ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

THELEM CONSULTING

ON

STAGE 1 ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED SENIORS LIVING DEVELOPMENT

AT

3 QUARRY ROAD, DURAL, NSW

16 MARCH 2018 **REF: E31137Krpt**

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Document Distribution Record

Report Reference	Distribution	Report Date
E31137Krpt Draft	Client via email	16 March 2018
E31137Krpt Final	Client via email	8 June 2018

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EXECUTIVE SUMMARY

Thelem Consulting ('the client') commissioned Environmental Investigation Services (EIS) to undertake a Stage 1 Environmental Site Assessment (ESA) for the proposed seniors living development at 3 Quarry Road, Dural ('the site'). The site location and boundaries are shown on Figure 1.

A geotechnical investigation was undertaken previously to this assessment by JK Geotechnics. The results of the investigation are presented in a separate report (Ref. 31137Srpt, dated 8 January 2018). This report should be read in conjunction with the JK report.

The scope of work included the following:

- Review of site information, including background and site history information from a Lotsearch Pty Ltd *Environmental Risk and Planning Report* and other sources;
- Preparation of a CSM;
- Design and implementation of a sampling, analysis and quality plan (SAQP);
- Interpretation of the analytical results against the adopted Site Assessment Criteria (SAC);
- Data Quality Assessment; and
- Preparation of a report including a Tier 1 risk assessment.

The Stage 1 Environmental Assessment included a desktop site history assessment and fill/soil sampling from a total of six boreholes. The historical assessment identified various potential sources of contamination/AEC, including historical agricultural land use (orchards and farming), fill and hazardous building materials (i.e. from former demolition and existing site structures).

Fibre cement fragments (FCF) were identified around the site structure at No.3 Quarry Road and on the site surface and within fill in the southern section of the site. All FCF inspected was considered to be in good condition and could not be broken by hand pressure (i.e. it was considered to be bonded).

The representative sample of surficial FCF analysed was found to contain asbestos. None of the soil results were above the site acceptance criteria adopted for the investigation.

EIS consider that the report objectives outlined in Section 1.2 have been addressed. The ESA included a desktop site history assessment and fill/soil sampling from a total of six boreholes. The historical assessment identified various potential sources of contamination/AEC, including historical agricultural land use (orchards and farming), fill material and hazardous building materials (i.e. from former demolition and within existing site structures). The site inspection identified numerous stored materials that could be a source of contamination.

Asbestos was detected in the FCF analysed for the investigation. Elevated concentrations of contaminants above the SAC were not identified in the soil during the investigation. Based on the current site development, the potential contamination sources/contaminants identified, and the perceived potential for contamination, further investigation of the contamination conditions within the fill material, particularly in the southern portion of the site should be undertaken.

EIS recommend that any further sampling is undertaken using a combination of backhoe or small excavator and a drill rig. The additional sampling should:

i. Aim to increase the overall sampling density to that recommended in the NSW EPA Sampling Design Guidelines 1995;
ii. Targeted additional sampling in the fill containing inclusions of building and demolition materials identified in the southern section of the site;
iii. Establish whether remediation or contamination management is likely to be required.

The analytical schedule should include: heavy metals; total recoverable hydrocarbons (TRH); benzene, toluene, ethyl benzene and xylene (BTEX); polycyclic aromatic hydrocarbons (PAHs); organochlorine and organophosphate pesticides (OCPs & OPPs); polychlorinated biphenyls (PCBs) and asbestos.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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ABBREVIATIONS

Asbestos Fines/Fibrous Asbestos	**AF/FA**
Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Australian Drinking Water Guidelines	**ADWG**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Above-Ground Storage Tank	**AST**
Below Ground Level	**BGL**
Benzo(a)pyrene Toxicity Equivalent Factor	**BaP TEQ**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Environmental Investigation Services	**EIS**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environment Protection Authority	**EPA**
Environmental Site Assessment	**ESA**
Ecological Screening Level	**ESL**
Fibre Cement Fragment(s)	**FCF**
General Approval of Immobilisation	**GAI**
Health Investigation Level	**HILs**
Hardness Modified Trigger Values	**HMTV**
Health Screening Level	**HSLs**
International Organisation of Standardisation	**ISO**
Lab Control Spike	**LCS**
Light Non-Aqueous Phase Liquid	**LNAPL**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Potential ASS	**PASS**
Polychlorinated Biphenyls	**PCBs**
Photo-ionisation Detector	**PID**

ABBREVIATIONS

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

Units

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

1 INTRODUCTION

Thelem Consulting ('the client') commissioned Environmental Investigation Services (EIS)[1] to undertake a Stage 1 Environmental Site Assessment (ESA) for the proposed seniors living development at 3 Quarry Road, Dural ('the site'). The site location and boundaries are shown on Figure 1.

A geotechnical investigation was undertaken previously to this assessment by JK Geotechnics[2]. The results of the investigation are presented in a separate report (Ref. 31137Srpt, dated 8 January 2018[3]). This report should be read in conjunction with the JK report.

1.1 Proposed Development Details

The proposed development includes nine buildings of three and four storey construction with basement car parking.

1.2 Aims and Objectives

The primary aims of the assessment were to identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make a preliminary assessment of the soil contamination conditions. The assessment objectives were to:

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

1.3 Scope of Work

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP46666K) of 22 February 2018 and written acceptance from the Thelem Consulting on behalf of the client of 22 February 2018.

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)
[2] Geotechnical consulting division of J&K
[3] Referred to as JK Geotechnics (2018) report

The scope of work included the following:

- Review of site information, including background and site history information from a Lotsearch Pty Ltd *Environmental Risk and Planning Report* and other sources;
- Preparation of a CSM;
- Design and implementation of a sampling, analysis and quality plan (SAQP);
- Interpretation of the analytical results against the adopted Site Assessment Criteria (SAC);
- Data Quality Assessment; and
- Preparation of a report including a Tier 1 risk assessment.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[4], other guidelines made under or with regards to the Contaminated Land Management Act (1997)[5] and State Environmental Planning Policy No.55 – Remediation of Land (1998)[6]. A list of reference documents/guidelines is included in the appendices.

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

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

[6] *State Environmental Planning Policy No. 55 – Remediation of Land 1998* (NSW) (referred to as SEPP55)

2 SITE INFORMATION

2.1 Site Identification

Table 2-1: Site Identification

Current Site Owner:	Grace Custodian Pty Ltd (Lot 2A in DP158064) H Investments International Pty Limited (Lot 1 in DP230172)
Site Address:	3 Quarry Road and 4 Vineys Road, Dural NSW 2158
Lot & Deposited Plan:	Lot 2A in DP158064 and Lot 1 in DP230172
Current Land Use:	Semi-rural residential
Proposed Land Use:	Seniors living (medium-high density residential)
Local Government Authority:	Hornsby Shire Council
Current Zoning:	RU2 – Rural landscape
Site Area (m^2):	~29,850
Geographical Location (decimal degrees) (approx.):	Latitude: -33.694699 Longitude: 151.035313
Site Location Plan:	Figure 1
Sample Location Plan:	Figure 2

2.2 Site Location and Regional Setting

The site is located in an urban area of Dural. The site is bounded by Vineys Road to the north and Quarry Road to the south. A tributary of Tunks Creek runs through the centre of the site.

2.3 Topography

The site is located in undulating topography which slopes down to the north-east at approximately 2° to 3°, towards Tunks Creek. The site is cut by a broad gully, with the southern portion of the site sloping down at approximately 3° to 4° to the north-east and the northern portion sloping down at approximately 4° to 6° to the south. Near the centre of the site are the headwaters of a meandering creek, which flows towards the north-east. The site is bound by Vineys Road and Quarry Road to the north and south, respectively.

2.4 Site Inspection

A walkover inspection of the site was undertaken by EIS on 1 March 2018. The inspection was limited to accessible areas of the site and immediate surrounds. An internal inspection of the buildings and structures was not undertaken. Selected site photographs obtained during the inspection are attached in the appendices.

A summary of the other inspection findings are outlined in the following subsections:

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

At the time of the inspection, the site was occupied by a single storey residential structure on the north boundary with the Vineys Road frontage and a single storey residential structure located in the south-west corner of the site with the Quarry Road frontage. The remainder of the site was generally grass covered, with large piles of felled trees in the southern portion of the site and a large volume of stored materials (cars, boats, tractors, paint tins, 44 gallon drums, building materials, etc) in the northern portion.

2.4.2 Buildings, Structures and Roads

The residence in the north of the site was generally constructed on brick piers with weatherboard/moulded fibre cement walls and a tile roof. To the immediate south of the residence was a fibre cement clad and roofed garage/granny flat structure built on a concrete slab. Concrete paths were present around the structures.

The residence in the south-west of the site was generally constructed with fibre cement walls and roof on a concrete slab.

2.4.3 Visible or Olfactory Indicators of Contamination

In the northern portion of the site a large amount of stored disused materials were observed. These included items such as: 44 gallon drums of unknown contents; international bunded containers (IBCs) containing paint tins and other drums/tins; boats; building materials (pre-fabricated wall sheets etc.), shipping containers of unknown contents; mowers and tractors; a car battery; IBCs of unknown contents; a crane; a cold storage truck and other numerous disused items (refer to site photographs in the appendices). In the southern section of the site several piles of building and demolition rubble were identified (corrugated iron and timber furniture/wall partitions, etc.) across the site surface, in addition to a bus located at the end of the residence's garden area.

Fibre cement fragments (FCF) were identified at the site:

- Several fragments were identified on the ground surface around the residence at No.3 Quarry Road; and

- A large number of FCF (>10 fragments) were identified on and within fill material located in the south-west section of the site. The fill material in this section of the site was observed to also contain building and demolition waste such as metal, glass, timber, etc. (see Figure 2).

One representative sample of FCF was analysed and found to contain asbestos (KTF1).

2.4.4 Presence of Drums/Chemicals, Waste and Fill Material

As described above, at least three 44 gallon drums, numerous IBCs and dis-used paints tins were observed to be stored in the north of the site. At least two piles of woodchips/fill material were observed to be located to the east of the residence at no.4 Vineys Road. The tenants of No.4 Vineys Road informed EIS during the site inspection that four 20 litre jerry cans of fuel (for the mower) were stored within the structures.

Fill material was observed to be present across the surface of the site in areas of exposed soil. The fill material appeared to be relatively homogenous across the northern portion of the site. However, the fill material located north of the bus in No.3 Quarry Road (see Figure 2) was observed to contain building and demolition waste including FCF, metal, plastic, glass, etc.

2.4.5 Drainage and Services

Any surface water not absorbed into the ground would be expected to flow to the centre of the site and then to the east flowing into the tributary. During the site inspection the tenant of No.4 Vineys Road informed EIS that following heavy rain and or prolonged periods of inclement weather the low-lying area in the centre of the site floods from the neighbouring dam to the head of the tributary.

2.4.6 Sensitive Environments

A tributary of Tunks Creek runs through the site and appeared to be fed by the dam located on the neighbouring property to the west of the site.

2.4.7 Landscaped Areas and Visible Signs of Plant Stress

The northern portion of the site (No.4 Vineys Road) was generally grass covered with densely vegetated areas along the creek bed in the low-lying central area and around the eastern boundary of the site. Large mature gum trees were located in the north-and sporadically around the residence and terraced areas. At least five large piles of felled trees were observed across the southern portion of the site (No.3 Quarry Road), with the area around the residence generally grass covered. All vegetation inspected appeared to be in good condition.

2.5 Surrounding Land Use

The site was generally located in an area of Dural with low density residential, semi-rural residential and commercial (nurseries, schools, etc.) properties.

Several farming/agricultural (flower nurseries and fruit orchards, etc.) properties were located adjacent to the site. EIS are of the opinion that these land uses could be potential contamination sources for the site as they are located adjacent to and up-gradient of the site to the south and west.

2.6 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the assessment in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration. Major services were not identified that would be expected to act as preferential pathways for contamination migration.

2.7 Section 149 Planning Certificate

The s149 (2 and 5) planning certificate for 4 Vineys Road was reviewed for the assessment. A copy of the certificate is attached in the appendices. A summary of the relevant information is outlined below:

- The site is not located in an area of ecological significance;
- The site is not deemed to be: significantly contaminated; subject to a management order; subject of an approved voluntary management proposal; or subject to an on-going management order under the provisions of the CLM Act 1997;
- The site is not the subject of a Site Audit Statement (SAS);
- The site is not located within an acid sulfate soil (ASS) risk area; and
- The site is not located in a heritage conservation area.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology

Regional geological information presented in the Lotsearch report (attached in the appendices) indicated that the site is underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey shale and laminite.

3.2 Acid Sulfate Soil (ASS) Risk and Planning

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

3.3 Hydrogeology

Hydrogeological information presented in the Lotsearch report (attached in the appendices) indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were a total of 38 registered bores within the report buffer of 2,000m. In summary:

- The nearest registered bore was located approximately 251m from the site. This was utilised for monitoring purposes;
- The majority of the bores were registered for domestic/stock purposes;
- There were no nearby bores (i.e. within 250m) registered for domestic or irrigation uses; and
- The drillers log information from the closest registered bores typically identified fill and/or clay soil to depths of 2.2m-2.8m, underlain by sandstone bedrock. Standing water levels (SWLs) in the bores ranged from 2.8mBGL to 88.0mBGL.

The information reviewed for this assessment indicated that the subsurface conditions at the site are expected to consist of moderate to high permeability (alluvial) soils overlying relatively deep bedrock. Abstraction and use of groundwater at the site or in the immediate surrounds may be viable under these conditions, however the use of groundwater is not proposed as part of the development.

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

3.4 Receiving Water Bodies

The site location and regional topography indicates that excess surface water flows have the potential to enter the tributary of Tunks Creek dissecting the site through the centre from west to east. This water body is a potential receptor.

4 SITE HISTORY INFORMATION

4.1 Review of Historical Aerial Photographs

Historical aerial photographs were included in the Lotsearch report (attached in the appendices). EIS has reviewed the photographs and summarised relevant information in the following table:

Table 4-1: Summary of Historical Aerial Photographs

Year	Details
1956	The site could generally be described as a long rectangle (north to south) with a jagged section jutting out to the east. The site appeared to be predominantly utilised for agricultural purposes (orchards), with defined areas of cultivation visible. The most eastern section of the site appeared to be densely covered with mature/large trees (following Tunks Creek) and several structures were visible. Two structures were visible in the south-west corner (No.3 Quarry Road), and a second structure (assumed to be a large shed), was visible in the central section of the site. The surrounding land use appeared similar to the site and was most likely used for grazing and or orchard purposes. The land extending away from the site to the east (following Tunks Creek) appeared to be densely covered in large/mature trees.
1961	The site and surrounding land use appeared similar to the 1956 aerial photograph.
1965	The southern half of the site (No.3 Quarry Road) appeared to be cleared of trees, although defined fields were still visible. The northern half of the site (No.4 Vineys Road) appeared to be generally overgrown with shrubs and trees across most of the site. The surrounding land use appeared similar to the 1961 aerial photograph.
1970	A cleared area was visible along the northern boundary (foundations of No.4 Vineys Road) and a small structure was visible in the centre of the northern half of the site. The southern half of the site (No.3 Quarry Road) appeared to be grass covered. The surrounding land use appeared similar to the 1965 aerial photograph.
1982	A residential structure was visible on the northern boundary of the site (No.4 Vineys Road). Several other smaller structures were also visible around the main residence including the detached granny flat/garage building. In the low-lying central area of the site medium to large trees were visible. The surrounding land use appeared similar to the 1970 aerial photograph.
1991	Only one structure was visible at No.3 Quarry Road. Otherwise, the site appeared similar to the 1982 aerial photograph. On the western neighbouring property a dam was visible (in line with the Tributary to Tunks Creek). A large residential structure was visible on this neighbouring plot to the west of No.4 Vineys Road and construction works were observed on the plot to the east.

Year	Details
2003	Scouring was visible along the creek line to the central area of the site. Some scouring was also visible on the northern section of the site around the residence and further south, where previously large trees had been observed. The southern half of the site (No.3 Quarry Road) appeared to be covered in new growth (potentially a tree plantation), with a line of large trees marking the northern boundary of the Lot. A large residential structure on the plot to the west of No.3 Quarry Road and the commercial area to the south-west of the site along Quarry Road were visible.
2009	The northern portion of the site (No.4 Vineys Road) appeared to be predominantly grass covered with a few sporadic trees remaining. The only visible site structures were the residence at and detached granny flat/garage at No.4 Vineys Road and the residence, shed and (static) bus at No.3 Quarry Road. Sandstone retaining walls are visible along the creek bed in the central east of the site. Large trees predominantly cover the southern portion of the site (No.3 Quarry Road – potentially tree plantation). The commercial area to the south-west of the site appeared to have been further developed.
2015	The site and immediate surrounds appeared similar to the 2009 aerial photograph.

4.2 Review of Historical Land Title Records

Historical land title records were reviewed for the assessment. The record search was undertaken by Advance Legal Searchers Pty Ltd. Copies of the title records are attached in the appendices. The title records indicate the following:

- Between 1894 and 2016 Lot 2A, has been owned by individuals The professions of the individuals as listed on the title records included two orchardists, a farmer, a policeman, a fireman and a gardener;
- Between 1894 and 2017 Lot 1 in DP230172 has been owned by individuals. Professions of the individual as listed on the title records included two orchardists and an electrician; and
- The site has been owned by companies between 2002 to the present day. H Investments International Pty Limited is the registered proprietor of Lot 1 in DP230172 and Grace Custodian Pty Ltd is the registered proprietor of Lot 1 in DP230172.

The historical land title records identified several professions of individuals potentially associated with land contamination.

4.3 Review of Council Records

Council records were sourced under an informal access to information request and were reviewed for the assessment. The council records indicate the following:

- A septic tank with onsite effluent disposal absorption trench was approved under file reference PP029351; and

- Noise complaints were made in regards to the site being used as a race track in October 1999.

4.4 SafeWork NSW Records

A review of SafeWork NSW records for the site is currently underway. The results will be summarised in a separate letter when received.

4.5 NSW EPA Records

The Lotsearch report (attached in the appendices) included information from the NSW EPA databases for the following:

- Records maintained in relation to contaminated land under Section 58 of the CLM Act 1997;
- Records of sites notified in accordance with the Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997 (2015)[7]; and
- Licensed activities under the Protection of the Environment Operations Act (1997)[8].

The search included the site area and surrounding areas in the report buffer of 1,000m. The search indicated the following:

- There were no records for the site or any properties in the report buffer under Section 58 of the CLM Act 1997;
- The site has not been notified with regards to the Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997. There was one notified property within the report buffer (BP Service Station). Although up-gradient from the site, due to the distance this property is considered unlikely to pose a contamination risk to the site; and
- There were three records for licenced activities (application of herbicides to waterways) at the site under the POEO Act 1997, however these activities are considered unlikely to pose a contamination risk to the site.

4.6 Historical Business Directory and Additional Lotsearch Information

Historical business records for the site and surrounding areas in the report buffer were included in the Lotsearch report (attached in the appendices). The records indicated the following:

- A motor bus services business was registered within the report buffer in 1986. This business was located 139m cross-gradient from the site; and
- There were eight motor garage and service station businesses registered within the report buffer between the 1970s and the early 1990s. All of these businesses were located over 250m from the site and cross-gradient from the site.

[7] NSW EPA, (2015). *Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997.* (referred to as Duty to Report Contamination)

[8] Protection of the Environment Operations Act 1997 (NSW) (referred to as POEO Act 1997)

EIS are of the opinion that the historical businesses in the report buffer are unlikely to represent potential off-site sources of site contamination due to their distance from site and the regional topography.

In addition to the above, EIS have reviewed additional information contained within the Lotsearch report and note the following:

- There were no local or state heritage items at the site or in the immediate surrounds; and
- There were no significant ecological constraints at the site or in the immediate surrounds.

4.7 Summary of Site History Information

A time line summary of the historical land uses and activities is presented in the table below. The information presented in the table is based on a weight of evidence assessment of the site history documentation and observations made by EIS.

Table 4-2: Summary of Historical Land Uses

Year(s)	Potential Land Use / Activities
1894 - 1966	Historical land title records indicate the site was owned by orchardists and a farmer during this time period. Aerial photographs support the assumption of this land use of the site.
1965 - 1991	Potential filling of the site may have occurred during demolition or construction of the site structures during this time. Aerial photographs indicate site structures in the centre and southern portion of the site (No.3 Quarry Road) were demolished between 1978 and 1982. Aerial photographs indicated that several new structures were constructed in the northern portion of the site (No.4 Vineys Road) during 1982 - 1991.
~2003	Potential filling of the site may have occurred and or be associated with the scouring of the site surface as observed on No.4 Vineys Road, in the 2003 aerial photograph. This could be in conjunction with the landscaping of the tributary dams areas in the eastern part of the site and/or the terracing at the base of the storage area behind No.4 Vineys Road. Fill may also have been imported onto the site for planting purposes in conjunction with the tree plantation observed around this time at No.3 Quarry Road.
2015 to present	A range of random stored materials including drums and paint tins, tractors and piles of wood chip/fill were observed on the site during the site inspection. Fill material comprising building and demolition rubble (including asbestos FCF) was observed on the site surface during the walkover inspection.

4.8 Integrity of Site History Information

The majority of the site history information was obtained from government organisations as outlined in the relevant sections of this report. The veracity of the information from these sources is considered to be relatively high. A certain degree of information loss can be expected given the lack of specific land use details over time. EIS have relied upon the Lotsearch report and have not independently verified any information contained within. However, it is noted that the Lotsearch report is generated based on databases maintained by various government agencies and is expected to be reliable.

5 CONCEPTUAL SITE MODEL

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

A review of the CSM in relation to source, pathway and receptor (SPR) linkages has been undertaken as part of the Tier 1 risk assessment process, as outlined in Section 10.

5.1 Potential Contamination Sources/AEC and CoPC

The potential contamination sources/AEC and CoPC are presented in the following table:

Table 5-1: Potential (and/or known) Contamination Sources/AEC and Contaminants of Potential Concern

Source / AEC	CoPC
Fill material – The site appears to have been historically filled to achieve the existing levels. The fill may have been imported from various sources and could be contaminated. Asbestos FCF were identified on the site surface during the site inspection.	Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs) and asbestos.
Historical agricultural use (Orchards & farming) – The site appears to have been used for grazing and market garden purposes. This could have resulted in contamination across the site via use of machinery, application of pesticides and building/demolition of various structures. Irrigation pipes made from asbestos cement may also be associated with this AEC.	Heavy metals, TRH, PAHs, OCPs, PCBs and asbestos
Use of pesticides – Pesticides may have been used beneath the buildings and/or around the site.	Heavy metals and OCPs
Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. These materials may also be present in the existing buildings/ structures on site.	Asbestos, lead and PCBs

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

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

Table 5-2: CSM

Potential mechanism for contamination	The primary mechanisms for contamination for all sources/AEC predominantly include 'top-down' impacts (e.g. leaching from surficial material), spills or sub-surface release (e.g. impacts from buried material).
Affected media	Soil/soil vapour and groundwater have been identified as potentially affected media.
Receptor identification	Human receptors include site occupants/users (including adults and children), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas), and freshwater ecology in the tributary to Tunks Creek.
Potential exposure pathways	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRH, naphthalene and BTEX). The potential for exposure would typically be associated with the construction and excavation works, and future use of the site. Potential exposure pathways for ecological receptors include primary contact and ingestion. Exposure during future site use could occur via direct contact with soil in unpaved areas such as gardens, inhalation of airborne asbestos fibres during soil disturbance, or inhalation of vapours within enclosed spaces such as buildings and basements.
Potential exposure mechanisms	The following have been identified as potential exposure mechanisms for site contamination: • Vapour intrusion into the proposed basement and/or building (either from soil contamination or volatilisation of contaminants from groundwater); • Contact (dermal, ingestion or inhalation) with exposed soils in landscaped areas and/or unpaved areas; • Migration of groundwater off-site and into nearby/on-site water bodies, including aquatic ecosystems.
Presence of preferential pathways for contaminant movement	The tributary may act as a preferential pathways for contaminant migration. This would be dependent on the contaminant type and transport mechanisms.

6 SAMPLING, ANALYSIS AND QUALITY PLAN

6.1 Data Quality Objectives (DQO)

Data Quality Objectives (DQOs) were developed to define the type and quality of data required to achieve the project objectives outlined in Section 1.2. The DQOs were prepared with reference to the process outlined in Schedule B2 of NEPM (2013) and the Guidelines for the NSW Site Auditor Scheme, 3rd Edition (2017)[9]. The seven-step DQO approach for this project is outlined in the following sub-sections.

The DQO process is validated in part by the Data Quality Assurance/Quality Control (QA/QC) Evaluation. The Data (QA/QC) Evaluation is summarised in Section 8.1 and the detailed evaluation is provided in the appendices.

6.1.1 Step 1 - State the Problem

The CSM identified potential sources of contamination/AEC at the site that may pose a risk to human health and the environment. Investigation data is required to assess the contamination status of the site, assess the risks posed by the contaminants in the context of the proposed development/intended land use, and assess whether remediation is required. This information will be considered by the consent authority in exercising its planning functions in relation to the development proposal.

6.1.2 Step 2 - Identify the Decisions of the Study

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

- Did the site inspection, or does the historical information identify potential contamination sources/AEC at the site?
- Are any results above the SAC?
- Do potential risks associated with contamination exist, and if so, what are they?
- Is remediation required?
- Is the site characterisation sufficient to provide adequate confidence in the above decisions?
- Is the site suitable for the proposed development, or can the site be made suitable subject to further characterisation and/or remediation?

6.1.3 Step 3 - Identify Information Inputs

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

- Existing relevant environmental data from previous reports;
- Site information, including site observations and site history documentation;
- Sampling of potentially affected media, including soil;

[9] NSW EPA (2017). *Guidelines for the NSW Site Auditor Scheme, 3rd ed.* (referred to as Site Auditor Guidelines 2017)

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

6.1.4 Step 4 - Define the Study Boundary

The sampling will be confined to the site boundaries as shown in Figure 2 (spatial boundary). The sampling was completed on 1 March 2018 (temporal boundary). The assessment of potential risk to adjacent land users has been made based on data collected within the site boundary.

Sampling was not undertaken within the existing building footprint due to access constraints.

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

6.1.5.1 Tier 1 Screening Criteria

The laboratory data will be assessed against relevant Tier 1 screening criteria (referred to as SAC), as outlined in Section 7. Exceedances of the SAC do not necessarily indicate a requirement for remediation or a risk to human health and/or the environment. Exceedances are considered in the context of the CSM and valid SPR-linkages.

For this assessment, the individual results have been assessed as either above or below the SAC. Statistical evaluation of the dataset via calculation of mean values and/or 95% upper confidence limit (UCL) values has not been undertaken due to the spatial distribution of the data and the number of samples submitted for analysis.

6.1.5.2 Field and Laboratory QA/QC

Field QA/QC included analysis of an intra-laboratory duplicate sample. Further details regarding the sampling and analysis undertaken, and the acceptable limits adopted, is provided in the Data Quality (QA/QC) Evaluation in the appendices.

The suitability of the laboratory data is assessed against the laboratory QA/QC criteria which is outlined in the attached laboratory reports. These criteria were developed and implemented in accordance with the laboratory’s National Association of Testing Authorities, Australia (NATA) accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence are reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory is undertaken in an effort to establish the cause of the nonconformance. Where uncertainty exists, EIS typically adopt the most conservative concentration reported (or in some cases, consider the data from the affected sample as an estimate).

6.1.5.3 Appropriateness of Practical Quantitation Limits (PQLs)

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

6.1.6 Step 6 – Specify Limits on Decision Errors

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

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

6.1.7 Step 7 - Optimise the Design for Obtaining Data

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

The sampling plan and methodology are outlined in the following sub-sections.

6.2 Soil Sampling Plan and Methodology

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

Table 6-1: Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	Samples were collected from five locations as shown on the attached Figure 2. Based on the site area (30,000m^2), this number of locations corresponded to a sampling density of approximately one sample per 6,000m^2. The sampling plan was not designed to meet the

Aspect	Input
	minimum sampling density for hotspot identification, as outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)[10].
Sampling Plan	The sampling locations were placed on a judgemental sampling plan and were broadly positioned for site coverage, taking into consideration areas that were not easily accessible. This sampling plan was considered suitable to make a preliminary assessment of potential risks associated with the AEC and CoPC identified in the CSM, and assess whether further investigation is warranted.
Set-out and Sampling Equipment	Sampling locations were set out using a hand held GPS unit (with an accuracy of ±2m). In-situ sampling locations were cleared for underground services by an external contractor prior to sampling as outlined in the SSP. Samples were collected using a hand auger.
Sample Collection and Field QA/QC	Soil samples were obtained on 1 March 2018 in accordance with the standard sampling procedure (SSP) attached in the appendices. Soil samples were collected from the fill and natural profiles based on field observations. The sample depths are shown on the logs attached in the appendices. Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. During sampling, soil at selected depths was split into primary and duplicate samples for field QA/QC analysis.
Field Screening	A portable Photoionisation Detector (PID) fitted with a 10.6mV lamp was used to screen the samples for the presence of volatile organic compounds (VOCs). PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. PID calibration records are maintained on file by EIS. Fill/spoil at the sampling locations was visually inspected during the works for the presence of fibre cement fragments.
Decontami-nation and Sample Preservation	Sampling personnel used disposable nitrile gloves during sampling activities. Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with the SSP. On completion of the fieldwork, the samples were stored temporarily in fridges in the EIS warehouse before being delivered in the insulated sample container to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures.

[10] NSW EPA, (1995), *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)

6.3 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 6-2: Analytical Schedule

Analyte/CoPC	Fill Samples	Natural Soil Samples	Fibre Cement Material Samples
Heavy Metals	6	3	-
TRH/BTEX	6	3	-
PAHs	6	3	-
OCPs/OPPs	6	3	-
PCBs	6	3	-
Asbestos	6	NA	1

6.3.1 Laboratory Analysis

Samples were analysed by an appropriate, NATA Accredited laboratory using the analytical methods detailed in Schedule B(3) of NEPM 2013. Reference should be made to the laboratory reports attached in the appendices for further details.

Table 6-3: Laboratory Details

Samples	Laboratory	Report Reference
All primary samples and field QA/QC sample (intra-laboratory duplicate)	Envirolab Services Pty Ltd NSW, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	186248

7 SITE ASSESSMENT CRITERIA (SAC)

The SAC were derived from the NEPM 2013 and other guidelines as discussed in the following sub-sections. The guideline values for individual contaminants are presented in the attached report tables and further explanation of the various criteria adopted is provided in the appendices.

7.1 Soil

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

7.1.1 Human Health

- Health Investigation Levels (HILs) for a 'residential with minimal access opportunities for soil access' exposure scenario (HIL-B);
- Health Screening Levels (HSLs) for a 'low-high density residential' exposure scenario (HSL-A & HSL-B). HSLs were calculated based on the soil type and the most conservative depth interval of 0m to 1m;
- Where exceedances of the HSLs were reported for hydrocarbons (TRH/BTEX and naphthalene), the soil health screening levels for direct contact presented in the CRC Care Technical Report No. 10 – Heath screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document (2011)[11] were considered; and
- Asbestos was assessed on the basis of presence/absence. Asbestos HSLs were not adopted as detailed asbestos quantification was not undertaken.

7.1.2 Environment (Ecological – terrestrial ecosystems)

- Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for an 'urban residential and public open space' (URPOS) exposure scenario. These have only been applied to the top 2m of soil as outlined in NEPM (2013); and
- ESLs were calculated based on the soil type. EILs for selected metals were calculated based on the most conservative added contaminant limit (ACL) values presented in Schedule B(1) of NEPM (2013) and published ambient background concentration (ABC) values presented in the document titled Trace Element Concentrations in Soils from Rural and Urban Areas of Australia (1995)[12]. This method is considered to be adequate for the Tier 1 screening.

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

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

7.1.3 Waste Classification

Data for the waste classification assessment were assessed in accordance with the Waste Classification Guidelines, Part 1: Classifying Waste (2014)[13] as outlined in the following table:

Table 7-1: Waste Categories

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

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

8 RESULTS

8.1 Summary of Data (QA/QC) Evaluation

The data evaluation is presented in the appendices. In summary, EIS are of the opinion that the data are adequately precise, accurate, representative, comparable and complete to serve as a basis for interpretation to achieve the investigation objectives.

8.2 Subsurface Conditions

A summary of the subsurface conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 8-1: Summary of Subsurface Conditions

Profile	Description
Fill	Fill was encountered in all boreholes and extended to depths of approximately 0.3m to 0.7m. BH102 was terminated in the fill at a maximum depth of approximately 0.7m due to hand auger refusal. The fill typically comprised silty sand, sandy silt, and silty clay with inclusions of ironstone gravels, root fibres, ash, brick and clay. Odours or staining were not observed in the fill during the investigation. Potential asbestos containing material was not observed within the fill during the investigation.
Natural Soil	Natural sandy clay, clayey sand and silty sand sandy soils were encountered beneath the fill soils in BH101, BH103, BH104, BH105 and BH106. Neither odours nor staining was observed in the natural soils during sampling.
Groundwater	Groundwater seepage was not encountered in the boreholes during drilling. All boreholes remained dry on completion of drilling and a short time after.

8.3 Field Screening

PID soil sample headspace readings are presented in attached report tables and the COC documents attached in the appendices. All results were 0ppm to 1.0ppm isobutylene equivalents which indicates a lack of significant PID detectable VOCs.

8.4 Soil Laboratory Results

The soil laboratory results are compared to the relevant SAC in the attached report tables. A summary of the results assessed against the SAC is presented below:

8.4.1 Human Health and Environmental (Ecological) Assessment

Table 8-2: Summary of Soil Laboratory Results – Human Health and Environmental (Ecological)

Analyte	Results Compared to SAC
Heavy Metals	All heavy metals results were below the SAC.
TRH	All TRH results were below the SAC.
BTEX	All BTEX results were below the SAC. All BTEX concentrations were below the laboratory PQLs.
PAHs	All PAH results were below the SAC. All PAH concentrations were below the laboratory PQLs. All carcinogenic PAH results were below the SAC. All carcinogenic PAH concentrations were below the laboratory PQLs.
OCPs and OPPs	All OCP and OPP results were below the SAC. All pesticide concentrations were below the laboratory PQLs.
PCBs	All PCB results were below the SAC. All PCB concentrations were below the laboratory PQLs.
Asbestos	Asbestos was detected in the representative fragment of fibre cement analysed for the investigation. All soil asbestos results were below the SAC (i.e. asbestos was absent in the soil samples analysed for the investigation).

8.4.2 Waste Classification Assessment

The laboratory results were assessed against the criteria presented in Part 1 of the Waste Classification Guidelines, as summarised previously in this report. The results are presented in the report tables attached in the appendices. A summary of the results is presented below.

Table 8-3: Summary of Soil Laboratory Results Compared to CT and SCC Criteria

Analyte	No. of Samples Analysed	No. of Results > CT Criteria	No. of Results > SCC Criteria	Comments
Heavy Metals	9	0	0	-
TRH	9	0	0	-
BTEX	9	0	0	-
Total PAHs	9	0	0	-

Analyte	No. of Samples Analysed	No. of Results > CT Criteria	No. of Results > SCC Criteria	Comments
Benzo(a)pyrene	9	0	0	-
OCPs & OPPs	9	0	0	-
PCBs	9	0	0	-
Asbestos	6	0	0	Asbestos was not detected in the soil samples analysed.
Asbestos in FCF	1	-	-	Asbestos was detected in the FCF analysed.

9 PRELIMINARY WASTE CLASSIFICATION ASSESSMENT

9.1 Preliminary Waste Classification of Fill

Table 9-1: Preliminary Waste Classification

Material	Classification	Disposal Option
Fill material in the southern portion of the site (see Figure 3)	General Solid Waste (non-putrescible) containing asbestos	Appropriately licensed landfill. The landfill should be contacted to obtain the required approvals prior to commencement of excavation.
Fill material not containing any anthropogenic inclusions in the northern half of the site (see Figure 3)	General Solid Waste (non-putrescible)	Appropriately licensed landfill. The landfill should be contacted to obtain the required approvals prior to commencement of excavation.

The fill material must be disposed of to a NSW EPA licensed facility. It is the responsibility of the receiving facility to ensure that the material meets their EPA license conditions. EIS accepts no liability whatsoever for illegal or inappropriate disposal of excavated material.

9.2 Classification of Natural Soil

Based on the scope of work undertaken for this screening, and at the time of reporting, EIS are of the opinion that the natural soil at the site meets the definition of **VENM** for off-site disposal or re-use purposes. VENM is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. In accordance with Part 1 of the Waste Classification Guidelines, the VENM is pre-classified as general solid waste and can also be disposed of accordingly to a facility that is licensed to accept it.

10 DISCUSSION AND CONCLUSIONS

10.1 Summary of Site Contamination

The assessment has identified the following issues associated with the AEC identified at the site.

10.2 Tier 1 Risk Assessment and Review of CSM

For a contaminant to represent a risk to a receptor, the following three conditions must be present:

1. Source – The presence of a contaminant;
2. Pathway – A mechanism or action by which a receptor can become exposed to the contaminant; and
3. Receptor – The human or ecological entity which may be adversely impacted following exposure to contamination.

If one of the above components is missing, the potential for adverse risks is relatively low.

10.2.1 Soils

Elevated concentrations of CoPC were not encountered above the adopted SAC in any of the soil samples analysed.

10.2.2 Asbestos in FCF

FCF containing asbestos (KTF1) was identified on the site surface around the structure at No.3 Quarry Road (see Figure 2). The fragment observed could not be broken by hand pressure. The source of this FCF is considered to be associated with uncontrolled imported fill material at the site as there was no corresponding damage identified to the site structure adjacent to the material.

FCF containing asbestos in excess of 10 pieces, was identified on the site surface and embedded in the fill material in the southern portion of the site (refer to Figure 2). The fragments observed could not be broken by hand pressure. The source of this FCF is considered to be associated with uncontrolled imported fill material at the site.

It is noted that the existing buildings and structures at the site are of an age consistent with containing hazardous building materials including asbestos fibre cement.

10.3 Decision Statements

The decision statements are addressed below:

Did the site inspection, or does the historical information identify potential contamination sources/AEC at the site?

Yes. The inspection identified the presence of FCF containing asbestos across the southern portion of the site, fill across the entire site and stored materials that could be a source of contamination. The historical assessment identified various potential sources of contamination/AEC, including fill, historical agricultural land use (orchards and farming) and, hazardous building materials (i.e. from former demolition and existing structures).

Agricultural/horticultural activities are listed in Table 1 of the SEPP55 Planning Guidelines as activities that may cause contamination.

Are any results above the SAC?

Asbestos was detected in the representative sample of FCF analysed for the investigation. None of the soil results were above the SAC.

Do potential risks associated with contamination exist, and if so, what are they?

EIS are of the opinion that there are potential risks associated with contamination at the site. Potential risks include contamination within fill material in the southern portion of the site identified to contain inclusions of building and demolition waste (there is the possibility of encountering more FCF containing asbestos in demolition rubble). EIS note that the preliminary soil screening was undertaken from six locations.

Is there a requirement for remediation or further investigation?

Further investigation to assess whether remediation is required or whether the asbestos issue can be managed by implementing an Asbestos Management Plan (AMP) is considered to be required.

Is the investigation area(s) suitable for the proposed development, or can the investigation area(s) be made suitable subject to further characterisation and/or remediation?

EIS are of the opinion that the site can be made suitable for the proposed development outlined in Section 1.1, subject to the implementation of the recommendations outlined in Section 11.

10.4 Data Gaps

The assessment has identified the following data gaps:

- The presence of hazardous building materials in the existing buildings has not been assessed;
- Areas beneath the existing site structures have not been investigated;
- The minimum sampling density for a Stage 2 Environmental Site Assessment has not been met. The investigation was designed as a preliminary screening;
- Groundwater at the site has not been investigated; and
- The current waste classification is based on a limited amount of data. The extent of the various waste streams can be further refined with additional data.

11 CONCLUSIONS AND RECOMMENDATIONS

EIS consider that the report objectives outlined in Section 1.2 have been addressed. The ESA included a desktop site history assessment and fill/soil sampling from a total of six boreholes. The historical assessment identified various potential sources of contamination/AEC, including historical agricultural land use (orchards and farming), fill material and hazardous building materials (i.e. from former demolition and within existing site structures). The site inspection identified numerous stored materials that could be a source of contamination.

Asbestos was detected in the FCF analysed for the investigation. Elevated concentrations of contaminants above the SAC were not identified in the soil during the investigation. Based on the current site development, the potential contamination sources/contaminants identified, and the perceived potential for contamination, further investigation of the contamination conditions within the fill material, particularly in the southern portion of the site should be undertaken.

EIS recommend that any further sampling is undertaken using a combination of backhoe or small excavator and a drill rig. The additional sampling should:

i. Aim to increase the overall sampling density to that recommended in the NSW EPA Sampling Design Guidelines 1995;
ii. Targeted additional sampling in the fill containing inclusions of building and demolition materials identified in the southern section of the site;
iii. Establish whether remediation or contamination management is likely to be required.

The analytical schedule should include: heavy metals; total recoverable hydrocarbons (TRH); benzene, toluene, ethyl benzene and xylene (BTEX); polycyclic aromatic hydrocarbons (PAHs); organochlorine and organophosphate pesticides (OCPs & OPPs); polychlorinated biphenyls (PCBs) and asbestos.

12 LIMITATIONS

The report limitations are outlined below:

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

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IMPORTANT INFORMATION ABOUT THIS REPORT

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

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

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

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

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

Changes in Subsurface Conditions

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

This Report is based on Professional Interpretations of Factual Data

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

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

Assessment Limitations

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

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

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

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

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

EIS

REPORT FIGURES

LABORATORY SUMMARY TABLES

Appendix A: Site Information including Site History

Proposed Development Plan

Site Photographs 1 March 2018

Project Ref: E31137K
Site Address: 3 Quarry Road, Dural NSW
Selected Site Photos Dated: 1 March 2018

Photograph 1: Stored disused paint tins and other drums/containers of unknown contents in three international bunded containers (IBCs) located in northern corner of site (see Figure 2).

Photograph 2: Stored 44 gallon drums located in northern corner of site (see Figure 2).

Photograph 3: Stored cars located in northern section of site (see Figure 2).

Photograph 4: Stored building materials located in northern section of site (see Figure 2).

Photograph 5: Stored Crane and Cold storage truck located in northern section of site (see Figure 2).

Photograph 6: Stored IBCs x9 located in central north section of site (see Figure 2).

Photograph 7: Disused diesel tractor located in central section of site to the north of the creek (see Figure 2).

Photograph 8: Stored boats along southern side of creek in central section of site (see Figure 2).

Photograph 9: Building/demolition rubble in stockpile within the southern section of site (see Figure 2).

Photograph 10: Building/demolition rubble in stockpile within the southern section of site (see Figure 2).

Photograph 11: Piles of felled trees located in the southern section of site (see Figure 2).

Photograph 12: Example of observed fibre cement fragments on surface of site (see Figure 2).

Photograph 13: Residence at No.4 Vineys Road. Generally constructed with weatherboard/fibre cement clad walls and tile roof.

Photograph 14: Detached granny flat/garage, No.4 Vineys Road. Generally constructed with fibre cement clad walls and corrugated fibre cement sheet roof.

Photograph 15: Residence at **No.**3 Quarry Road. Structure generally constructed with fibre cement clad walls and corrugated fibre cement roof.

Lotsearch Environmental Risk and Planning Report

Land Title Records

Section 149 Certificates

Appendix B: Borehole Logs

Appendix C: Laboratory Report & COC Documents

Appendix D: Report Explanatory Notes

STANDARD SAMPLING PROCEDURE

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by EIS. The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

Soil Sampling

- Prepare a borehole/test pit log or made a note of the sample description for stockpiles.
- Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill rig/excavator such that the machine can operate in a safe manner.
- Ensure all sampling equipment has been decontaminated prior to use.
- Remove any surface debris from the immediate area of the sampling location.
- Collect samples and place in glass jar with a Teflon seal. This should be undertaken as quickly as possible to prevent the loss of any volatiles. If possible, fill the glass jars completely.
- Collect samples for asbestos analysis and place in a zip-lock plastic bag.
- Label the sampling containers with the EIS job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
- Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled zip-lock plastic bags. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.
- Record the lithology of the sample and sample depth on the borehole/test pit log generally in accordance with AS1726-1993[14].
- Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with the standards outlined in the report.
- Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork where it is safe to do so. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.
- Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

Decontamination Procedures for Soil Sampling Equipment

- All sampling equipment should be decontaminated between every sampling location. This excludes single use PVC tubing used for push tubes etc. Equipment and materials required for the decontamination include:
  - Phosphate free detergent (Decon 90);
  - Potable water;
  - Stiff brushes; and
  - Plastic sheets.
- Ensure the decontamination materials are clean prior to proceeding with the decontamination.
- Fill both buckets with clean potable water and add phosphate free detergent to one bucket.

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[14] Standards Australia, (1993), *Geotechnical Site Investigations.* (AS1726-1993)

- In the bucket containing the detergent, scrub the sampling equipment until all the material attached to the equipment has been removed.
- Rinse sampling equipment in the bucket containing potable water.
- Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure, high-pressure water cleaning is recommended. If any equipment is not completely decontaminated by both these processes, then the equipment should not be used until it has been thoroughly cleaned.

Groundwater Sampling

Groundwater samples are more sensitive to contamination than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

- After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.
- Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling, the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.
- Measure the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.
- Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or other low flow) techniques.
- Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
  - Stericup single-use filters (for heavy metals samples);
  - Bucket with volume increments;
  - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles;
  - Bucket with volume increments;
  - Flow cell;
  - pH/EC/Eh/Temperature meters;
  - Plastic drums used for transportation of purged water;
  - Esky and ice;
  - Nitrile gloves;
  - Distilled water (for cleaning);
  - Electronic dip meter;
  - Low flow peristaltic pump and associated tubing; and
  - Groundwater sampling forms.

- Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.
- Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.
- Groundwater samples are obtained from the monitoring wells using low flow sampling equipment to reduce the disturbance of the water column and loss of volatiles.
- During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.
- All measurements are recorded on specific data sheets.
- Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles, BTEX vials or plastic bottles.
- All samples are preserved in accordance with water sampling requirements specified by the laboratory and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice.
- At the end of each water sampling complete a chain of custody form for samples being sent to the laboratory.

<u>Decontamination Procedures for Groundwater Sampling Equipment</u>

- All equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.
- The following equipment and materials are required for the decontamination procedure:
    - Phosphate free detergent;
    - Potable water;
    - Distilled water; and
    - Plastic Sheets or bulk bags (plastic bags).
- Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.
- Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.
- Flush pump head with distilled water.
- Change water and detergent solution after each sampling location.
- Rinse sampling equipment in the bucket containing distilled water.
- Place cleaned equipment on clean plastic sheets.
- If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994)[15] methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (1991)[16].

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

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

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

Precision

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

Accuracy

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

Representativeness

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

Completeness

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

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

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

[16] Keith., H, (1991). *Environmental Sampling and Analysis, A Practical Guide.*

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

Comparability

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

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

Blanks

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

Matrix Spikes

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

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

Surrogate Spikes

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

Duplicates

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

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

SCREENING CRITERIA DEFINITIONS

The following definitions have been adopted based on Schedule B(1) of NEPM (2013) and are relevant to Tier 1 screening criteria adopted for contamination assessments.

Health investigation levels (HILs) have been developed for a broad range of metals and organic substances. The HILs are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions should determine the depth to which HILs apply for other land uses.

Health screening levels (HSLs) have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via the inhalation and direct contact pathways. The HSLs depend on specific soil physicochemical properties, land use scenarios, and the characteristics of building structures. They apply to different soil types, and depths below surface to >4 m. HSLs have also been developed for asbestos and apply to the top 3m of soil.

Ecological investigation levels (EILs) have been developed for selected metals and organic substances and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and land use scenarios and generally apply to the top 2 m of soil.

Ecological screening levels (ESLs) have been developed for selected petroleum hydrocarbon compounds and total petroleum/recoverable hydrocarbon (TPH/TRH) fractions and are applicable for assessing risk to terrestrial ecosystems. ESLs broadly apply to coarse- and fine-grained soils and various land uses. They are generally applicable to the top 2 m of soil.

Groundwater investigation levels (GILs) are the concentrations of a contaminant in groundwater above which further investigation (point of extraction) or a response (point of use) is required. GILs are based on Australian water quality guidelines and drinking water guidelines and are applicable for assessing human health risk and ecological risk from direct contact (including consumption) with groundwater.

Management Limits for Petroleum hydrocarbons are applicable to petroleum hydrocarbon compounds only. They are applicable as screening levels following evaluation of human health and ecological risks and risks to groundwater resources. They are relevant for operating sites where significant sub-surface leakage of petroleum compounds has occurred and when decommissioning industrial and commercial sites.

Interim soil vapour health investigation levels (interim HILs) have been developed for selected volatile organic chlorinated compounds (VOCCs) and are applicable to assessing human health risk by the inhalational pathway. They have interim status pending further scientific work on volatile gas modelling from the sub-surface to building interiors for chlorinated compounds.

Appendix E: Data (QA/QC) Evaluation

DATA (QA/QC) EVALUATION

INTRODUCTION

This Data (QA/QC) Evaluation forms part of the validation process for the DQOs documented in Section 6.1 of this report. Checks were made to assess the data in terms of precision, accuracy, representativeness, comparability and completeness. These 'PARCC' parameters are referred to collectively as DQIs and are defined in the Report Explanatory Notes attached in the report appendices.

Field and Laboratory Considerations

The quality of the analytical data produced for this project has been considered in relation to the following:

- Sample collection, storage, transport and analysis;
- Laboratory PQLs;
- Field QA/QC results; and
- Laboratory QA/QC results.

Field QA/QC Samples and Analysis

A summary of the field QA/QC samples collected and analysed for this assessment is provided in the following table:

Sample Type	Sample Identification	Frequency (of Sample Type)	Analysis Performed
Intra-laboratory duplicate (soil)	Dup 1 (primary sample BH103 0-0.1m)	Approximately 11% of primary samples	Heavy metals, TRH/BTEX, and PAHs

The results for the field QA/QC samples are detailed in the laboratory summary table (Table E) attached to the assessment report and are discussed in the subsequent sections of this Data (QA/QC) Evaluation report.

Data Assessment Criteria

EIS adopted the following criteria for assessing the field and laboratory QA/QC analytical results:

Field Duplicates

Acceptable targets for precision of field duplicates in this report will be less than 50% RPD for concentrations greater than 10 times the PQL, less than 75% RPD for concentrations between five and 10 times the PQL and less than 100% RPD for concentrations that are less than five times the PQL. RPD failures will be considered qualitatively on a case-by-case basis taking into account factors such as the sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Laboratory QA/QC

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

A summary of the acceptable limits adopted by the primary laboratory (Envirolab) is provided below:

RPDs

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

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics;
- 60-140% recovery acceptable for organics; and
- 10-140% recovery acceptable for VOCs.

Surrogate Spikes

- 60-140% recovery acceptable for general organics; and
- 10-140% recovery acceptable for VOCs.

Method Blanks

- All results less than PQL.

DATA EVALUATION

Sample Collection, Storage, Transport and Analysis

Samples were collected by trained field staff in accordance with the EIS SSP. The SSP was developed to be consistent with relevant guidelines, including NEPM (2013) and other guidelines made under the CLM Act 1997.

Appropriate sample preservation, handling and storage procedures were adopted. Laboratory analysis was undertaken within specified holding times in accordance with Schedule B(3) of NEPM (2013) and the laboratory NATA accredited methodologies.

Envirolab noted that the asbestos results were reported to be consistent with the recommendations in NEPM (2013), however this level of reporting is outside the scope of their NATA accreditation. In the absence of other available analytical methods for asbestos, this was found to be acceptable for the purpose of this assessment.

Review of the project data also indicated that:

- COC documentation was adequately maintained;
- Sample receipt advice documentation was provided for all sample batches;
- All analytical results were reported; and

- Consistent units were used to report the analysis results.

Laboratory PQLs

Appropriate PQLs were adopted for the analysis and all PQLs were below the SAC.

Field QA/QC Sample Results

Field Duplicates

The results indicated that field precision was acceptable. RPD non-conformances were reported for some heavy metals chromium and zinc. As both the primary and duplicate sample results were less than the SAC, the exceedances are not considered to have had an adverse impact on the data set as a whole.

Laboratory QA/QC

The analytical methods implemented by the laboratory were performed in accordance with their NATA accreditation and were consistent with Schedule B(3) of NEPM (2013). The frequency of data reported for the laboratory QA/QC (i.e. duplicates, spikes, blanks, LCS) was considered to be acceptable for the purpose of this assessment.

DATA QUALITY SUMMARY

EIS are of the opinion that the data are adequately precise, accurate, representative, comparable and complete to serve as a basis for interpretation to achieve the investigation objectives.

Appendix F: Guidelines and Reference Documents

Contaminated Land Management Act 1997 (NSW)

Department of Land and Water Conservation, (1997). 1:25,000 Acid Sulfate Soil Risk Map (Series 9130N3, Ed 2)

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

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

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

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

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

National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

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

Protection of the Environment Operations Act 1997 (NSW)

State Environmental Planning Policy No.55 – Remediation of Land 1998 (NSW)