accept the waste as classified.
2	Excavation and onsite consolidation in 'borrow pit' below building footprint or hardstand	Contaminated material could be consolidated and placed in an excavated 'borrow-pit' below the building footprint or suitable hardstand (dependent on geotechnical and design requirements), This would eliminate the exposure pathway to future site users and is a viable option where large buildings or extended areas of hardstand are proposed, for example a car park. The advantage of this option is reduced offsite waste disposal which means less potential exposure for the community and no use of community landfill resources. The potential disadvantages of this option are: • sufficiency of available hardstand cover for contaminated material. • impact on the preferred construction design. • Requirement for handling ACM impacted materials under asbestos controls. • The Site will require ongoing management of the barrier layers with the implementation of a Long-Term Environmental Management Plan (LTEMP).	Yes – This option would effectively remove the exposure pathway and represent a sustainable option
3	On site capping of impacted material	Contaminated materials could be capped in place beneath a suitable barrier. That is, the contaminated material would be isolated in place by a covering layer (e.g., hardstand pavement, landscaping and/ or asphaltic cover). The advantages are that the contaminated material would be isolated in place by a capping layer without the requirement to excavate and relocate the contaminated material. This option would also reduce the requirement of waste disposal resources.	Yes – This option would effectively remove the exposure pathway and represent a sustainable option

		The disadvantage of this option may impact the preferred construction design and that the Site will require ongoing management of the barrier layers with the implementation of a Long-Term Environmental Management Plan (LTEMP).	
4	On-site treatment by mechanical removal	May include excavation and multi-directional raking of soil, sieving and/or picking of ACM fragments/foreign material. The disadvantage of this method is that it would only address ACM and would not be suitable for AF/FA or other potential contaminants such as heavy metals or PAHs. Potentially impacted fill would remain and suitable capping (Option 3) would also be required.	No - It is expected the fill material would need to be handled as part of cut/fill for the proposed development therefore this option is not preferred
5	On-site/off-site treatment	Contaminated soil could potentially be immobilised chemically to reduce risk to receptors. The advantages are: • Treated soils could be reinstated to Site for re-use. The disadvantages are: • The duration of the remedial works due to material handling and treatment may not be suitable with the proposed re-development milestone expectations. • Costs associated with treatment (particularly for offsite treatment). The treatment facility would need to be licensed to accept ACM impacted material and asbestos controls would need to be implemented. • Not guaranteed to be successful as the suitability dependent on achieving assessment criteria such as HSLs in the NEPM. Therefore, not likely effective for ACM.	No – not considered feasible based on remediation objectives, potential costs and timeframe for implementation. Would require repeated handling of contaminated material.

5.4 PREFERRED REMEDIAL STRATEGY

The remediation options outlined in Table 5-1 were assessed in conjunction with proposed final land uses and development concept plans for the Site, which includes:

- The development of a clinical services building, hardstand areas and landscaping as part of the proposed Cessnock Hospital Redevelopment.

Factors considered during the assessment included:

- The location and volumes of impacted soils
- Management of fill that will be required for the redevelopment.

The impacted fill material is present in the fill mounds in the northern grassed area of the Site in vicinity of the former incinerator and workshop buildings and the pathology building. These areas are identified in Figure 3 of Appendix A.

Based on consideration of potential remedial options the preferred remedial strategy for the Site is a combination of Option 2 - Excavation and onsite consolidation below building footprint or hardstand areas and Option 3 - Onsite capping of material below a suitable barrier layer (e.g. building footprint, hardstand pavement, landscaping and/ or asphaltic cover). The concept plan for the redevelopment includes a new, clinical services building and associated hardstand and landscaped areas and new car park in the western portion of the Site (which corresponds to the location of the existing car park).

Impacted fill material would be excavated and consolidated in a containment area ('borrow pit) below the building footprint or hardstand areas (Option 2) as required or be covered in place by a suitable barrier (hardstand, landscaping) (Option 3). These would act as the primary control for the elimination of exposure pathways to sensitive receptors and will sufficiently manage the risks associated with the impacted fill material.

Excavation and off-site disposal (Option 1) is considered an acceptable contingency or supplementary option in the event that the preferred strategy cannot be applied due to geotechnical engineering requirements, costs of the preferred strategy or other constraints.

The Site will be considered to be adequately remediated once the contaminated material is consolidated and isolated (or appropriately disposed offsite) and the final barrier layer(s) are constructed (i.e. building footprints, hardstand surfaces or landscaping.

Following the implementation of any remedial action undertaken in accordance with this RAP the barrier layer(s) will require maintenance in accordance with an approved Long-Term Environmental Management Plan (LTEMP).

5.5 PROPOSED REMEDIAL STEPS

To optimise and achieve efficiencies in the project, remediation works should be undertaken as per the general steps listed in Table 5-2 below provides a recommended sequence of events for carrying out the remediation and validation works. Suggested mitigation measures during project stages is provided in Table 5-3.

Table 5-2: General Steps in Remediation and Validation Strategy

Step	Item	Responsible Party
1	Carry out community consultation (as required) and prepare or include in a development application to council* seeking consent to undertake Category 1 Remedial Works (SEPP R&H, Clause 4.8) and obtain approval to undertake works.	Site Owner / Representative
2	Remediation work undertaken by a suitably qualified and licensed Remediation Contractor under the supervision of a suitably qualified environmental consultant.	Environmental Consultant/Remediation Contractor
3	Validate completion of remediation and prepare a Validation Report approved by a Certified Environmental Professional – Site Contamination Specialist (CEnvP-SC) and endorsed by an NSW EPA Accredited Site Auditor (if required under planning consent).	Environmental Consultant/ Certified Environmental Professional/Site Auditor
4	Prepare a Long-Term Environmental Management Plan (LTEMP) for the Site approved by a CEnvP-SC to be endorsed by the Site Auditor (if required under planning consent).	Environmental Consultant
6	Submit Validation Report and LTEMP to council	Environmental Consultant/Council
***Remediation DA is to be lodged with Council to remediate the site prior to the REF activities commencing**		

Table 5-3: Mitigation Measures during Stages of the Project

Project Stage	Mitigation Measures	Relevant Section of Report
Design (D)	Consideration of the required remediation program including materials management and capping requirements.	Section 5.4 to 5.6
Construction	Preparation and implementation of site-specific Work Health and Safety (WHS), and Construction Environmental Management Plan (CEMP) by the remedial contractor including but not be limited to the minimum controls outlined in the RAP.	Section 8
Operation	Final barrier layers (building footprint, hardstand surfaces (including car parks) and landscaped areas implemented as part of remediation must be managed under an approved Long-Term Environmental Management Plan (LTEMP) for the site. Should an area be changed/altered in the future, the reinstatement requirements included in the LTEMP will be in accordance with the requirements of this RAP.	Section 5

5.6 REMEDIAL APPROACH

The approach will see that impacted material is isolated at the Site beneath engineered capping surfaces comprising hardstand and/or landscaping. This includes excavation and consolidation of impacted fill material as required for the redevelopment in an excavated 'borrow pit' beneath the footprint of new clinical services building or other hardstand. Impacted material which is not excavated and consolidated would be managed under a suitable capping surface as part of hardstand, asphalt and/or landscaping.

Material which can't be accommodated as per the above would be managed by excavation and disposal in accordance with the NSW EPA 2014 Waste Classification guidelines after appropriate assessment of the excavated stockpile.

The following steps below outline the remediation work which will be required for successful remediation of the Site

1. Engagement of an experienced, suitably qualified and licensed Remediation Contractor.
    a. A site-specific Work Health and Safety (WHS), and Construction Environmental Management Plan (CEMP) must be prepared by the remedial contractor and include, but not be limited to the minimum controls outlined in Section 8.
2. Preparation of the Site including removal of any existing surface infrastructure, vegetation and foreign materials from the surface as required and disposal of same.
    a. Removal of existing asphalt pavement as required for the proposed design. The asphalt pavement should be removed and stockpiled separately from underlying basecourse and subgrade fill. Handling and tracking of excavated material should be undertaken as detailed in Section 5.6.1
    b. For disposal purposes, asphalt pavement (and basecourse containing asphalt) is preclassified as General Solid Waste under the NSW EPA (2014) Waste Classification Guidelines. Asphalt not containing coal tar or asbestos may be suitable for reuse under the NSW EPA reclaimed asphalt pavement order 2014. Subgrade fill would require classification under the NSW EPA (2014) Waste Classification Guidelines or may meet the requirements of NSW EPA Excavated Natural Material Order 2014 for off-site reuse as construction fill.
3. Completion of required site levelling and cut to fill activities including preparation of the 'borrowpit' to accommodate required volume of fill material for consolidation and isolation.
    a. Excavated material should be handled and tracked as detailed in Section 5.6.1. Fill soils should be segregated from any underlying natural soils excavated. Fill material impacted by asbestos or containing carcinogenic PAHs (identified in Figure 3, Appendix A) should be

excavated and segregated from to other site won material for backfilling and containment in the borrow-pit.

   b. The ‘borrow pit’ is to be excavated into the natural soil below the building footprint of the new clinical services building for containment of impacted fill. The borrow pit should be placed so that it will not be disturbed by the by the placement of supports for the foundation slab (suspended ground slab). Survey should be completed of the constructed borrow pit location and dimensions (including depth below surface).
   c. During excavation of the ‘borrow pit’ natural soil underling the fill should be segregated. The natural soil is to be beneficially reused as part of the western car park.
   d. Undertake excavation of impacted fill to the depth of natural soil. Impacted fill to be backfilled into the ‘borrow pit’ and compacted as specified for final levels of the design.
   e. The ‘borrow pit’ excavation is to be covered with a geotextile marker with survey completed of the final level.
   f. Excavated material which has not been consolidated or retained for beneficial reuse on-site should be classified in accordance with the NSW EPA Waste Classification Guidelines 2014 and disposed to an appropriately licensed facility or may be assessed against the NSW EPA Excavated Natural Material Order 2014 to enable beneficial reuse offsite.

4. Construction of the final barrier layers including building, hardstand pavements. The foundation slab of the constructed clinical services building will serve to sufficiently isolate the consolidated impacted soils and eliminate the exposure pathway to future site users. Standard concrete or asphalt pavements/surfaces or landscaping will provide sufficient coverage to eliminate the exposure pathways to future site users to impacted soils remaining in place.
5. Trenches excavated for installation of services should be backfilled with VENM or ENM materials as per Section 5.3.
   a. Where trenches are required to be excavated within impacted fill for services installation, a geotextile marker layer should be placed at the base and walls of the trench before backfilling with VENM or ENM materials. Excavated material from formation of the services trench would need to be managed according to its classification (see Section 5.6.1)
6. Landscaping proposed in residual impacted areas will require the installation of a high visibility geotextile marker layer on the surface of the impacted material and a minimum 300mm of imported landscaping material place above it. The marker layer must be high visibility yellow or orange, similar to colours used for safety equipment.
   a. The typical geotextile specifications are included in Table 5-4.
   b. Importation of clean capping material including topsoil or other appropriate VENM or ENM classified growth media (as per Section 7.3) for placement above the marker layer.
   c. Special provisions apply for deeper rooted trees to be established below this layer. Following removal of existing soil a geotextile marker should be placed at the base and walls of the excavation before backfilling with a suitable growth media comprising clean imported growth media, VENM or ENM as appropriate (as per Section 7.3).
   d. Survey of these areas should be completed to identify the location and reduced level (RL) of existing/ modified Site levels (ie area, level of marker layer and final level of landscaping) for maintenance and/ or redevelopment activities.
7. The final barrier layers including foundation surface levels and area covered by buildings, hardstand and landscaping are to be surveyed and included in the Works as Executed documentation in the final validation report following the completion of any remedial activity.
8. Final barrier layers (building footprint, hardstand surfaces (including car parks) and landscaped areas must be managed under the approved LTEMP. Should an area be changed/altered in the future, the reinstatement requirements included in the LTEMP will be in accordance with the requirements of this RAP.

Table 5-4: General High-Visibility Geotextile Specifications

Property	Test Method	Unit	Typical Value
Typical Mass	AS3706.1	g/m^2	140
Grab Tensile	AS3706.2B	N	400 - 500
Pore Size	AS3706.7	mm	0.12 - 0.2
Flow Rate	AS3706.9	$l/m^2/s$	150 - 300

5.6.1 Methodology for Classification, Excavation and Placement of Material

As detailed within Section 5.4, the preferred option for the remediation of contaminated fill at the Site involves onsite consolidation and isolation beneath barrier and capping layers The Remedial Approach discussed in Section 5.6, describes the general methodology for the progression of the remediation to be executed.

Excavation, stockpiling and backfilling should be undertaken under the guidance of a suitably qualified environmental scientist to ensure works are completed and validated in accordance with this RAP. Material tracking and classification should be recorded by the consultant including identification of the source area, volumes, temporary stockpile location and refence number assigned to the stockpile. Management measures for stockpiling are presented in Section 8.11. An example of a material tracking form and material classification form are presented in Appendix C.

In order to manage the movement of excavated materials, the process of material management at the Site involves the following steps:

- Material tracking – Identify the source and temporary stockpile location. The Site should be divided into grids or areas based on discussion with the Principal Contractor for the purpose of material tracking.
- Material volume – Stockpile volume should be determined by a surveyor and recorded. The stockpile volume may be estimated in the field where formal survey is not able to be completed for practical reasons.
- Material classification (via visual inspection and soil sample collection as required by a suitably qualified environmental scientist as per Section 5.6.1).
- Material receives classification:
    - Level A - Beneficial Reuse Onsite – Where material is visually and analytically assessed to be suitable for re-use above the barrier and/ or capping layer based on the proposed land use.
    - Level B -Below capping – Material which does not meet the beneficial re-use criteria may be selected to be placed below a barrier and/ or capping layer.
    - Level C -Off-site Disposal/Reuse – Where material is assessed to be unacceptable and cannot be managed below a barrier and/ or capping layer, is surplus to works, would be selected to be classified for off-site disposal or beneficial reuse (such as VENM or ENM as applicable).
- The Site Superintendent/ Principal Contractor to reinstate classified site-won spoil either above or below the barrier or capping layer as required. A survey of the backfilled material below a barrier and/ or capping layer will be required as per Section 7.5.1.
- The Site Superintendent/ Principal Contractor to organise for off-site disposal in accordance with Item 3f in Section 5.6 to a landfill site licensed to receive classified waste.
    - The volume and type of waste material to be recorded and records of disposal maintained.
    - Classified waste is to be transported to an appropriately licensed facility. In some cases (i.e. disposal of special (asbestos) waste), disposal approval may be required from the landfill prior to transportation.
- The final placement of classified stockpiles should be recorded by the consultant. Records of material imported to and disposed off-site from the Site should be provided by the Site Superintendent/ Principal Contractor to the consultant.

Unexpected finds encountered during excavation should be managed in accordance with Section 10 of this RAP under the guidance of a suitably qualified environmental consultant. An unexpected find is defined as any unanticipated potential contaminant discoveries not identified during previous assessments.

Specifically, unexpected finds will include but not be limited to:

- Contaminated materials (including lead slag and ash).
- Buried infrastructure (e.g. underground storage tanks, pipes, footings).
- LNAPL (Light Non-Aqueous Phase Liquid)/DNAPL (Dense Non-Aqueous Phase Liquid) contamination.
- Asbestos, including the presence of significant aggregates of friable asbestos materials (visible) as ACM and or material with the potential to be Asbestos Fines/ Friable Asbestos (AF/FA) impacted material (e.g. weathered fibrous cement sheet fragments, pipe lagging, insulation etc.).
- Potential acid sulphate soils.
- Human skeletal remains

5.6.2 Material Classification for Off-site Disposal or Beneficial Reuse

Sampling quantities and locations to confirm waste classification/ reuse should be undertaken as per the guidance from the NSW EPA (2022) *Sampling Design -Part 1 Application (SDG)* and summarised below in Table 5-4, Table 5-5 and Table 5-6.

With respect to asbestos, sampling numbers and locations outlined in the tables below should be doubled in accordance with Table 4 of the WA DoH (2021) *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites*.

Table 5-5: Minimum number of samples for stockpiles 200m^3 or less

Soil Volume m^3	No of Samples
< 75	3
75 – <100	4
100 – <125	5
125 – <150	6
150 – <175	7
175 – <200	8

For sample volumes > 200m^3 a sampling rate reduction can be applied subject to a comparison of the 95%UCL$_{AVERAGE}$ of the soil as per Table 4 of the SDG. The applicable sampling rate is dependent on the heterogeneity of the material being assessed. The sampling rates applicable to generally homogeneous material in excess of 200m^3 is included in **Table 5-5**.

Table 5-6: Minimum number of samples for soil volumes greater than 200m^3

Soil Volume m^3	Minimum Number of Samples 95%UCL$_{AVERAGE}$
>200 to 2,500	10
3000	12 (1:250)
4000	16 (1:250)
4500	18 (1:250)
5000	20 (1:250)
>5000	1:250

Sampling rates and in the event that additional in-situ assessment is required, the minimum number of sampling locations required are outlined in Table 5-6.

Table 5-7: Minimum Number of Sampling Locations for In-Situ Sampling (for area of up to 0.5 ha)

Size of Site (ha)	Minimum Number of Sampling Locations	Grid Size (m)	Diameter of the Hotspot that can be Detected with 95% Confidence (m)
0.05	8	8	9.3
0.1	8	11	13.2
0.2	8	16	18.7
0.3	9	18	21.5
0.4	11	19	22.5
0.5	13	20	23.1

Table 5-8: Sampling for On-site reuse and Offsite Disposal

Item	Validation Sampling Frequency	Analytical Suite
NSW EPA General or Specific Resource Recovery Exemption/Order	As per Resource Recovery Order/Exemption requirements Refer to Table 1, Table 2 and Table 3 of the NSW EPA (2014) The Excavated Natural Material Order (ENM Order 2014) Refer to Section 4.2 of the NSW EPA (2014) The Recovered Aggregate Order (Recovered Aggregate Order 2014) Relevant sampling requirements for other Resource Recovery Orders will be required based on the material type.	• Analysis required in line with each specific Resource Recovery Order/Exemption. • Supplier documentation as included in the resource recovery exemption to be reviewed by Tetra Tech prior to arriving on site. • The analytical suite for ENM is provided in Table 4 of the ENM Order (2014). • The analytical suite for Recovered Aggregate is provided within Table 1 of the Recovered Aggregate Order (2014). • The required analytical suite for any other Resource Recover Order will be required based on the type of material and proposed use.
Site won fill material/ natural soils validated as suitable to be retained within Site as capping material.	As per Table 6-5 and Table 6-7 derived from the NSW EPA (2022) *Sampling Design: Part 1 Application*.	List of analytes and relevant criteria are included Section 4.
Impacted Fill material for Offsite disposal	Sampling in accordance with Table 5-4, Table 5-5, Table 5-6 derived from the NSW EPA (2022) Sampling Design: Part 1 Application.	As determined by the nature of the impact

5.6.3 Laboratory Analysis for Stockpile Disposal to Landfill or Consideration of Onsite Reuse

Where required, the stockpile waste classification / assessment samples will be dispatched to a NATA-accredited laboratory for analysis. Each sample will be analysed for the following suite of contaminants:

- Heavy Metals
- TRH
- BTEXN

- PAH
- Asbestos (Presence/Absence) for material classification or quantitative for consideration for onsite reuse (material sourced from non-asbestos impacted sections of the Site).

For material sourced from asbestos impacted sections of the Site (fill mounds), samples must be assessed quantitatively in accordance with the requirements in Table 8 of the current WA DOH Guidelines for reuse above capping.

In addition, for waste classification selected samples may be analysed for leachability using the Toxicity Characteristic Leaching Procedure (TCLP), based on the initial results.

6. DATA QUALITY OBJECTIVES

The DQO process is a seven-step iterative planning approach used to plan for environmental data collection activities. It provides a systematic approach for defining the criteria that a data collection design should satisfy, including when, where, who and how to collect samples or measurements, determination of tolerable decision error rates and the number of samples or measurements that should be collected.

The specific DQOs for validation are summarised in Table 6-1.

Table 6-1: Data Quality Objectives

Step 1 **State the Problem**	ACM impacted fill is present in areas of the Site proposed for redevelopment. This has the potential to pose unacceptable health risk construction and maintenance workers and future site users if left unmanaged. Remediation and validation is required to render the Site suitable for the proposed development (clinical services health facility)
Step 2 **Identify the Decision**	Does residual contamination on the Site pose an unacceptable potential health-based and/or ecological risk for use as: • Health facility (land use scenario (HIL-D)), including final design including buildings, hardstand pavement, open space and landscaped areas.
Step 3 **Identify Inputs to the Decision**	The primary inputs to assessing the above include: • Data collected during the previous contamination assessments. • Relevant legislation and regulatory guidelines. • Field observations, civil design and landscaping plans and survey drawings. • Laboratory analysis of samples collected during site validation.
Step 4 **Define the Boundaries of the Study**	The investigation area is defined by the boundaries of the Site confirmed by detailed survey. The vertical boundary extends to the depth of fill (approximately 1.6mBGL).
Step 5 **Develop the Analytic Approach**	The analytical approach for soil for each chemical/ layer within soils at the Site is to assess the suitability for it proposed use, will be as follows: • Relevant population parameter to make inferences about the target populations, which include: ▪ The 95% upper confidence limit arthritic mean (95% $UCL_{AVERAGE}$) to be at or below relevant criterion[2]. ▪ If decision relies on 95% $UCL_{AVERAGE}$ concentration, then: ○ No individual sample to exceed 250% of relevant criterion. ○ The standard deviation to be <50% of relevant criterion. • To assess if the validation samples collected are suitable for intended land use, analytical action levels are to be based on validation criteria within Section 4. ▪ If soil samples exceed the validation criteria, the material will be required to be appropriately isolated or be classified in accordance with the NSW EPA (2014) Waste Classification Guidelines: Part 1 Classifying Waste off-site disposal. ▪ If the relevant statistical parameters of the sampling data exceed the adopted investigation or screening criteria in Section 5.9, then additional remedial works may be required.
Step 6 **Specify Performance or Acceptance Criteria**	Step 6 of the DQOs process establishes acceptance criteria, based on the type of problem being addressed: • The decision rule as a statistical hypothesis:

[2]Locations containing asbestos HSL exceedances to be remediated. Consideration of 95%$UCL_{AVERAGE}$ will not apply for asbestos.

	▪ The null hypothesis is that the material is contaminated and exceeds the adopted validation criteria. The alternative hypothesis is that the material is not contaminated above the adopted validation criteria. • Possible decision-making errors would mean: ▪ The material being accepted as suitable for residential land use when it is not, thereby potentially risking human or environmental health unless appropriately managed. ▪ Unnecessary disposal of the material offsite or on-site containment, imposing needless financial and resource burdens on the development project. • Acceptable limits on the likelihood of making decision errors: ▪ Null hypothesis (H_0): the 95% UCL, and other requirements, are above the action level. ▪ Alternate hypothesis (H_A): the 95% UCL, and other requirements, are at or below the action level. • Potential outcomes include Type I and Type II errors: ▪ Type I error of determining the material is acceptable for the proposed health and/ or ecological land use when it is not (wrongly rejects true H_0). ▪ Type II error of determining the material is unacceptable for the proposed health and/ or ecological land use when it is acceptable (wrongly accepts false H_0). • For performance criteria, the acceptable limits on the likelihood of making decision errors to be applied are: ▪ alpha risk (Type I error) of $\alpha = 0.05$.
Step 7: Develop the Plan for Obtaining Data	Step 7 identifies alternative sampling and analytical designs, select the resource effective sampling and analytical plan which will meet the adopted performance criteria. • The validation methodology and analytical design, with key assumptions when developing this design included: ▪ Visually assess that the marker layers are placed, and containment layers meet thickness described in this RAP. ▪ Where required, validation sampling locations assessed to in accordance with the NSW EPA (2022) *Sampling Design Guidelines Part 1 - Application*. • Sampling strategy for soil samples are appropriate and Quality Assurance/ Quality Control considerations. • Operation details and theoretical assumptions of the assessment design: ▪ Contamination impact from improper segregation or containment of contaminated filling material. ▪ Quality and properties of material at Site (e.g. homogenous). Filling and other potential contamination that may exist at the Site discernible from natural soil profiles at the Site.

6.1 DATA QUALITY INDICATORS

Data Quality Indicators (DQIs) for the project will be based on the field and laboratory considerations in Schedule B2 Appendix B, (ASC NEPM (2013)). These comprise:

- Completeness – a measure of the amount of useable data (expressed as %) from a data collection activity.
- Comparability – the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.
- Representativeness – the confidence (expressed qualitatively) that data are representative of each media present on the site.
- Precision – a quantitative measure of the variability (or reproducibility) of data; and
- Accuracy – a quantitative measure of the closeness of reported data to the true value.

Laboratory analyses will be undertaken in laboratories which are NATA accredited for the analyses undertaken. The following laboratory QA/QC analyses will be undertaken:

- Laboratory duplicates – at least one per batch
- Matrix spike – at least one per batch or approximately at 5% of analyses
- Method blank – at least one per batch or approximately at 5% of analyses
- Laboratory control samples – at least one per batch or approximately at 5% of analyses
- Surrogates – for relevant analytes
- Surrogate spikes – for relevant analytes

Specific indicators for field and laboratory QC samples are shown below in Table 6-2.

Table 6-2: Data Quality Indicators for Analytical Results

Type of Quality Control Sample	Control Limit
Duplicate Samples	Relative Percentage Difference (RPD) within 50% for soil
Triplicate Samples	RPD within 50% for soil
Spikes	Recoveries within the following ranges • 70% - 130% for inorganics / metals • 60% - 140% for organics • or as specified in laboratory's quality plan
Blanks	Analytes not detected

6.2 QUALITY ASSURANCE/ QUALITY CONTROL

The QA/QC plan is designed to achieve predetermined data quality indicators (DQIs) as indicated in Step 6 of the DQO process. The DQIs will demonstrate accuracy, precision, comparability, representativeness and completeness of the data generated.

6.2.1 Quality Assurance

Fieldwork will be undertaken by experienced and appropriately qualified environmental scientists/ engineers following written field procedures.

Field procedures should be consistent with relevant Tetra Tech Standard Operating Procedures which are based on general industry standards including:

- *National Environment Protection (Assessment of Contamination) Measure 1999 as amended 2013, Schedules B2 and B3.*
- *Australian/New Zealand Standard AS/NZS 5667.1:1998, Water quality – Sampling, Part 1 – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.*
- *WA DoH (2021) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*

6.2.2 Field Quality Control Samples

During each round of soil and groundwater sampling, the following additional quality control samples will be collected and analysed:

- Intra-laboratory duplicate samples will be collected at the rate of 5% of the number of primary samples scheduled for chemical analysis, excluding samples for asbestos analysis.
- Inter-laboratory duplicate samples will be collected at the rate of 5% of the total number of primary samples scheduled for chemical analysis, excluding samples for asbestos analysis.
- An equipment rinsate sample from decontaminating multi-use sampling equipment will be collected at the rate of one per day (when samples proposed for chemical analysis have been collected); and
- Trip blanks and trip spikes will be collected at a rate of one per day (where COPCs include volatile compounds).

6.2.3 Laboratory Quality Control Samples

Laboratory quality control will include the following:

- The laboratory analysis of samples will be undertaken by NATA accredited environmental testing laboratories.
- The NATA accredited environmental testing laboratories will implement a quality control plan conforming to Schedule B3 ‘Guideline on Laboratory Analysis of Potentially Contaminated Soils’ of the ASC NEPM.
- The laboratory will perform reagent blanks, spike samples, duplicate spikes, matrix spikes, surrogate spikes and duplicates to assess laboratory quality control.

7. VALIDATION PROGRAMME

Validation aims to confirm that the barrier and/ or capping layers have been installed and/or impacted material has been removed in accordance with the requirements of the RAP. The validation process is discussed in the sections below.

7.1 GENERAL

The validation approach to demonstrate the effectiveness of remedial works is summarised in Table 7-1.

Table 7-1: Summary of Validation Areas and Proposed Validation Method

Validation Area	Proposed Validation Method
Excavations of impacted material	Validation sampling of the base and walls of excavations of impacted materials or stockpile footprints (as required) with chemical analysis for COPC
Building footprint	Confirmation of placement of the material within the 'borrow pit' including material tracking. A survey of the constructed 'borrow pit' and final level to be provided. Construction of the barrier layer consisting of the suspended slab foundation. A survey of the foundation slab to be conducted.
Landscaped Areas	Confirmation of the placement of the geotextile marker layer and minimum 300mm of growth media including survey where impacted material has been retained. Confirmation the imported growth media in Section 7.3.1.
Pavement layers	The pavement layers will be constructed in accordance with an approved design. Complete survey of pavement area and thickness of pavement surface/ wearing course, base and sub-grade layers to be completed by a licenced surveyor to RL mAHD.
Offsite disposal	Confirmation of materials, volumes and classification taken offsite for disposal in accordance with the NSW EPA Waste Classification Guidelines 2014 or beneficial reuse such as ENM or VENM or other resource recovery order.

7.2 VALIDATION SAMPLING

The validation sampling and analysis required for remedial excavations and imported materials is presented below. Relevant ASC NEPM Soil Criteria for the proposed final land uses are listed in Table 4-2 and Table 4-3.

Sample collection will be conducted Soil sampling will be undertaken by an appropriately qualified and experienced scientist/ engineer in general accordance with:

- NSW EPA (2022) Sampling Design Part 1 – Application.
- National Environment Protection (Assessment of Contamination) Measure 1999 as amended 2013 (ASC NEPM), Schedules B1 and B2.
- Australian/New Zealand Standard AS/NZS 5667.1:1998, Water quality – Sampling, Part 1 – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.
- WA DoH (2021) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.

Specific sampling protocols are presented in Section 7.4

7.2.1 Site excavations/ trenches

Excavations and trenches within impacted fill require validation sampling at a rate of 1 sample per 25m^2 from the base and 1 sample per 10 linear metres from each soil type to a maximum depth of 2 metres for each wall.

7.2.2 Stockpile footprints

Where stockpiles are not placed on impervious material, sampling of the stockpile footprints at a rate of 1 sample per 25m^2.

7.2.3 Sampling in Asbestos Impacted Areas

In areas where asbestos contaminated fill was removed, an Asbestos Clearance certificate must be issued before validation sampling commences.

For material sourced from asbestos impacted sections of the Site (fill mounds), samples must be assessed quantitatively in accordance with the requirements in Table 8 of the current WA DOH Guidelines. In brief,10 L of fill/soil is first sieved through a 7-mm sieve or spread against a colour contrasting surface if not able to be sieved (e.g. clay) prior to collecting 500 g of sample material into a Ziplock bag that has passed through the sieve. Any asbestos material retained on the 7 mm sieve is to be placed into a separate Ziplock bag and analysed as ACM in soil.

7.2.4 Laboratory Analysis for Validation

Validation samples will be analysed for the following suite of contaminants:

- Heavy Metals
- TRH
- BTEX
- PAH
- Asbestos (quantitative)

7.3 IMPORTED FILL REQUIREMENTS

Imported material needs to be able to be applied to land and exempt from being a Scheduled Activity under the POEO Act. Imported material is also required to be suitable for the proposed development and future land use.

- Virgin Excavated Natural Material (VENM), with a written certificate and inspection of source site by the environmental consultant prior to delivery to the Site.
- Excavated Natural Material (ENM) assessed in accordance with *The Excavated Natural Material Order 2014*.
- Other materials assessed and supplied in accordance with NSW EPA resource recovery orders or resource recovery exemptions determined to be suitable for importation.
- Some commercial material or quarry product may be used (e.g. aggregate, topsoil, mulch, etc.) with prior approval from a suitably qualified environmental consultant.
- Imported topsoil, landscaping or soil growth media must be compliant with Australian Standard AS4419:2018 with relevant documentation provided by the supplier confirming compliance.

Material being imported to the Site shall also be tracked and the following information shall also be recorded:

- Origin of material.
- Material type.
- Approximate volume.
- Relevant classification documentation.
- Proposed use onsite.
- Proposed location for use.
- Observations of material and confirmation it matches approved material, with photographs of each load.

Where adequate documentation is provided to demonstrate the material is suitable for use and the source is considered unlikely to vary in quality, the environmental consultant shall complete periodic inspections to check the material is consistent with the descriptions provided in the documentation. If the material has potential for variation in quality, then the environmental consultant shall inspect each load of imported material.

If the documentation is not sufficient to demonstrate the material is suitable for use or may potentially be suitable for use pending further assessment, the environmental consultant shall collect representative samples for laboratory analysis to assess whether the material is suitable for use.

7.3.1 Imported Fill Validation Requirements

Imported materials must be subject to the validation requirements summarised in Table 7-2.

Table 7-2: Validation Requirements for Imported Materials

Materials Importation	Validation Requirements
Material proposed to be imported to site as VENM from another construction site or site that is not a licensed quarry.	• Importation as per VENM checklist completed for supplier site (inclusive of three (3) samples tested and analysed. Analytical suite to include TRH, BTEX, PAHs, phenols and heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) and other relevant COPCs (such as PFAS, OCP/OPPs) depending on the source site. • Meets the requirements for VENM under Schedule 1 of the POEO Act 1997 (is natural material, not contaminated, does not contain sulfidic ores, asbestos or other wastes • Results must also be below the relevant ASC NEPM HIL/HSL B land use criteria Documentation requirements, and the completion and retention of inspection checklists as described must be satisfied prior to importation of VENM. • Inspection of source site of VENM by environmental consultant must have satisfactory findings.
Material proposed to be imported to site as VENM being a commercial product sourced from a licensed quarry.	• No analysis required. However, evidence of the POEO quarry licence and a commercial product description must be obtained from the supplier or the NSW EPA website prior to imported material arriving on site. • Inspection of quarry operations by environmental consultant must have satisfactory findings.
Material proposed to be imported as Landscaping Soil Mix must meet the requirements of the Australian Standard (2018) AS4419:2018 Soils for Landscaping and Garden Use.	• The material should be visually assessed, sampled at a rate of 1/25m^3 and analysed according to the schedule of analytes presented in Table 7-3 and relevant documentation reviewed by Tetra Tech prior to arriving on site.
Material under NSW EPA General or Specific Resource Recovery Order.	• Analysis required in line with each specific Resource Recovery Order.

Written confirmation that the material conforms with the specific resource recovery order and exemption must be provided. Documentation must be reviewed by Tetra Tech to ensure material has been assessed in accordance with the relevant EPA order. • Refer to Table 1, Table 2 and Table 3 of the NSW EPA (2014) The Excavated Natural Material Order (ENM Order 2014) • Refer to Section 4.2 of the NSW EPA (2014) The Recovered Aggregate Order (Recovered Aggregate Order 2014) • Relevant sampling requirements for other Resource Recovery Orders will be required based on the material type.	• Supplier documentation as included in the resource recovery exemption to be reviewed by Tetra Tech prior to arriving on site.

Table 7-3 provides a summary of the laboratory analysis required to assess the suitability of imported soils.

Table 7-3 Proposed Laboratory Analysis for Imported Soil Materials

Type	Rate	Analysis
VENM	1/100 m^3 with a minimum of 3 samples per source[3]	Source dependant although may include TRH, BTEX, PAH, OCP, OPP, PCB, metals and asbestos.
ENM	As per Table 1 of the NSW EPA Excavated Natural Material Order 2014	As per Table 4 of the NSW EPA Excavated Natural Material Order 2014 (metals, electrical conductivity, pH, TRH, BTEX, PAHs, metals, foreign materials), OCP, OPP, PCB and asbestos.
Landscaping Mix including Mulch	1/25m^3 with a minimum of 3 samples per source.	Metals, OCP, OPP, PCB, Asbestos, Microorganisms

TRH: Total recoverable hydrocarbons
BTEX: Benzene, toluene, ethylbenzene and xylene
PAH: Polycyclic aromatic hydrocarbons
OCP/OPP: Organochlorine pesticides/ organophosphate pesticides
PCB: Polychlorinated biphenyls
Metals: arsenic, cadmium, chromium, lead, nickel, zinc, mercury and copper

7.3.2 Aesthetic Requirements

In addition to the quantitative criteria, soils shall not present unacceptable aesthetic impacts as described within Section 3.6 of Schedule B1 of the ASC NEPM (NEPC, 2013). Such impacts would include highly odorous or discoloured/stained soils.

7.4 VALIDATION SAMPLING PROTOCOLS

Fieldwork must be undertaken by experienced and appropriately qualified environmental scientists/engineers following written field procedures which are based on industry accepted standard practice and Schedule B2 of the ASC NEPM 2013.

- Soil samples will be collected using hand tools or from material obtained using an excavator depending on the dimensions of excavation or stockpile.
- A PID will be used to screen soil samples for the presence of volatile organic compounds (VOCs).
- Dedicated nitrile gloves to each sampling location will be used to reduce the potential for cross contamination.

[3] Rate may vary depending on volume and availability of accompanying source documentation.

- Samples will be kept chilled while in the field and in transit to the laboratory

7.4.1 Laboratory Analysis

Selected soil samples will be analysed by ISO/IEC 17025 certified laboratories with National Association of Testing Authorities (NATA) accredited methods for the analytes.

7.4.2 Sample Nomenclature

Samples collected will be given a unique sample identifier. The sample identifier will be included on all sample jars and associated paperwork including field sheets and chain of custody forms.

Sample labels will be completed in permanent ink and will include the following information:

- Project number.
- Sample identifier. The sample identifier should be related to the type of material such as VENM, ENM or other resource recovery material or an identifier related to material placement on site (grid or area reference) and sequentially numbered.
- Date of sample collection (day/month/year).
- Initials of sampler.

Quality control samples will be labelled:

- Intra-laboratory (blind) and inter-laboratory (split) duplicates: “QA” + sequence number (i.e. QA1, QA2 etc.).
- Trip blanks: “TB” + date (i.e. TB180724, TB190724 etc.).
- Trip Spikes: “TS” + date (i.e. TS180724, TS190724 etc.).
- Rinsate blanks: “RB” + date (i.e. RB180724, RB190724 etc.).

7.4.3 Sample Storage and Preservation

Samples will be placed into laboratory prepared and supplied sample containers (i.e. jars and bags) with Teflon-lined lids and preservatives, where required.

For analysis of volatiles, samples will be sealed as rapidly as possible with zero headspace where practicable, attempting to minimise volatile losses. Samples will be placed directly into an ice-cooled container on-site and transported to the laboratories under chain of custody protocol.

Samples will be submitted as soon as possible to the laboratories to prevent loss while in storage or transit and analysed within recommended holding times. The condition of samples as received by the laboratory will be recorded and reported with analytical results.

7.4.4 Sampling Equipment Decontamination Procedures

Non-disposable sampling equipment (e.g. trowel) will be decontaminated between collection of samples as follows:

- Scrub all surface of the equipment with a wire brush to remove soil and/or gross contamination.
- Scrub the equipment in a bucket filled with a solution of phosphate free detergent (Decon 90), using a brush that can reach all surfaces.
- Rinse the equipment in potable water.

7.4.5 Equipment Calibration

Equipment will be calibrated as per the manufacturer's instructions and checked daily.

The PID will be bump-tested with isobutylene gas at 0 ppm (fresh air) and 100 ppm iso-butylene in air at the commencement of each day of sampling and if necessary, during the day in accordance with the procedure provided by the supplier.

Calibration certificates and bump-test records will be retained and provided within the validation report.

7.5 VALIDATION OF BARRIER OR CAPPING

Once Site surfaces have been prepped, the Site Super Intendant/ Principal Contractor will:

- **Building Footprint** – construct the Barrier Layer, namely clinical services building footprint, hardstand surfaces or car park with asphalt cover. Services beneath this barrier must not be in contact with contaminated fill material and services trench (base and sides) should be lined with high visibility geotextile.
- **Landscaped Areas** – A geotextile marker layer will be placed on the surface of contaminated fill material within landscaped areas and be overlaid with imported a commercially available growing medium (meeting the requirements as per Section 7.3.1).
- **'Borrow Pit' Isolation Area** – The proposed isolation area will be appropriately excavated to accommodate the contaminated fill. A geotextile marker layer will be placed along the walls of the excavation and surveyed. The contaminated material will placed in the excavation, compacted and covered by geotextile and then surveyed. The barrier layer is the clinical services building ground floor slab.

Photographs will be taken during the above process to document the barrier and/ or capping layers have been appropriately completed as part of the validation of the containment area(s).

7.5.1 Site survey

In order to validate the barrier and capping layers, surfaces (existing, constructed and landscaped) will be surveyed by a Registered Surveyor. To validate the barrier and capping layers the following surveying will be required:

- A location plan with co-ordinates of boundary change points listed.

Building Footprint

- Prior to the construction of the Barrier Layers across the Site (namely building footprint, hardstand surfaces or car park with asphalt cover), Site surfaces will be surveyed for plan and elevation.
- Material imported to raise site surface levels will be surveyed once placed and compacted to design level.
- Once building footprints, hardstand surfaces and car park areas have been constructed, survey of plan and elevation.

Landscaped Areas

- A geotextile marker layer will be placed on the surface of contaminated fill material (if any) within landscaped areas and surveyed in plan and elevation.
- Once a minimum of 300mm of imported a commercial growing medium is backfilled/ placed, the finished surface will be surveyed in plan and elevation.

'Borrow Pit' Isolation Area

- Once proposed isolation area is excavated, it will be surveyed in plan and elevation.

- After the impacted material is placed and compacted and covered by a geotextile layer, it will then be surveyed in plan and elevation.

The survey information will be used in the Validation Report and EMP to define the location and thickness of remaining contaminated fill material on the site.

7.5.2 Site Observations

In addition to the site survey, regular observations (including photographic evidence) will be carried out by the environmental consultant to record the following:

- When and where the barrier and capping layers have been installed.
- Photographic evidence of the barrier layer, marker layer and material placed at the Site.
- The material used to reinstate the Site.
- Temporary stockpile areas for contaminated fill will be inspected, and photographic evidence collected to confirm that contaminated fill has been removed.
- The final landform at the completion of the construction and landscaping works.

7.6 VALIDATION REPORT

At the completion of the remedial works and validation activity, a validation report must be prepared in general accordance with NSW EPA 2020, documenting the works as completed, type and extent of residual contamination and the CSM at the end of remediation. The validation report must provide a statement as to the suitability of the Site for the intended land use.

The validation report must also include evidence of appropriate disposal of material removed from the Site (e.g. waste disposal dockets).

This report shall contain information including:

- Information demonstrating compliance with appropriate regulations and guidelines.
- Site description (post remediation).
- Survey drawings showing the location of the isolated contaminated material.
- Details of the excavation and validation works completed at the Site.
- Details of the capping layer installed across the Site.
- Details of the source, classification and suitability of all imported materials.
- Any variations to the strategy undertaken during the implementation of the remedial works.
- Details of any environmental incidents and/or unexpected or new finds of contamination occurring during the course of the remedial works and the actions undertaken in response to these incidents.
- Details on waste classification, tracking and off-site disposal (including environment protection licence (EPL) details).
- Clear statement of the suitability of the Site that is the subject of the validation report, for the proposed use.

Because residual contaminated fill material is expected to be present on the site, an LTEMP will describe ongoing management of residual contamination which poses a potentially unacceptable risk if recommended control is not maintained.

8. SITE MANAGEMENT DURING REMEDIATION

The management strategies for environmental issues that may arise during site works are discussed in the sections below. These strategies are considered a minimum requirement to be followed by the remediation contractor before and during remediation activities. It is envisaged that the remediation contractor will develop site specific environmental work plans for soil removal.

8.1 COMMUNITY CONSULTATION

A community consultation plan shall be developed and distributed by Turner Townsend / Principal Contractor in general accordance with Schedule B8 of the amended ASC NEPM. The notice shall outline:

- That remediation work to isolate asbestos impacted fill material beneath the new building footprint will be carried out at the site.
- The program of remediation work.
- That works are being conducted to control the potential health risk of existing site contamination. That works will be conducted in accordance with NSW State and national Health and safety procedures and protocols for asbestos removal and remediation of contamination.
- The contact information and processes required for obtaining additional information and registering any complaints.

8.2 SITE SPECIFIC SAFETY PLAN

- The licensed asbestos removal contractor (LARC) and Principal Contractor will be required to comply with the requirements of the WHS Act 2011 and the WHS Regulation 2011. A Site-Specific Safety Plan should be prepared including, but not be limited to:
- A review of the requirements of SafeWork NSW.
- Risk assessments.
- Safe work method statements (SWMS).
- Site Specific Safety requirements associated with the remediation works detailed in this RAP including excavation and management of asbestos impacted soil.

8.3 SITE ACCESS

Access to the site during remediation shall be controlled by the LARC and Principal Contractor, with the remedial work areas being off limits to all non-essential personnel. The public shall not have access.

Temporary site fencing and appropriate signage is to be maintained, and entry by unauthorised personnel is prohibited.

8.3.1 Traffic Management

The management and control of traffic (both vehicular and pedestrian as applicable) must be managed by the Contractor in accordance with an approved Traffic Management Plan (TMP). The TMP must be prepared as part of their Construction Environmental Management Plan developed for the remediation works. The TMP must ensure the following:

- The safety of workers, the public, vehicular traffic, sub-contractors, the client and their representatives, pedestrians and cyclists during the execution of the remediation works.
- Disturbances and delays to the smooth flow of traffic are minimised during the remediation works.

- Disruption and disturbances to nearby and surrounding businesses are kept to a minimum.
- Disruptions of residential activities are kept to a minimum.
- Control of the interactions between pedestrians and vehicles.
- Identification and control of accesses into and out of the Site.

8.4 TOOLBOX TALKS

Prior to commencing remedial works where excavation and handling of impacted soil or following change in site conditions, all relevant site personnel should participate in a toolbox talk. The toolbox talk must incorporate details and instructions on how to manage impacted soil in accordance with the RAP and these management measures. The toolbox talk can be combined with the Induction if practicable.

8.5 MATERIAL TRACKING

During construction works, the Site Superintendent / Principal Contractor will be responsible for the tracking and systematic recording of soil and fill materials that are imported to the site, and removed from the site, as per Section 5.6.1 and to provide required information to the consultant for site validation, including copies of weighbridge dockets from off-site disposal and importation of material will be retained by the Site Superintendent / Principal Contractor.

Tracking of material onsite will be according to Section 5.6.1

8.6 NOISE

- The LARC shall minimise noise emissions are controlled and limited in accordance with federal and local government statutory requirements through:
- Selection of low noise and vibration construction equipment wherever possible.
- Regular servicing of equipment.
- Use of equipment silencers/ mufflers.
- Keeping closed the panels and covers of plant.
- Switching off equipment when not in use.
- Restricting the hours of work as appropriate to the maintenance activities.
- Regularly monitoring equipment likely to be of concern.

8.7 DUST

The remediation works will involve excavation of the subsurface, movement of soils, and general vehicular movements across the Site. As such, dust generation is considered a potential environmental impact to the hospital, the surrounding environment and the public.

The following management measures should be implemented to prevent dust impacts.

- A communications and complaints register should be kept on site to ensure that concerns of local residents and workers are recorded and addressed.
- Boundary fences should be maintained around the perimeter of the Site to prevent dust from migrating laterally from these areas.
- Excavated soils should be watered as required to minimise the potential for dust generation.

- If dust migration from excavation areas is considered excessive due to high winds, the works should be delayed or limited during these periods.
- Trucks removing material from the Site must have loads covered.
- Vehicular movements entering and exiting the Site should be kept to a minimum; and Works should be limited during times of high winds.

Based on the proposed remedial strategy, stockpiling of soils is expected. The procedures detailed in Section 8.11 are to be followed to mitigate dust generation from stockpiles.

8.8 MANAGEMENT OF EARTHWORKS

Given that the proposed works will be undertaken in proximity to the general public, there is a likelihood for soil and sediments from bulk earthworks to have indirect impact. Prior to the commencement of construction and excavation works, sandbags or similar water diversion measures will be used to divert surface runoff away from construction zones and proposed excavation areas towards any existing site drainage lines or constructed basins. This will be typically established just outside of the works perimeter as the sands are highly permeable, which will in itself limit direct runoff opportunities.

Activities that involve soil disturbance will be avoided during rain periods or when heavy rain is forecast.

Excavation areas will be isolated from the surrounding site through the use of temporary barricades and fencing.

8.9 MANAGEMENT OF EXCAVATED MATERIAL

Excavated soil should be stockpiled on an impervious surface (hardstand) or a sacrificial fill layer and in areas designated by the Site Superintendent / Principal Contractor for assessment for reuse or additional waste classification. Any stockpiling of material on bare ground may require re-validation for stockpile footprints following removal of stockpiles, particularly for storage of asbestos impacted fill. Stockpiles potentially impacted by asbestos will be covered and stored separately to other materials.

8.10 HAULAGE OF SOILS

The following procedures will be followed on-site to limit the potential for transport of soil/dust off-site via vehicular movement:

- Vehicles, plant and equipment on the site at any one time will be kept to a practical minimum.
- Vehicles, plant and equipment entry to and exit from the site will be kept to a practical minimum.
- Movements within site to use defined haul roads.
- Transport of loads within the site boundaries (cut to fill activities) should minimise the generation of dust (covering or wetting down the loads).
- Plant and equipment will be washed down before it leaves the site.

The minimum requirements for transport of material from the site are:

- All material transported off-site by a licensed contractor.
- Excess dust or load material will be removed from the outside of the truck (and dog where relevant) prior to leaving the site. This may require on-site a wheel wash or spray wash to dislodge excess material. Where soil is tracked outside the site, it will be promptly cleaned up in a manner that does not adversely affect the surrounding land, surface water bodies or local stormwater system.
- Trucks will be covered prior to leaving the site and throughout travel to the disposal site.

- Trucks will enter and exit the site in predetermined points and will follow strict transport routes to and from the disposal site/s.
- Trucks will not wait in the streets surrounding the site.

8.11 STOCKPILES

The following procedures are to be followed when stockpiling:

- Excavated material which is identified or suspected of being contaminated should be separated stockpiled separately from other stockpiled soils at the Site.
- Stockpiles will be placed on hardstand or a sacrificial fill layer.
- The stockpile heights will be kept to a maximum of approximately 2m and not be placed on slopes greater than 5°.
- Active stockpiles should be regularly watered to minimise dust generation.
- Inactive stockpiles must be covered by weighted geotextile fabric, HDPE sheets or tarpaulins to prevent dust generation, erosion of stockpiled materials. The sheets will be secured by the placement of heavy objects that do not contain sharp edges to prevent them from being blown by winds.
- Erosion controls, such as hay bales and/or silt fences will be placed around the perimeter of the stockpile area to filter runoff from the stockpiles and prevent overland stormwater flow from affecting the base of the stockpiles.
- A stormwater diversion bund will be created up gradient of the stockpiles to prevent stormwater running through the stockpiles.

The additional management procedures are required for stockpiled material that contains ACM, AF/ FA are outlined in Section 8.17 below.

8.12 LICENSED WASTE DISPOSAL FACILITIES

Table 8-1: Waste Facilities and Types of Waste Accepted

Waste Facility	Address	Environmental Protection Licence	Waste Accepted
Cessnock Waste Management Centre	1967 Old Maitland Road, Cessnock New South Wales 2325	6121	Application to land: General Solid Waste, Special Waste Asbestos
Cleanaway Technical Services	Raven Street, Kooragang, NSW 2304	6124	Wastes that must be tracked, but excluding asbestos impacted soils

8.13 EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT

Erosion and sediment controls must be in place prior to the commencement of work. The nature of the erosion and sediment controls will depend on the amount of water generated by construction activity and dust suppression. Examples include sediment barriers and traps to mitigate sediment load entering the stormwater system or migrating offsite. Sediment controls (i.e. hay bales, sandbags and/or silt fencing) shall be installed surrounding stockpiles.

Surface water runoff resulting from rainfall must be managed by the Contractor in accordance with an approved Stormwater Management Plan prepared as part of their Construction Environmental Management Plan. Stormwater must be managed as per industry practice in accordance with Landcom, Managing Urban Stormwater: Soils and Construction – Volume1 (2004).

8.14 PERSONAL PROTECTION EQUIPMENT (GENERAL CONSTRUCTION DUTIES)

In order to reduce short and long-term health risks associated with the potential exposure to the contaminants of concern, the minimum level of Personal Protective Equipment (PPE) required for people, during remedial works:

- **Head Protection:** Personnel working around excavation equipment will be required to wear a hard-hat. The hard hat must be in date, worn properly and not altered in ways that would lessen the degree of protection offered.
- **Eye Protection:** Eye protection is required to prevent eye injuries resulting from contact with dust, contaminated soil or liquid. Safety glasses are required to be worn by site personnel during the works.
- **Foot Protection:** Steel toed boots without laces will be worn by on-site personnel.
- **Skin Protection:** Long sleeves and trousers are to be worn. Skin protection will be required to prevent absorption of contaminated soil into the body. Gloves will be worn by personnel involved in site activities which will come into contact with contaminated soil or liquid. Sunscreen (SPF +30) shall also be worn to protect exposed skin areas not covered by PPE from the sun.
- **Hearing Protection:** Site workers will be required to have hearing protection (ear plugs or earmuffs) on site during works. Personnel who are likely to be exposed to high noise levels on site will be required to wear hearing protection.

Site personnel will be made aware during induction and at toolbox meetings that PPE required to be worn may limit manual dexterity, hearing, visibility and may increase the difficulty of performing tasks. PPE places an additional strain on the user when performing work that requires physical activity.

PPE required while remediating and/ or managing asbestos contaminated areas, are detailed in the Table 8-2.

8.15 WORKING HOURS

Working hours would need to be consistent with Council requirements. These are considered to be in the order of 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays.

8.16 ASBESTOS CONTROL MEASURES

Given that the selected remedial strategy includes excavation of asbestos impacted fill. The required control measures to be implemented during earthworks within asbestos impacted areas that must be followed during asbestos related remedial works are summarised below in Table 8-2.

Table 8-2: Asbestos Control Measures

Task	Details
Asbestos Awareness Training	Prior to commencement of any works within asbestos impacted soil, in line with the How to Manage and Control Asbestos in the Workplace Code of Practice (SafeWork NSW 2019), all relevant site personnel must have completed asbestos awareness training such that all workers are trained to recognise potential health risks and control measures associated with asbestos. The Class A/ B Supervisor or the Licenced Asbestos Assessor may provide the asbestos awareness training on site prior to commencement of excavation of asbestos impacted soil.
Barricades and Signage	Signs and barricades must be placed to clearly demarcate where earthworks and handling of asbestos impacted soil are being performed and restrict access to personnel not involved in the works. Barricades may comprise temporary fencing with wind rated mesh/ geofabric. It is recommended that the general public cannot see into the work site due of the perceived risk of exposure, which could be exacerbated when observing workers wearing asbestos related PPE/ Respiratory Protection Equipment (RPE).

Task	Details
	Signs should be in accordance with AS 1319-1994 Safety Signs for the Occupational Environment for size, illumination, location and maintenance. The following graphic is an example of warning sign provided in SafeWork NSW How to Manage and Control Asbestos in the Workplace Code of Practice 2019.
Personal Protective Equipment (during Asbestos Disturbance Works)	Personnel onsite within the work area, will be required to wear appropriate PPE in line with WHS requirements specific to the task while working within asbestos contaminated areas. For personnel working within asbestos exclusion zones, the following PPE/ RPE additional to what was specified in Table 9.1 is mandatory: **Respiratory Protection** • A P2 disposable respirator. A half face respirator (i.e. Sundstrom SR900 Half Mask) with P3 particle filter shall be donned at the discretion of the occupation hygienist or Class A LARC. • Respirators must comply with AS/NZS1715–2009 Selection, use and maintenance of respiratory equipment. **Skin and Clothing Protection** • Type 5 Tyvek suits at the discretion of the occupation hygienist or Class B LARC. **Hand Protection** • Disposable nitrile gloves if handling soil. • Excavator operators or truck drivers may be exempt from asbestos PPE requirements within the cab if it can be shown that the excavator/ truck cabs can be sealed during works and reverse cycle air conditioning can be engaged. • Occupational protective gloves shall comply with AS/NZS 2161.2:1998 – Occupational Protective Gloves, Part 2 General Requirements.
Decontamination	Where asbestos is disturbed, decontamination facilities will be required for machinery, equipment, and workers carrying out remedial activities. Decontamination procedures shall include, but not be limited to: • Establishment of a ‘personal decontamination area’ and ’personal clean area’ adjacent to the asbestos work area using bollards, and 200 µm polythene sheeting on the ground. A trailer mounted 3 or 5 Stage Modular Decontamination Unit may be used for personal decontamination in place of a dry-decontamination area. • When entering the asbestos exclusion area: o Workers must enter the ‘Personal Clean Area’ and change into clean asbestos specific protective clothing. o Any removed personal clothing must be stored in a dust-proof container. o Move into the site. • When leaving the asbestos exclusion area: o Workers must enter the ’Personal Decontamination Area’ and: - Remove any visible asbestos dust/residue from protective clothing by wiping down with damp cloths/ wet wipes. - Place cloths/ wet wipes into heavy duty polythene asbestos waste bags (1200mm long, 900mm wide, and 200 µm thick). - Carefully remove disposable protective clothing and place into asbestos waste bags (PPE must still be worn). - Use a footbath and/ or damp cloths/ wet wipes to wipe down footwear and place cloths/ wet wipes into asbestos waste bags. - Place disposable mask into asbestos waste bags or wet wipe half face respirator. - Seal all asbestos waste bags with duct tape and place each into a second plastic bag. - Seal this second plastic bag and label/ mark as ‘Asbestos Waste’ for subsequent off-site disposal. The bags must be twisted tightly and have the neck folded over and secured with adhesive tape (referred to as goose-necking). o Move into the ‘Personal Clean Area’ and put on personal clothes.

Task	Details
	• To reduce the risk of an asbestos waste bag tearing or splitting and to assist in manual handling, asbestos waste bags should not be filled more than half full (depending on the weight of the items) and excess air should be gently evacuated from the waste bag in a way that does not cause the release of dust. • The 200 µm polythene sheeting which was placed on the ground in the personal decontamination area shall be disposed of as asbestos waste at the completion of the works. • Machinery and reusable equipment shall be decontaminated in a designated Decontamination Area using water and/ or wet rags.
Handling of Asbestos Impacted Soil	Asbestos impacted soil shall be handled in manner to minimise the potential for cross contamination of other areas of the site by: • Placing the soil directly into trucks. • Not overloading trucks. • Keeping movements of vehicles, plant and equipment to a practical minimum and maintaining low speeds during transportation. • Using designated transportation routes/ corridors between remedial areas, designated stockpile areas and final containment location. • Tracking of soil from cradle to grave by remedial contractor. • Stockpiling soil on a reasonably robust barrier (i.e. concrete, geofabric and plywood).

Stockpile Management (Asbestos Impacted)	• Stockpiles shall be established:
	  ○ Away from adjacent properties, drainage lines and water bodies. Avoid designated drains, sumps and low-lying areas subject to flooding or runoff.
	  ○ On a reasonably robust barrier (i.e. concrete) or on existing fill. If stockpiles are placed on natural/uncontaminated soil, then over-excavation is likely to be required to facilitate validation.
	• Dust suppression and erosion and sediment controls shall be in place in accordance with Section 8.11.
	• Stockpiles shall:
	  ○ Not exceed the height of site boundary hoarding to minimise dust generation from the site.
	  ○ Be less than 2m in height with side slopes to be a maximum ratio of 1V:2H.
	  ○ Be appropriately labelled to minimise the risk of cross contamination.
	  ○ Be positioned and formed to minimise potential for stockpile erosion where possible.
	At the end of each day, stockpiles shall be wetted down, covered with 200µm polythene sheeting or geofabric and secured to prevent the soil cover being removed by wind, or unauthorised persons.
	Additional controls would be required for longer-term management of stockpiles. If stockpiles are to be kept for longer-term (i.e. greater than 3 months) then this management plan shall be updated to include additional controls.
	In the event that over excavation of natural material and subsequent stockpiling is required, stockpiles should be positioned away from asbestos impacted stockpiles. Appropriate signage marking the material should be posted for each stockpile.

Asbestos Fibre Air Monitoring	Controlled monitoring using static or positional samples during excavation and handling of asbestos impacted soil is required. A suitably trained environmental scientist, occupational hygienist or LAA shall carry out air monitoring of the work area during excavation and handling of asbestos impacted soil. Where friable asbestos is assessed, a LAA is required to complete the air monitoring. Asbestos fibre air monitoring results shall be discussed at the following shift toolbox talk and presented on a site noticeboard to inform site workers of the results. Air monitoring shall be conducted by a National Association of Testing Authorities (NATA) accredited laboratory in accordance the Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC: 3003 (2005)] and Australian Standard AS ISO/IEC 17025 – 2005, General requirements

<table>
<tr><th>Task</th><th>Details</th></tr>
<tr><td></td><td>for the competence of testing and calibration laboratories. Air Monitoring Reports are required to be issued in accordance with NATA's accreditation requirements.
Works must be suspended if the air monitoring results are found to be above the detection limit of 0.01 fibres per millilitre of air (f/mL). The control limits/action levels are set out below.
<table>
<tr><th>Action Level (fibres/ ml</th><th>Control</th><th>Action</th></tr>
<tr><td><0.01</td><td>No new control measures necessary.</td><td>Continue with control Measures.</td></tr>
<tr><td rowspan="3">0.01 to ≤0.02</td><td>1 – Review.</td><td>Review control measures.</td></tr>
<tr><td>2 – Investigate.</td><td>Investigate the cause.</td></tr>
<tr><td>3 – Implement.</td><td>Implement controls to eliminate or minimise exposure and prevent further release.</td></tr>
<tr><td rowspan="5">>0.02</td><td>1 – Stop works.</td><td>Stop earthworks.</td></tr>
<tr><td>2 – Notify the regulator.</td><td>Notify the regulator (SafeWork NSW) by phone followed by written statement that the work has ceased and the provide the results of the air monitoring.</td></tr>
<tr><td>3 – Investigate the cause.</td><td>Conduct a thorough visual inspection of the Site in consultation with all workers involved.</td></tr>
<tr><td>4 – Implement controls to eliminate or minimise exposure and prevent further release.</td><td>Review the controls to eliminate or minimise exposure and prevent further release.</td></tr>
<tr><td>5 – Do not recommence any works until further air monitoring is conducted.</td><td>Do not recommence until fibre levels are ≤0.01.</td></tr>
</table></td></tr>
<tr><td>Asbestos Clearance</td><td>After the removal of asbestos impacted fill a clearance inspection should be undertaken to ensure it is free from visible asbestos. A licensed asbestos assessor or a competent person must issue a clearance certificate, confirming that the area is safe for reoccupation.</td></tr>
<tr><td>Transportation and Management of Asbestos Waste</td><td>There are regulatory requirements under Part 7 of the POEO Waste Regulation that apply to the transport and management of asbestos waste, including but not limited to:
Requirement relating to storage of waste generally.
Waste must be stored on the premises in an environmentally safe manner.
General requirements applying to transportation of asbestos waste:
Any part of any vehicle in which the person transports the waste is covered and contained (i.e. the load is covered and contained to prevent the release of asbestos to the surrounding environment during transportation).
Non-friable asbestos material must be securely packaged.
Friable asbestos material must be kept in a sealed container.
Asbestos-contaminated soil must be wetted down.
Asbestos waste must be disposed of at a landfill site that can lawfully receive this waste.
Always contact the landfill beforehand to find out whether asbestos is accepted and any requirements for delivering asbestos to the landfill:</td></tr>
</table>

Task	Details
	○ When a person delivers asbestos waste to a landfill site, the person must inform the occupier of the landfill site that the waste contains asbestos. ○ It is illegal to dispose of asbestos waste in domestic garbage bins. ○ It is also illegal to re-use, recycle or dump asbestos waste.
Reporting and Tracking of Asbestos Waste	For asbestos, the POEO (Waste) Regulation 2014 requires tracking of each load of asbestos greater than 100 kilograms, or 10 square metres within NSW. The POEO (Waste) Regulation 2014 requires the transport of asbestos in NSW to be recorded from the place of generation to its final destination using the NSW EPA's online " Integrated Waste Tracking Solution (IWTS)" system. Transporters of asbestos waste are required to fulfil their duties with regards to tracking of asbestos and asbestos contaminated soil.
Asbestos Record Keeping	During material removal and containment at the Site the following information shall be recorded (i.e. on a Materials Tracking Plan) and maintained by remedial contractor and provided to the environmental consultant at the completion of the works: • Area asbestos found. • Extent and surveyed volumes placed within the isolation area. • The environmental controls employed to mitigate health risks. • Dates where the above tasks were undertaken and completed. Where asbestos waste is selected for off-Site disposal, the Remedial Contactor will record and maintain the following and provide to the environmental consultant at the completion of the project. • Landfill dockets and Environmental Protection Licence (EPL) numbers. • Date and time of disposal. • Name and address of landfill. • Amount of waste (volume or weighed mass). • Type of waste (waste classification). • Material description. • Transport company including Truck registrations.

8.17 CONTINGENCY PLAN

Conditions that may be encountered during remedial works can be uncertain. A set of typical issues and proposed corrective actions associated with a remediation program is provided in Table 10-1.
Should an unexpected find be identified then the unexpected finds procedure in shall be followed.

Table 8-3: Contingency Plan

Potential Issues	Proposed Corrective Actions, as Appropriate	Responsible Person	Communication and Additional Assessment
Excessive dust	• Use water sprays. • Stop dust generation activity until better dust control can be achieved or apply interim capping systems on stockpiles or exposed material. • Stop work in high wind conditions.	Remedial contractor	• Breaches are to be recorded in the daily site log. • Additional assessment may be required.
Heavy rain	• Ensure sediment and surface water controls are effective.	Remedial contractor	None, unless contaminated material stockpiled rills beyond the sediment controls.

	• If possible, divert surface water away from active work areas or excavations. • Cover stockpiles.		
Equipment failures	• Maintain spare equipment or parts. • Keep rental options available or shut down affected operations until repairs are made.	Remedial contractor	Sample any impacted stockpiles, surface soils for COPCs (TRH, BTEX, PAH) and assess the appropriate management, treatment/ disposal option based on an assessment of the analytical results.
Complaints are received directly relating to the works	• Follow up with complainant to discuss identified issue • Revise management plans and identify the source of the complaint e.g. dust, noise and odours. • Increase monitoring of the source of the complaint. • Implement control measures to address the complaint (if possible).	Remedial contractor	Notify relevant Council project contact following complaint and follow incident procedure.

8.18 UNEXPECTED FINDS

an 'Unexpected find' is defined as any unanticipated potential contaminant or archaeological discovery not identified during previous assessments. An unexpected find may include:

- Contaminated materials.
- Buried infrastructure (e.g., underground storage tanks, pipes, footings).
- LNAPL/ DNAPL contamination.
- Asbestos.
- Potential acid sulphate soils.
- Aboriginal and Non-Aboriginal Heritage artefacts.
- Human skeletal remains.

If during enabling, construction works, there is any unexpected find the following applies.

- Cease Work Immediately and notify the Site Supervisor.
- Identification and classification of the find (Aboriginal/European Heritage, buried infrastructure, possible ACM, Contaminants).
- Ensure safety of workers and general public, call for Emergency Response if necessary.

A detailed protocol for management of any UFs is included within Appendix B.

9. LICENSES AND APPROVALS

This section discusses some of the regulatory compliance requirements associated with the remediation. It is important to note that this section is not exhaustive, and the Contractor must ensure they comply with all relevant and applicable legislation and guidelines.

9.1 CATEGORY 1 REMEDIATION DEVELOPMENT APPLICATION

The preferred RAP strategy includes the consolidation and isolation of impacted fill material below a barrier and capping layer consisting of building footprints, hardstand surfaces and landscaped areas.

If remediation works are not anticipated in planning approval for the hospital redevelopment, then a remediation development application is needed for the works. Under SEPP R&H (Clause 4.8) remediation work needing development consent is considered Category 1.

All approvals required to complete the works are to be obtained prior to commencing the works. Once planning approval is obtained, the Site Owner / Representative and its nominated Site Superintendent/ Principal Contractor are expected to comply with all approval conditions. The Site Superintendent/ Principal Contractor will also be responsible for obtaining all permits and/or licences required from, or by, regulatory agencies for remediation related works.

9.2 ASBESTOS RELATED LICENCES

Where asbestos handling and removal is required as part of the remedial process, a summary of the licenses required based on the asbestos form identified is as follows:

• A SafeWork NSW Class A Or Class B Licensed Asbestos Removal Contractor (LARC) would be engaged to conduct and/ or oversee friable/ bonded asbestos related removal works respectively.

• A Competent Person/ Occupational Hygienist/ LAA carries out asbestos-fibre air monitoring and visual clearances. Where AF of Friable Asbestos (FA) is identified, the asbestos air monitoring and visual clearances will be undertaken by an LAA.

9.3 REGULATOR NOTIFICATION

Where asbestos removal works are required, the LARC will be required to lodge the necessary SafeWork NSW notice of intent to remove asbestos prior to excavation (5 business days notification required). An Asbestos Removal Control Plan (ARCP) will be required to be prepared by the LARC and submitted with the notification. The ARCP must include:

- Details of the asbestos which will and may be encountered, including the location, type and condition of the asbestos; and
- Details of how the earthworks will be carried out and how asbestos impacted soil will be handled, including the method to be used and the tools, equipment and personal protective equipment to be used.

Once the ARCP is prepared, a copy must be:

- Given to the person who commissioned the licensed asbestos removal work.
- Readily accessible on-site for the duration of the licensed asbestos removal work to a person conducting a business or undertaking at the workplace.
- Made available to workers and their health and safety representatives.

The ARCP must also be made available for inspection by the regulator (SafeWork NSW) under the NSW 2011 WHS Act.

9.4 OTHER REQUIREMENTS

Other legislative requirements that may be applicable include, but are not limited to:

- *Contaminated Land Management Act 1997*
- *Environmental Planning and Assessment Act 1979*
- *Protection of the Environment Operations Act 1997 and related regulations*
- *Waste Avoidance and Resource Recovery Act 2001*

10. RESPONSIBILITIES

A summary of responsibilities in relation to implementation of the RAP is tabulated in Table 10-2.

Table 10-1: Summary of Responsibilities

Role	Contact Information	Responsibilities
Site Owner/ Representative	Turner & Townsend	• Project management and execution, Health Infrastructure authorised representative. • Preparation of development application for the proposed Category 1 Remediation works to City of Newcastle as per SEPP R&H.
Site Superintendent/ Principal Contractor	To be confirmed	• Arrange for themselves (including contractors/subcontractors) and relevant representatives to be inducted into this RAP, both now and in the future as required, by a competent environmental professional or appropriately trained alternative representative. • Ensure that this RAP is implemented and adhered to. • Provide relevant information regarding site environmental management to contractors and subcontractors working at the site. • Ensure that contractors and subcontractors undertaking works at the site are fulfilling the environmental protection/management responsibilities for the work, including holding relevant licences and permits. • Maintain records and documents produced as a result of this RAP, especially for movement of soil materials within, from and onto the site.
Contractors/ subcontractors	To be confirmed	• Liaise with the Site Superintendent/ Principal Contractor, other contractors and parties, and relevant authorities. • Ensure overall compliance with the RAP, applicable legislation and regulations for their contribution to site works. • Regular reporting of the RAP performance to the Site Superintendent / Principal Contractor.
Licensed Asbestos Contractor (LARC)	To be confirmed	• Asbestos removal and containment works.
Licensed Asbestos Assessor (LAA)	To be confirmed	• Asbestos hygiene related works (asbestos air monitoring and clearances)
Environmental Consultant	To be confirmed	• Induct the Civil Contractor into the requirements of the RAP, as required. • Provide advice to the Site Superintendent/ Principal Contractor and relevant parties regarding management of environmental issues as detailed in this RAP. • Classify Waste for offsite disposal • Address unexpected finds, as required. • Required to validate the remediation and make a conclusion on the suitability of the site for the proposed end use (s). • Undertake periodic review of the effectiveness of the RAP, and revise the RAP as required at the request of the Site Superintendent / Principal Contractor.

11. CONCLUSIONS

A remediation options assessment was undertaken for the asbestos in soil contamination identified at the Site based on the developed CSM and the proposed final land use and conceptual plan for the development of an clinical services building, hardstand areas and landscaping as part of the proposed Cessnock Hospital Redevelopment. Factors considered during the options assessment included the location and volumes of impacted soils and the management of fill that will be required as part of bulk earthworks for the redevelopment.

Based on consideration of potential remedial options the preferred remedial strategy for the Site is a combination of Option 2 - Excavation and onsite consolidation below building footprint or hardstand areas and Option 3 - Onsite capping of material below a suitable barrier layer (e.g.hardstand pavement, landscaping or similar cover). The concept plan for the redevelopment includes a new clinical services building and associated hardstand and landscaped areas and car park in the western portion of the Site, which corresponds to the existing car park.

Impacted fill material would be excavated and consolidated in a containment area ('borrow pit) below the building footprint or hardstand areas (Option 2) as required or be covered in place by a suitable barrier (hardstand, landscaping) (Option 3). These would act as the primary control for the elimination of exposure pathways to sensitive receptors and will sufficiently manage the risks associated with the impacted fill material.

Excavation and off-site disposal (Option 1) is considered an acceptable contingency or supplementary option in the event that the preferred strategy cannot be applied.

The Site will be considered to be adequately remediated once the contaminated material is consolidated and isolated (or appropriately disposed offsite) and the final barrier layer(s) are constructed (i.e. building footprints, hardstand surfaces or landscaping).

It is considered that the Site can be made suitable for the proposed development by successful implementation of the remediation measures and acceptable validation findings detailed in the RAP.

At the completion of the remediation process a Long-Term Environmental Management Plan (LTEMP) must be prepared by an appropriately experienced and accredited contaminated land consultant. The LTEMP will provide a summary of the remedial and validation works completed, the type and extent of residual contamination and the post-remediation CSM as well as guidance for the management of the isolated impacted material during the lifetime of the Site.

12. LIMITATIONS

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY ENVIRONMENTAL REPORT

Introduction

This report has been prepared by Tetra Tech Coffey for you, as Tetra Tech Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Tetra Tech Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Tetra Tech Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Tetra Tech Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Tetra Tech Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Tetra Tech Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Tetra Tech Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Tetra Tech Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Tetra Tech Coffey prepared the report and has familiarity with the site, Tetra Tech Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Tetra Tech Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

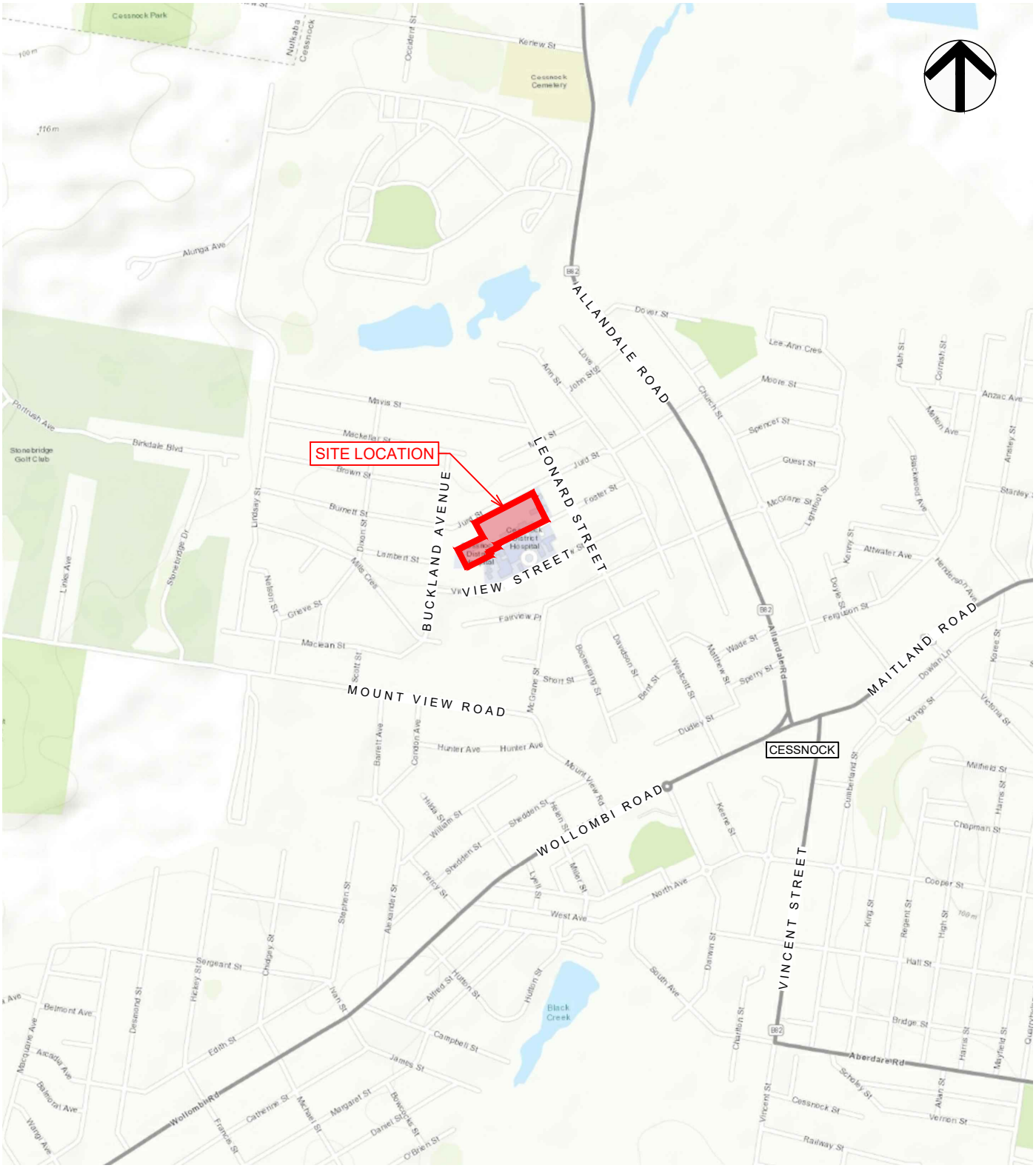
The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

APPENDIX A: FIGURES



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DRAFT

drawn	PS / DR
approved	-
date	09-10-2024
scale	AS SHOWN
original size	A4

TETRA TECH COFFEY

client: TURNER TOWNSEND

project: CESSNOCK HOSPITAL
24 VIEW STREET, CESSNOCK, NSW

title: SITE LOCATION PLAN

project no: 754-NTLEN347071-R03 | figure no: FIGURE 1 | rev: A

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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	-

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:1000

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date	09-10-2024
scale	AS SHOWN
original size	A3

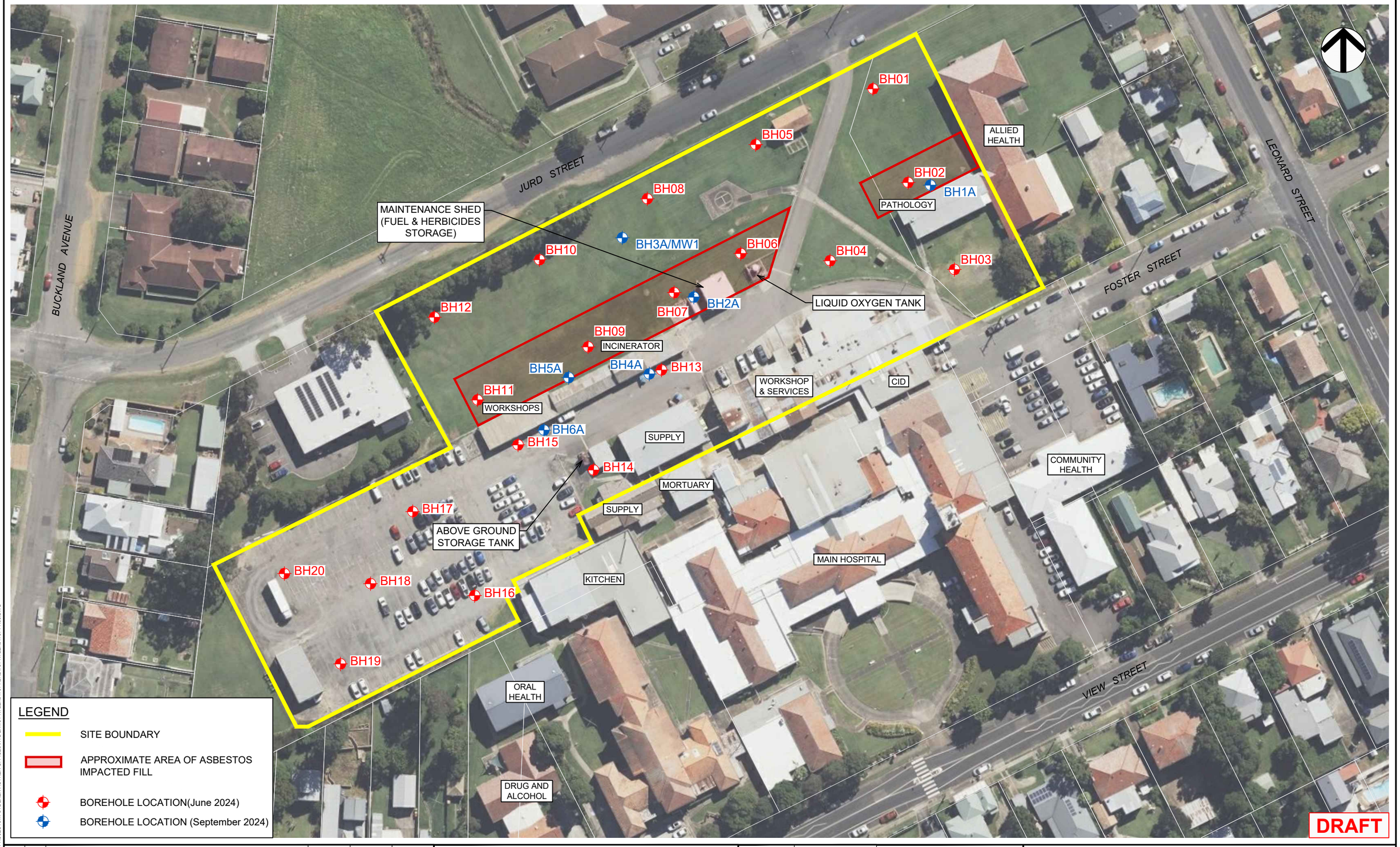
TETRA TECH COFFEY

client: TURNER TOWNSEND

project: CESSNOCK HOSPITAL
24 VIEW STREET, CESSNOCK, NSW

title: SITE LAYOUT

project no: 754-NTLEN347071-R03 | figure no: FIGURE 2 | rev: A



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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	-	-	-

MAP PROJECTION: GDA2020 MGA ZONE 56

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Scale (metres) 1:1000

drawn	PS / DR
approved	-
date	09-10-2024
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: TURNER TOWNSEND

project: CESSNOCK HOSPITAL
24 VIEW STREET, CESSNOCK, NSW

title: SOIL SAMPLING PLAN

project no: 754-NTLEN347071-R03 | figure no: FIGURE 3 | rev: A

APPENDIX B: UNEXPECTED FINDS PROTOCOL

1. Unexpected Finds Procedure

As discussed in the RAP, an unexpected find would include the but not be limited to the following:

- Contaminated materials (including black slag, ash, stained and/ or odorous soils).
- Asbestos, including the presence of significant aggregates of friable asbestos materials (visible) as ACM and or material with the potential to be Asbestos Fines/ Friable Asbestos (AF/FA) impacted material (e.g. weathered fibrous cement sheet fragments, pipe lagging, insulation etc.).
- Buried infrastructure (e.g. underground storage tanks, pipes, footings).
- LNAPL (Light Non-Aqueous Phase Liquid)/ DNAPL (Dense Non-Aqueous Phase Liquid) contamination.
- Potential acid sulphate soils.
- Human skeletal remains.

If an unexpected find is identified during earthworks, the following procedure shall be followed:

1. Cease disturbance of the affected portion of the Site.
2. Immediately implement controls if it is considered that the unexpected find may pose an immediate risk of harm to human health or the environment, and it is safe to do so.
3. Notify the relevant authorities if required (i.e. NSW EPA, SafeWork NSW).
4. Contact the Site Supervisor, Principal Contractor and the Environmental Consultant to assess the find.
5. Site Supervisor, Principal Contractor and Environmental Consultant to assess the location and extent of the unexpected find, if safe to do so.
6. Work Health and Safety (WHS) and environmental controls shall be established based on initial observations, if required. These may include but not be limited to:
    a. Controlling access by establishment of barricades and warning signs.
    b. Encapsulating with clean soil, plastic or geofabric.
    c. Establishing erosion and sediment controls
    d. Employing dust mitigation measures.
    e. Air monitoring.
7. Further visual assessment and sample collection and analysis shall be carried out by a qualified Environmental Consultant or occupational hygienist/ Licensed Asbestos Assessor (LAA), if required. If necessary, samples shall be collected and analysed at a laboratory for contaminants of potential concern using National Association of Testing Authorities (NATA) accredited methods.
8. Depending on the outcome of the assessment by the Environmental Consultant/ occupational hygienist/ LAA, the unexpected find may need to be further assessed, managed, remediated or disposed offsite in accordance with regulatory requirements.
9. A toolbox meeting shall be held by the Principal Contractor. The Environmental Consultant/ occupational hygienist/ LAA and key stakeholders shall attend the meeting to determine an appropriate course of action. This should include discussions around:
    a. The handling, treatment, remediation and disposal of material.
    b. Workplace Health and Safety considerations.
    c. How the affected area shall be validated.
10. Affected areas shall be reopened for earthworks following validation and/ or clearance of the location and issuance of a report by the Environmental Consultant/ occupational hygienist/ LAA and/ or instruction from the Principal Contractor or CER.

1.1. Visual Assessment of Unexpected Finds Material

The unexpected finds will initially be assessed in-situ for indications of contamination and then again as they are excavated and/ or moved around the Site. The visual assessments will be used to identify indicators of potential contamination, or areas of contamination not previously identified during capping investigations (i.e. buried containers, heavily impacted soils and wastes, indications of asbestos sheeting etc.). Such indicators will include:

- Soils and waste materials that exhibit a strong odour.
- Soils and waste materials that appear to be oil-stained, fibrous or have unusual colours.
- Materials that contain slag materials, are black, metalliferous or shiny.

If the unexpected find appears to contain contaminated materials, or contamination is identified through laboratory analysis, these will be stockpiled in a location separate from the other site works and further assessed, in accordance with the procedures outlined in the following sections.

1.2. Management of Potentially Contaminated Material

1.2.1. Temporary Stockpiling

The following general procedures will be followed during stockpiling of excavated potentially contaminated material:

- Potentially contaminated material will be stockpiled separately from other stockpiled soils in an isolated area of the Site.
- Access to stockpiles of potentially contaminated fill will be limited by keeping the stockpiles within the Site's fencing.
- Stockpiles will be placed on level ground with a height of no greater than 1m. Stockpiles will not be placed on slopes greater than 5°.
- Stockpiles will be placed on reasonably robust barrier (i.e. concrete, geofabric and plywood) or on existing fill. If stockpiles are placed on natural/uncontaminated soil, then over-excavation is likely to be required to facilitate validation. If this procedure is not followed there is the potential for contaminants to migrate into the surface soils.
- The stockpile heights will be kept to a maximum of approximately 2m.
- Where stockpiles are proposed to remain in a location overnight, the stockpiles will be covered by weighted HDPE sheets or tarpaulins to prevent erosion of stockpiled materials. Heavy objects not containing sharp edges will be placed on the sheets to prevent them from being blown by winds.
- Adequate hay bales and/or silt fences will be placed around the perimeter of the stockpile area to filter runoff from the stockpiles and prevent overland stormwater flow from affecting the base of the stockpiles.
- A stormwater diversion bund will be created up gradient of the stockpiles to prevent stormwater running through the stockpiles.

The stockpiles should be assessed by the Environmental Consultant, or in the event that suspected asbestos material is occupational hygienist (for non-friable asbestos) and/or LAA (for friable asbestos) in accordance with Section 1.2.3, as soon as practical, to remove the risk of stockpiling potentially contaminated materials on Site.

1.2.2. Management of Open Excavations

Excavations resulting from the removal of potentially contaminated soil will be barricaded in order to restrict access to the excavation areas. Appropriate warning signs will be placed around the excavations, in accordance with applicable regulations and codes of practice.

The excavations will remain barricaded until such time when the excavations have been validated and backfilled (where appropriate). Gas monitoring will be required whilst the excavation remain open.

The validation of excavations should be carried out by a suitably qualified environmental consultant, in accordance with Section 1.2.5, as soon as practical, to remove the risk of open excavations on Site.

1.2.3. Assessment of Potentially Contaminated Stockpiled Materials for Offsite Disposal on Onsite Reuse

Sampling of Stockpiles

To validate stockpiles for re-use on site, or to provide waste classification to allow disposal to landfill, the sampling rates included in Table 8-2 and Table 8-3 of the RAP are applicable.

- Where stockpiles are not placed on impervious material, sampling of the stockpile footprints at a rate of 1 sample per 25m^2.
- Soil samples from large stockpiles will be taken with the aid of excavators to provide representative samples of material from within the stockpiles.
- Samples will be taken from the centre of the excavator bucket in order to minimise the potential for cross-contamination.
- A clean pair of disposable gloves will be worn when collecting each sample.
- Samples will be kept chilled while in the field and in transit to the laboratory.

Laboratory Analysis

Where required, the stockpile waste classification samples will be dispatched to a NATA-accredited laboratory for analysis. Each sample will be analysed for the following suite of contaminants:

- Heavy Metals
- TRH
- BTEX
- PAH
- Asbestos (Presence/Absence) or quantitative for consideration for onsite reuse (material sourced from non-ACM impacted sections of the Site).
- For material sourced from ACM impacted sections of the Site, samples must be assessed quantitatively in accordance with the requirements of the WA Guidelines.

In addition, selected samples may be analysed for leachability using the Toxicity Characteristic Leaching Procedure (TCLP), based on the initial results.

Classified waste is to be transported to an appropriately licensed facility. In some cases (i.e. disposal of special (asbestos) waste), disposal approval may be required from the landfill prior to transportation.

1.2.4. Re-Use or Disposal of Stockpiled Soil

On-Site Re-Use of Stockpiled Soils

If the stockpiled soils are to be re-used on Site, the results of the laboratory analysis will be compared to validation criteria detailed in Section 1.2.6. If the results meet the adopted validation criteria, the material will be able to be re-used on Site. If the results exceed the adopted guidelines, the soils will either be selected for on-site containment beneath the foundation raft slab or road and/ or be disposed offsite.

Off-Site Disposal of Stockpiled Soils

If the stockpiled soils are to be disposed offsite, the results of the laboratory analysis will be compared to the NSW EPA (2014) Waste Classification Guidelines in order to provide a waste classification for the stockpiled soils.

Stockpiled fill material, with an appropriate waste classification, can be disposed of at a landfill licensed to accept that type of waste. For example, hazardous waste can only be disposed of to a landfill licensed to accept hazardous waste.

Materials of different waste classifications should not be mixed prior to offsite disposal. Should they become mixed, the material will take on the higher classification. For example, should hazardous waste be mixed with general solid waste, then the entire stockpile will be classed as hazardous waste.

Waste disposal dockets will need to be retained for material being disposed offsite. The dockets will record the amount of material being disposed, the final fate of the material, and demonstrate that the material was disposed appropriately.

If material is disposed offsite, we recommend that a wash down bay or tyre grid be installed at entrance/exit point of the site in order to minimise potentially contaminating material being tracked offsite in vehicle tyres.

Documentation

Records should be maintained during removal of materials from Site, including the quantities of contaminated material contained or disposed offsite. This will also need to be accompanied by waste disposal dockets.

1.2.5. Validation of Excavations

Excavations resulting from the removal of potentially contaminated material will need to be validated prior to works re-commencing in those areas. Validation will be required in order to assess whether the potentially contaminated material has been adequately removed, or if further excavations or management of the material are necessary.

Validation requirements (i.e. strategy, sample quantities, analytical testing requirements etc.) are outlined in Section 5 of the RAP.

1.2.6. Validation Criteria

Health Investigation and Screening Levels

Health Investigation Levels (HILs) are applicable for assessing human health risk via relevant exposure pathways. HILs were developed for a broad range of metals and organic substances. These are generic to all soil types and apply generally to a depth of 3m below the soil surface for residential sites.

Health screening levels (HSLs) have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via inhalation after vapour intrusion into indoor air and direct contact with soil and groundwater. These HSLs depend on general soil type (sand, silt and clay mixture), building configurations and land use scenarios. Given that the area is proposed for use as an acute care facility, the HSLs for vapour intrusion would only be applicable to locations where buildings are proposed to be constructed.

The usage scenario of the proposed building supports an adult population of staff with patients accessing acute care (not frequently used by more sensitive receptors). Tetra Tech considers that the

exposure pathways for the future developed Site are consistent with those for the derivation of both HIL/ HSL D (Commercial/Industrial land) with final developed including landscaped areas.

The adopted HIL/HSLs are compared against residential based criteria based on the proposed future land use and are summarised in Table 1-1 and Table 1-2 respectively. Based on soils observed during fieldworks, which comprised coarse sand, HSLs have been compared against coarse grained soils.

Table 1-1: Health Investigation Levels

Chemical	HIL – D Commercial/ Industrial (mg/kg)
Arsenic	3,000
Cadmium	900
Chromium (VI)	3,600
Copper	240,000
Lead	1,500
Mercury	730
Nickel	6,000
Zinc	400,000
Carcinogenic PAHs, expressed as Benzo(a)pyrene TEQ	40
Total PAHs	4,000

Table 1-2: Health Screening Levels for Commercial/ Industrial (HSL D) Land Use

Chemical	HSL D – Commercial/ Industrial (Sand) (mg/kg)[1]			HSL-D Direct Contact[2] (mg/kg)	HSL – Intrusive Maintenance Worker (Shallow Trench) (Sand)[3]	
	0m to <1m	1m to <2m	2m to <4m		0m to <2m	2m to <4m
Benzene	3	3	3	430	77	160
Toluene	NL	NL	NL	99,000	NL	NL
Ethylbenzene	NL	NL	NL	27,000	NL	NL
Xylenes	230	NL	NL	81,000	NL	NL
Naphthalene	NL	NL	NL	11,000	NL	NL
F1 (TRH C_6-C_{10} – BTEX)	260	370	630	-	NL	NL
TRH C_6-C_{10}	-	-	-	26,000	-	-
F2 (TRH >C_{10}-C_{16} – Naphthalene)	NL	NL	NL	-	NL	NL
TRH C_{10}-C_{16}	-	-	-	20,000	-	-
TRH C_{16}-C_{34}	-	-	-	27,000	-	-
TRH C_{34}-C_{40}	-	-	-	38,000	-	-

Ecological Investigation and Screening Levels

To assess the potential impact on terrestrial ecosystems from contamination within the upper 2m of soil / fill material, the ASC NEPM presents EILs for different settings (e.g. areas of ecological significance, urban residential/ public open space, commercial).

Section 3.5.1 of NEPM Schedule B5a states that the aim of the EILs is that varying levels of protection will be provided to the following ecological receptors at all sites:

- "Biota supporting ecological processed including microorganisms and soil invertebrates
- Native flora and fauna
- Introduced flora and fauna
- Transitory or permanent wildlife."

The following EIL/ ESLs provided in Table 1.3 are derived from Tables 1B(4) to Table 1B(6) of the ASC NEPM for coarse soil textures. Site specific EIL criteria for zinc will be required to be derived from assessing pH, Cation Exchange Capacity, iron content, Total Organic Carbon and clay content.

Table 1-3: Ecological Investigation and Screening Levels

Chemical	EIL – Urban Residential/ Public Open Space (mg/kg)	ESL – Urban Residential and Public Open Space
	Contaminant Limit (mg/kg)	
Arsenic	100	-
Chromium	330*	-
Copper	65*	-
Lead	1,100	-
Nickel	250*	-
Zinc	180*	-
Naphthalene	170	-
Benzo(a)pyrene	-	20
TRH C6 – C10	-	180
TRH >C10 – C16	-	120
TRH >C16 – C34	-	300
TRH >C34 – C40	-	2800
Benzene	-	50
Toluene	-	85
Ethylbenzene	-	70
Xylene	-	105

*EIL criteria derived from assessing pH, Cation Exchange Capacity, iron content, Total Organic Carbon and clay content as part of the DSI.

We note that the ESL for benzo(a)pyrene (B(a)P) listed within the ASC NEPM (2013) (0.7mg/kg) is derived from the 1999 Canadian Soil Quality Guideline (SQG) values (Warne, 2010). Due to the availability of a significant amount of new toxicity data, the SQG was revised and published in *Canadian Council of Ministers of the Environment, Canadian Soil Quality Guidelines for Environmental Health* (CCME, 2010), however these revisions were not considered in the amended ASC NEPM (2013) revision. As such, Tetra Tech considers that the low reliability ESLs prescribed in the ASC NEPM (2013) are now outdated and the revised SQG for B(a)P as presented in CCME 2010

has been derived based on a similar methodology to that prescribed in Schedule B5b of the NEPM (i.e. based on the species sensitivity distribution approach). As such the 0.7mg/kg SQG is superseded by the relevant value contained in Table 1 (CCME 2010) with the adopted ESLs for B(a)P being 20mg/kg.

Asbestos Screening Levels

In accordance with Section 4.8 of Schedule B1 of the ASC NEPM, consideration to HSLs for asbestos have been included where laboratory analysis is completed as part of additional assessment and/ or validation sampling. HSLs for asbestos in soils assess three forms of asbestos, which include:

- Asbestos Containing Material (ACM) – material that is 'bound in a matrix such as cement or resin (e.g. asbestos fencing and vinyl tiles). This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release'.
- Fibrous Asbestos (FA) – material that 'comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling)'.
- Asbestos Fines (AF) – material that 'includes free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substantial degree of damage which increases the potential for fibre release.)'.

No visible forms of asbestos relating to 'All forms of asbestos' relate to the top 0.1m of soil.

The HSL criteria for asbestos in soils is presented in Table 1.4.

Table 1-4: Asbestos HSLs

Form of Asbestos	Recreational HSL-D (%w/w)
Bonded ACM	0.05%
FA and AF	0.001%
All forms of asbestos	No visible asbestos for surface soil (surface to a depth of 0.1m)

ACM: Asbestos Containing Material, FA: Friable Asbestos, AF: Asbestos Fines; No visible forms of asbestos related to the top 0.1m of soil.

Management Limits

In accordance with Section 2.9 of Schedule B1 of the ASC NEPM, consideration of Management Limits for petroleum hydrocarbons has been included to assess the potential for accumulation of explosive vapours, the potential risk to buried infrastructure, or the formation of phase separated hydrocarbons (PSH). As a conservative measure, coarse soil texture management limits have been adopted as the assessment criteria and may be revised based on the predominant soil texture following fieldworks.

A summary of the adopted management limits for this Site is provided in Table 1-6.

Table 1-5: Management Limits

Chemical	Management Limits Commercial and Industrial (mg/kg) – Coarse Soil Texture
F1 - TRH C6-C10	700

Chemical	Management Limits Commercial and Industrial (mg/kg) – Coarse Soil Texture
F2 - TRH C10-C16	1,000
F3 - TRH C16 – C34	3,500
F4 - TRH C34 – C40	10,000

1.3. UFP Record Keeping

Any unexpected finds encountered should be listed on a UFP register, which should include the action taken and the status of the unexpected find. A suitable register is attached.

Prior to closing out an unexpected find it will be important to ensure the appropriate documentation is

obtained, such as: photographs, the UFP form, details of the reuse and/ or containment, waste classification assessment(s) and a validation report or clearance letter.

UNEXPECTED FINDS PROTOCOL FORM

To be completed by the Site Supervisor/Environmental Representative

Form Completed By	
Company Name	
Contact Details	
Date Form Completed	
Date Unexpected Finds Identified	
UFP Reference No.	
Location of Unexpected Finds (including sketch)	
Description of Unexpected Finds	
Persons Contacted Notified	
Unexpected Finds Isolated (Y / N)	
Descriptions of Controls Established	
Photographs Taken (Y / N)	
Further Assessment Required (Y / N)	
Other Comments	

UFP Reference No.	Date UFP Identified	Suspect Material	Recorded on UFP Form (Y / N)	Action Taken	Status

APPENDIX C: MATERIAL TRACKING FORMS

Material Classification Form MCF Reference Number: 001	

Completed by		
Date and Time		
Source Area / Grid Reference		
RAP Reference		
Stockpile ID		
Material Location (GPS Coordinates, Site Grid Reference)		
Estimated Volume of Material (m^3)		
Material description (material type, colour, inclusions, etc.)		
Material Classification Report Reference (as applicable)	Document Name/Number: Date:	
Summary of Material Characterisation Report	Level A (Beneficial Reuse Onsite) Level B (Below capping) Level C (Off-site Disposal/Reuse)	☐ ☐ ☐
Other Comments		

	Daily On-site Materials Tracking Form
Project:	**Project Number:**
Location:	**Document Number:**
Date:	**Purpose: Materials Tracking and Management**

Source Location				Classification Level A. B, C					Destination	
Time	Grid Ref.	Area	GPS Location (Unexpected Finds)	Description (visual and odour)	PID Reading	Material Type	Estimated Quantity	MCF Reference #	Grid Ref.	Comment
AM/PM			*easting & northing*	*Visual/Olfactory Assessment of Material*	*ppm*	*Level B or Unexpected Find*	*m^3*	*004*		