Upgrades to Chatswood Public School and Chatswood High School

Appendix 13 - Remediation Action Plan

SSD 9483
Prepared by JSB&G
For School Infrastructure NSW, Department of Education

Artists impression of upgrades to Chatswood Public School

Upgrades to Chatswood Public School and Chatswood High School

Chatswood Public School Remedial Action Plan

5 Centennial Avenue, Chatswood NSW

20 February 2020

55579/127236 (Rev 0)

JBS&G Australia Pty Ltd

www.jbsg.com.au

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Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AHD	Australian Height Datum
ASS	Acid Sulfate Soils
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
COC	Chain of Custody
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
DA	Development application
DCP	Development Control Plan
DSI	Detailed Site Investigation
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EIL	Ecological Investigation Levels
EMP	Environmental Management Plan
ENM	Excavated Natural Material
EPA	NSW Environment Protection Authority
ESA	Environmental Site Assessment
ESL	Ecological Screening Levels
ha	Hectare
HIL	Health Investigation Levels
HSL	Health Screening Levels
JBS&G	JBS&G Australia Pty Ltd
LCS	Laboratory Control Sample
LEP	Local Environmental Plan
LOR	Limit of Reporting
NATA	National Association of Testing Authorities
NEPC	National Environmental Protection Council
OCP	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness and Sensitivity
PCB	Polychlorinated Biphenyls
pH	Potential of Hydrogen
PID	Photo-ionisation Detector
ppm	Parts Per Million
QA/QC	Quality Assurance / Quality Control
RAP	Remedial Action Plan
RPD	Relative Percent Difference
SMF	Synthetic Mineral Fibre
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
VENM	Virgin Excavated Natural Material

1. Introduction

1.1 Introduction and Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by Pells Sullivan Meynink (PSM, the client), on behalf of Johnstaff, to prepare a Remedial Action Plan (RAP) to facilitate the redevelopment of the Chatswood Public School site, located at 5 Centennial Avenue, Chatswood, NSW (the site). The site is legally identified as Lot 1 in Deposited Plan DP 812207 and Lot C in DP 346499. The site covers an area of approximately 1.4 ha. The site location and site layout are shown in **Figures 1** and **2**, respectively.

The site, along with Chatswood High School, forms the broader Upgrades to Chatswood Public School and Chatswood High School. The Upgrade forms part of the NSW Government's investment in primary and secondary education to meet the increasing demand for educational facilities. It is understood by JBS&G that the site (current Chatswood Public School) will be retained for use as a primary school campus.

Previous investigations at the site (DP 2018[1], JBS&G 2019a[2]) have identified heavy metals, polycyclic aromatic hydrocarbon (PAHs) and total recoverable hydrocarbon (TRH) impacts in soils, which pose a potentially unacceptable risks to human health under the proposed redevelopment and associated land uses, pursuant to the *National Environmental Protection Measure (NEPM)* (NEPC 2013[3]). It is noted that the since the completion of the site investigations, the proposed land use has been updated from a secondary education facility (open space land use criteria) to a primary education facility (residential land use criteria). The conclusions of the investigation remain relevant to the site.

A Remedial Action Plan (RAP) is required for the remediation/management of contaminated fill material to enable the site to be considered suitable for the proposed primary education facility, consistent with the most conservative NEPC (2013) land use scenario - residential with garden/accessible soil and including childcare centres, preschools and primary schools..

It is also noted that a number of previous hazardous building materials registers have been prepared for the site, including that completed by Douglas Partners (DP 2018[4]) and Greencap (Greencap 2014[5]). A hazardous building materials survey (HBMS) was completed by JBS&G (2019b[6]) on the structures at the site. It was recommended that the hazardous materials be removed appropriately prior to the demolition and/or refurbishment of the structures.

This RAP has been prepared with reference to relevant guidelines made or endorsed by the NSW Environment Protection Agency (EPA) inclusive of NEPC (2013) and also the requirements of *State Environmental Planning Policy 55 – Remediation of Land* (SEPP 55[7]).

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1 Report on Preliminary Site (Contamination) Investigation with Limited Sampling: Proposed Redevelopment Chatswood Public School, High School and Public School "Bush Campus", Chatswood, Douglas Partners 2018 (DP 2018)

2 *Chatswood Public School, Chatswood Education Precinct Detailed Site Investigation*. JBS&G Australia Pty Ltd, issued 28 October 2019, Rev B (JBS&G 2019a)

3 *National Environment Protection (Assessment of Site Contamination) Measure, Amendment No 1 (2013).* National Environment Protection Council (NEPC 2013)

4 *Hazardous Building Materials (HBM) Register, Chatswood Public School. 5 Centennial Ave, Chatswood, NSW 2067.* Douglas Partners Pty Ltd, Ref: 86260.03.R.001.Rev0, issued 9 March 2018 (DP 2018).

5 *Asbestos Register, Chatswood Public School*. Greencap Pty Ltd, issued 13 August 2014 (Greencap 2014)

6 *Hazardous Building Materials Survey, Chatswood Public School.* JBS&G Australia Pty Ltd, issued 19 February 2019 Rev 0 (JBS&G 2019b).

7 *Managing Land Contamination – Planning Guidelines SEPP 55 Remediation of Land*. Department of Urban Affairs and Planning. Environment Protection Authority 1998 (DUAP 1998)

1.2 Objective

The objectives of this RAP are to:

- Define the conceptual site model (CSM) of the proposed site development including identification of potential areas of contaminant exposure as specific to the proposed redevelopment and continued use as a primary educational facility;
- Define the extent of remedial works required to make the site suitable for the proposed redevelopment and ongoing school use;
- Establish a framework and methodologies to validate the removal of risk to site contamination as identified as posing a potential risk; and
- Include provision for management of environmental and safety risks during the implementation of the remedial works, and guidance for the any requirements of ongoing management of impacted materials retained on the site.

2. Site Condition & Setting

2.1 Site Location and Description

The site details are summarised in **Table 2.1**. A plan showing the location of the site is provided as **Figure 1**, and a plan showing the boundaries of the site is provided as **Figure 2**.

Table 2.1: Site Identification

Lot / DP Number	Lot 1, DP 812207 and Lot C, DP 346499
Street Address	5 Centennial Avenue, Chatswood
Local Government Authority	Willoughby City Council
Site Area	Approximate centre of site: 331312.749 E 6258715.294 N (GDA94-MGA56)
Current Zoning	R2 Low Density Residential
Geographic Coordinates	Approximately 1.4 ha
Previous Land Use	Primary School
Current Land Use	Primary School
Potential Future Use and Permissible Uses	Primary School

2.2 Site Description

The following site inspection is included from documentation recently prepared by JBS&G (2019a).

A detailed site inspection was undertaken on 9 January 2019, and field works were completed on 23, 24 and 25 January, and 10, 11 October 2019, by two of JBS&G's trained and experienced field scientists. Site observations are discussed below.

The site comprised an irregular shaped parcel of land. The site was secured with perimeter fencing, with three access points via locked gates located at the north-east (Pacific Highway), south-east (Centennial Avenue), and west boundaries of the site (Jenkins Street).

The site generally sloped in a westerly direction. Considering the substantially sloped and terraced topography, a degree of cut and fill is likely to have occurred at the site.

Five large buildings were present across the southern portion of the site, utilised as classrooms, offices, a library, and a canteen. Asphalt sealed playgrounds and an asphalt sealed carpark were located at the centre and north east corner of the site. Additional playgrounds were located at the north and north west portion of the site, which featured an open space sports field covered with synthetic grass, a basketball court and a tennis court.

Additionally, a complex of buildings was located in the southeast corner of the site (Lot C, DP 346499).

The site contained some vegetation in between hardstand areas including large gum and eucalyptus trees, some minor grass cover and perennial herbs. Vegetation was found sporadically throughout the site and its borders. All vegetation appeared unstressed and in good health.

No visible evidence of widespread contamination or significant areas of environmental concern were identified on readily visible/accessible ground surfaces during the site inspection.

2.3 Surrounding Land-Use

Surrounding land-uses at the time of site inspection are described following:

- North – The northern boundary is formed by low to medium density residential land and commercial properties fronting the Highway. North along the Highway is a small public reserve (Kenneth Slessor Park) succeeded by Chatswood Toyota and Fullers Road;
- South – The southern boundary is formed by Centennial Avenue. This is succeeded by medium to high density residential apartments and Chatswood BMW;

- East – The eastern boundary is formed by the Pacific Highway. This is immediately succeeded by high density commercial buildings and residential apartments. This is followed by landmarks including Chatswood railway station, Dougherty Community Centre and Westfield Chatswood Shopping centre;
- West – The western boundary of the site was formed by Jenkins street and low density residential properties. Immediately adjacent and continuing westwards are low/medium residential properties and Chatswood High School along Centennial Avenue.

2.4 Environmental Setting

The environmental setting is detailed in JBS&G (2019a) and summarised below for completeness.

Table 2.2: Summary of Environmental Characteristics

Environmental Aspect	Characteristics
Topography	A review of topographical information available on Nearmap indicated the elevation of the site centre was approximately 109 m Australian Height Datum (AHD). The site sloped generally towards the west and south west, towards Ferndale Park and Swaines Creek at the western extent of Centennial Avenue. The site appeared to have undergone cut and fill activities including terracing of site areas based on observations made during the site inspection.
Hydrology	Precipitation to fall onto buildings and paved areas will flow into engineered drainage lines and the local stormwater system. Rainfall will potentially penetrate the soft ground (e.g. garden beds, unpaved areas across the school grounds) and migrate as shallow/perched groundwater towards Swaines Creek, and/or to stormwater infrastructure. It was anticipated that surface run-off will flow to engineered stormwater infrastructure and towards the nearby Swaines Creek, located approximately 700 m west of the site.
Geology and Soils	The site and surrounds are underlain by the Triassic Ashfield Shale of the Wianamatta Group, comprising dark grey to black which weathers to a residual clay profile of medium to high plasticity. The site is underlain by the Blacktown Soil Landscape Group. These soils comprise shallow to moderately deep (<100 cm) red and brown podzolic soils in well-drained areas, and deep (150-300 cm) yellow podzolic soils and soloths on lower slopes and poorly drained areas. Limitations of this group include moderately reactive highly plastic subsoil, low soil fertility and poor soil drainage. During the site investigation, 16 boreholes were advanced across the site, in which fill overlying natural materials was encountered from the ground surface to 1.2 m below ground surface (bgs). Natural materials encountered were observed to comprise a weathered shale profile consisting of clay grading to competent shale at varying depths.
Acid Sulfate Soils (ASS)	The *Acid Sulfate Soil Risk Map for Botany Bay*[8] indicates that the site is located in an area of no-known occurrences of ASS. Based on observations made during the intrusive investigation across the site, sediments typical of potential and actual ASS were not observed (i.e. absence of grey, organic rich, hydrogen sulphide odour etc) in the lithological profile.
Hydrogeology	A total of two registered groundwater wells fall within a 500 metre radius of site, and were located east of the site. These wells were installed into clay, shale and sandstone in 1967 and 2005 for recreational purposes and have drill depths of 21.6 and 162.6 metres below ground surface (m bgs). The standing water level was reported at 25.6 m bgs at one well. Based on the reported geology and surrounding topography it was anticipated the direction of groundwater flow would be to the west towards the Lane Cove River. Groundwater at the site was not expected to occur within shale bedrock, however may be present within more permeable strata such as sandstone or highly fractured bedrock. Perched groundwater was expected to occur at existing at interfaces of soils and underlying bedrock.

[8] *Acid Sulfate Soil Risk Map – Botany Bay, Edition 2, 1997*. 1:25 000 Ref: 91 30S3. NSW DLWC

2.5 Summary of Site History

The review of the site's history, as detailed in DP (2018) and JBS&G (2019a) indicated that the site was historically utilised as an orchard prior to the primary school's construction in 1895. The school has been subject to progressive renovations and additions of new structures since the 1890s.

2.6 Other Significant Site Information

JBS&G (2019a) included searches for the site and surrounding areas of the NSW Environmental Protection Authority (EPA) PFAS register and the NSW Fair Trading loose fill asbestos insulation register. No records pertaining to the site were found.

2.7 Proposed Development

The proposed layout for the site will generally involve:

- retention of the sealed terraced playing courts and passive play area at the north;
- retention of the majority of the central sealed courtyard area;
- construction of new multi-level buildings in the north; and
- retention of some existing trees and planting some new trees.

The proposed site layout at time of reporting is presented in **Figure 3**. Development plans are included in **Appendix A**.

3. Previous Investigations

3.1 Site Contamination Assessments

3.1.1 Preliminary Site (Contamination) Investigation (DP 2018)

Douglas Partners (DP) completed a preliminary environmental site assessment (ESA; referred to as Preliminary Site Investigation (PSI) in this report) of Chatswood Public School and the Chatswood High School site. The investigation included a desktop review of publicly available documents pertaining to the site history, and preliminary intrusive sampling associated with the geotechnical investigation.

The review of the site's history indicated that the site was historically utilised as an orchard prior to the primary school's construction in 1895. The school has been subject to progressive renovations and additions of new structures since the 1890s. Further review of the site's history indicated that a development application (DA) lodged by the school relating to works in a section of the playground known as the 'lowers' included information pertaining to an 'Incinerator Compound'. This is considered to represent a potential source of contamination at the site.

DP (2018) identified the following AECs at the site:

- Filling – potential for filling (likely from cut and fill of onsite soils) activities for the purpose of levelling the site for development. Associated contaminants of potential concern (COPC) identified were TRH, benzene, toluene, ethylbenzene and xylene (BTEX), PAH, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), organophosphate pesticide (OPPs), phenols and asbestos;
- Previous land use: Public School site was an Orchard during the 1800s. COPCs include heavy metals, PCBs, OCPs/OPPs;
- Incinerator: COPCs include PAHs, BTEX, PCBs; and
- Soils and contaminants associated with surrounding land uses such as Chatswood Toyota. Associated COPCs identified were metals, TRH, BTEX, PAHs, PCBs, OCPs, OPPs, Volatile organic compounds VOCs, phenols and asbestos.

DP (2018) undertook a limited intrusive assessment that was completed via solid flight auger and hand auger at 13 locations across the site. Fill materials were encountered from 0.15 m bgs to 2.0 m bgs (BH18) and was variably compacted predominantly silty clay material with various inclusions, which was observed to have "similar classification to the natural clay present at the site and in some instances was hard to distinguish from natural clays" (DP 2018). Inclusions within fill materials were observed to include gravels, ash, shale and some brick. Inclusions of asphalt were also observed within fill materials at the site. No asbestos was reported in soils by DP (2018).

DP (2018) adopted the most conservative NEPC (2013) human and ecological health assessment criteria, including; health investigation level (HIL) A for non-petroleum chemical contaminants, health screening levels (HSLs) A and B for vapour intrusion, HSL A for direct contact, and management limits for TRH.

The analytical data reported concentrations of COPCs in excess of the adopted site criteria at several locations. Exceedances of the adopted site criteria were reported for PAHs (HILs and ecological screening levels (ESLs)), TRH (management limits for coarse grained soils, and ESLs) at the following locations; BH16, BH18, BH21, BH23, BH24 and BH27. Soil sampling locations are shown in **Figure 4A** and **4B**, and soil exceedances are shown in **Figure 4C**.

No groundwater was encountered at any location during the sampling event.

The report concluded that exceedances of adopted site criteria were observed and as such, remediation may be required pending results from subsequent detailed site investigations (DSIs).

3.1.2 Detailed Site Investigation (DSI) (JBS&G 2019a)

JBS&G was engaged by PSM to undertake a Detailed Site Investigation (DSI) at the site. The objectives of the DSI were to characterise potential contamination at the site, and to draw conclusions regarding the suitability of the site for the proposed land use, or, to make recommendations to enable such conclusions.

JBS&G undertook sampling at 16 locations across the site utilising a combination of systematic and targeted sampling approaches, in addition to the 13 locations previously assessed by DP (2018), achieving a total of 29 systematic and targeted locations, exceeding EPA (1995) minimum sampling density guidance for the site area. Soil sampling was completed utilising an excavator equipped with an auger or via manual excavation utilising a hand auger. Selected soil samples were analysed for COPC including heavy metals, PAHs, TRH, BTEX, VOCs, OCPs, PCBs and asbestos.

All locations identified fill materials between the ground surface (or below hardstand) to a maximum depth of 1.2 m bgs. Fill materials generally comprised of brown silty sands and silty clays with gravels. Fill materials were noted to contain anthropogenic inclusions including asphalt, brick, shales and plastic. Inspection of fill materials did not identify fragments of suspected asbestos containing materials (ACM). Natural material underlying the site comprised of brown/grey clay and silty clay overlying shale bedrock.

The results of the analytical data indicated that there are potentially unacceptable risks to human and ecological health at several locations resulting from PAHs, heavy metals and TRH. It was noted that the likely source of these materials can be attributed to ash, bitumen and blue metal gravels identified in the fill profile. JBS&G did not identify any risks relating to the migration of contamination from the site. Soil sampling locations are shown in **Figure 4A** and **4B**, and soil exceedances are shown in **Figure 4C**.

In relation to the current use of the site as a primary school, noting that the school is predominantly covered by hardstand, buildings and synthetic surfaces with limited unsealed areas, and that it is expected to operate in a condition similar to that observed during the investigation, it was not considered that there was a complete contamination source-receptor pathway that would present a potentially unacceptable risk to current users of the site. As such, JBS&G concluded that in its current state (i.e. as observed during the investigation) the site is suitable for the current use. In the event that excavation works are required prior to redevelopment of the school, JBS&G recommended the development of a Construction Environmental Management Plan (CEMP), or similar, to ensure that contamination in fill is managed during and following redevelopment activities to ensure there are no complete source-receptor pathways to contaminants.

Based on the identified contamination, JBS&G recommended the development of a RAP to guide the required management of identified soil contamination during and following redevelopment such that the site can be considered suitable for the proposed educational land use.

3.2 Hazardous Material and Asbestos Survey Works

3.2.1 Asbestos Register (Greencap 2014)

An Asbestos Register re-inspection (Greencap 2014) was undertaken by Greencap in August 2014. The inspection included the re-assessment of previously identified ACM, sampling of previously unidentified ACM and details of the ACM locations. According to the report, the typical types of ACM found present within the buildings is summarised below:

- Various coloured vinyl floor tiles within internal areas;
- Fibre cement sheeting to internal ceilings, walls, and external eaves and soffits; and

- Electrical backing boards.

3.2.2 Douglas Partners (2018) – Hazardous Building Materials Register

A Hazardous Building Materials Register (DP 2018) was undertaken by Douglas Partners in February 2018. The inspection included the re-assessment of previously identified ACM in Greencap 2014, sampling and identification of previously unidentified ACM and other hazardous materials, and details of the hazardous materials locations. According to the report, the typical types of ACM and hazardous materials found present within the buildings is summarised below:

- Various coloured vinyl floor tiles within internal areas;
- Fibre cement sheeting to internal ceilings, walls, and external eaves and soffits;
- Electrical backing boards;
- Lead based paints to internal and external surfaces;
- Lead containing dust within roof voids;
- Synthetic mineral fibre (SMF) insulation in various forms within roof voids, and to boiler and air conditioning plant; and
- PCB containing capacitors to fluorescent light fittings.

3.2.3 Hazardous Building Material Survey (HBMS) (JBS&G 2019b)

JBS&G was engaged by PSM to undertake a pre-demolition hazardous building materials survey (HBMS) of the structures at the site. The objective of the investigation was to determine the presence, quantity and condition of any hazardous materials within the buildings prior to proposed demolition and refurbishment works.

The typical types of ACM and hazardous materials found present within the buildings is summarised below:

- Various coloured vinyl floor tiles within internal areas;
- Fibre cement sheeting in cubicle partitions, walls, flues and eaves;
- Lead containing dust within air conditioning lofts, roof voids and on the floor
- Lead based paints to internal and external surfaces consistent with DP (2018);
- SMF insulation assumed to be present in various forms within hot water systems, air conditioning units/ ducts, and a ceiling cavity; and
- PCB containing capacitors were assumed to be present within the older light fittings throughout the site.

It was recommended that the hazardous materials identified at the site are removed appropriately prior to the demolition and/or refurbishment of the structures. Suitably experienced and licensed removal contractors should be engaged to remove hazardous materials. It was also noted that areas that were inaccessible during the HBMS should be inspected by a suitably qualified competent person prior to any works commencing.

4. Conceptual Site Model

Based on the findings of JBS&G (2019a), the following conceptual site model (CSM) has been developed for the site.

4.1 Potential Areas of Environmental Concern

Based on the objectives of the assessment, desktop review and observations made during the site inspection, AECs and associated COPCs were identified at the site, as noted in **Table 4.1**. The actual presence of these constituents is discussed further in the following sections.

Table 4.1: Areas of Environmental Concern and Associated Contaminants of Potential Concern

Area of Environmental Concern (AEC)	Potentially Affected Media	Contaminant of Potential Concern (COPC)	Risk Profile
Fill Materials Imported and/or reworked fill materials used to create site levels (comprising material of unknown character and/or origin)	Soil	Heavy metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX), PAHs, polychlorinated biphenyls (PCB), organochlorine pesticides (OCP), and asbestos	Moderate
Former Orchards Areas formerly used as market gardens/orchards	Soil	Heavy metals, pesticides/herbicides (OCPs/OPP), asbestos	Low
Incinerator Areas in proximity to the former Incinerator	Soil	Heavy metals, PAHs, PCBs, asbestos	Low

4.2 Contaminated Media-Soils

Soil contamination identified at the site assessed by JBS&G (2019a) with respect to the residential (including primary school) NEPC (2013) land use criteria, (HIL/HSL A, NEPC 2013) is presented in **Table A**, and historical soil sampling locations are shown in **Figure 4A** (current site layout) and **4B** (proposed site layout)**.** Soil exceedances are shown in **Figure 4C**.

In consideration of the site's data set, potentially unacceptable risks to the health of ecological and human receptors at the site under the adopted land use were constrained to heavy metals (copper, nickel and zinc), PAHs (naphthalene, benzo(a)pyrene (B(a)P), carcinogenic PAHs as B(a)P toxicity equivalent quotient (TEQ), and total PAHs) and TRH.

In consideration of the site's data set, potentially unacceptable risks to the health of human receptors at the site under the adopted land use, pursuant to NEPC (2013), were constrained to PAHs, specifically; carcinogenic PAHS and total PAH, and TRH.

A review of the borelogs for the site, including those completed by DP (2018), indicate that fill materials encountered at a majority of the sampling locations were observed to contain ash, which is a likely source of elevated PAHs in soil. Furthermore, a majority of sampling locations were advanced utilising solid flight augers, through asphalt that was located at the ground surface. This may have resulted in the entrainment of PAH rich asphalt in the soil samples obtained as the boreholes were advanced. The binding agent utilised in asphalt is bitumen - a hydrocarbon product

comprised of long-chain hydrocarbons and rich in PAHs. JBS&G anticipate that the reported concentrations of PAHs are further enriched by the presence of asphalt within surficial soil samples.

Potentially unacceptable health risks from the potential intrusion of vapours to future site structures was noted from TRH (>C10-C16, F2 fraction) concentrations at two locations, BH_P_02 0-0.15 and BH18-1.0-1.1 (DP 2018). The former location was advanced in proximity to the school car park, and the latter was located at the westernmost driveway off Jenkins Street. Fill materials from BH18 (off Jenkins Street) were noted to exhibit hydrocarbon odours and ash within fill materials, which were observed between 0.8 m bgs and 1.8 m bgs. The source of these impacts is unknown. JBS&G consider that there are currently no risks posed by the reported hydrocarbon impacts as there are currently no structures overlying the sampling locations and therefore no risk for the accumulation of vapours. Furthermore, the reported concentrations only marginally exceed the adopted Tier 1 criteria and are likely to attenuate over time due to the volatile nature of the compounds.

Risks to ecological health are often considered in respect to the risks various compounds within the environment pose to ecological health under a given land use scenario and exist for the protection of soil processes, plant species and organisms that inhabit or contact soils.

In relation to the site's data set, concentrations of COPCs were generally reported below the adopted ecological criteria (ESLs/EILs), with the exception of the heavy metals of copper, nickel and zinc, petroleum hydrocarbons, and B(a)P.

A review of the borelogs indicate that basalt/dolerite (basic intrusive rock, i.e. blue metal) gravels were present in most locations beneath hardstand and within fill materials. These types of rock are naturally enriched in the heavy metals of nickel and zinc and are the likely source of these compounds in soil.

In relation to the reported concentrations of B(a)P and TRH reported in excess of the adopted ecological screening levels, observations made during the completion of field works indicated that vegetation in proximity to sampling locations that reported elevated levels of these compounds, and across the site in general, appeared to be healthy with no visual indicators of vegetative stress, indicating that soil processes responsible for ecological health did not appear to be inhibited. Furthermore, NEPC (2013) notes that high molecular weight PAHs such as B(a)P are not readily taken up by plants, and as such are unlikely to pose an unacceptable risk to plant growth. This would particularly be the case of PAH sources such as ash where the PAHs are bound into the matrix.

In relation to the current use of the site as a primary school, noting that the school is currently covered predominantly by hardstand/sealed surfaces and is expected to operate in a condition similar to those observed during the investigation at the site, JBS&G do not consider there to be a complete contamination source-receptor pathway that would present a potentially unacceptable risk to current users of the site.

4.3 Potential for Migration

The potential for migration of contaminants offsite is considered low given the nature, distribution and depth of identified contamination. JBS&G note that concrete/asphalt hardstand exists across the surface of the site and as such, do not consider there to be significant pathways for percolating surface waters to interact with the identified impacts in soils. In addition, the proposed redevelopment contains large areas of concrete/asphalt hardstand and structures, which will limit the capacity for surface water collection by site soils. Furthermore, natural clays beneath fill at the site are likely to retard vertical migration of percolating water, mitigating potential risks to groundwater and / or onsite receptors at the site.

JBS&G considers there is the potential for the aeolian and surface water transport of contamination from areas of the site that are not covered by hardstand during development. The management

strategy developed for the site will need to consider management options for dust and surface water.

4.4 Potential Exposure Pathways

Potential human receptors of environmental impact include future site users (school students, users of open spaces), visitors and construction/maintenance contractors engaged to work at the site who may potentially be exposed to COPCs through inhalation, direct contact and/or ingestion (children) of impacted soils.

Exposure to windblown dusts may pose a potential risk to sensitive human receptors however these are also considered unlikely given the predominantly sealed site surfaces.

During redevelopment of the site, potential human receptors will include:

- Inhalation of potential COPC dust and migrating upwards from fill material of unknown origins; and/ or
- Potential dermal and oral contact to impacted soils as present at shallow depths and/ or accessible by future service excavations across the extent of the site.

While existing sealed surfaces and structures over soil are retained and remain undisturbed, the exposure pathways are incomplete during normal school use. Potential exposure could occur where soils are readily accessible such as in gardens or where soils are exposed by removal of surface cover to facilitate excavation.

The site contains limited areas covered by vegetation presenting ongoing potential ecological receptors. Flora on site are potential receptors of shallow soil contamination if present. No vegetation stress relating to potential contamination from known AECs was observed during site inspection. Possible off-site ecological receptors during development include potential surface water receptors (i.e. Swains Creek to the southwest of the site).

4.5 Receptors

Potential human populations who may be exposed to site impacts in the future (if they are not remediated or appropriate management is not implemented prior to or during development) include:

- Potential future construction workers associated with the redevelopment of the site;
- Students and employees of the proposed primary school in areas where soils are readily accessible;
- Future construction and site maintenance workers undertaking ground disturbance; and
- Future and current sub-surface excavation and intrusive workers.

Given the majority of the site is currently sealed predominantly with hardstand pavement (concrete / asphalt) and proposed redevelopment will consist of predominantly sealed on-grade infrastructure, on site ecological flora/fauna are not considered likely receptors.

4.6 Preferential Pathways

Man-made preferential pathways are present throughout the assessment area, generally associated with fill materials, and at near surface depths over the remainder of the assessment area. Fill materials are anticipated to have a higher permeability than the underlying clayey soils.

Sub-surface services will be present as part of site redevelopment and preferential pathways can be created by the generally higher permeability backfill used to re-instate these trenches.

5. Remedial Action Plan

5.1 Remedial Goal

The goal for the remediation and/or management of environmental impact is to:

- Remove unacceptable risks to human populations utilising/working on/visiting the primary education facility by exposure to contaminated fill materials/soil;
- Remove or manage unacceptable ecological risks to flora/fauna posed by fill/soil contamination; and
- Undertake remedial works associated with site development works (i.e. bulk excavation, waste disposal etc) in a manner that best complies with the principles of ecologically sustainable development (ESD).

5.2 Extent of Remediation

The extent of remedial works has been determined by a review of the environmental status of the site as discussed in previous assessments and summarised in **Section 3** and **Section 4**. As well as addressing the areas of site contamination as required to meet health risk outcomes for the site, the remedial and validation works have been further designed to ensure that the direct contact pathway, which is considered to be the primary source-receptor pathway, has been appropriately managed such that the site can be considered suitable for the proposed land use.

Soils on the site are unsuitable for potential direct contact for potentially sensitive human users of the site and/or ecological receptors. Levels of a range of constituents including heavy metals, TRH, PAHs exceed criteria provided for the protection of health and/or ecological exposures. These soils are located across the entire extent of the site and are specifically shown on **Figure 4C**.

5.3 Assessment of Remedial Options

The *National Environmental Protection Measure* (NEPC 2013) lists the following order of preference for soil remediation and management, which is endorsed by EPA in EPA (2017) guidelines:

- On-site treatment of the contamination so that it is either destroyed or the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil so that the contamination is either destroyed or the associated risk is reduced to an acceptable level, after which the soil is returned to the site; or, if these are not practicable
- Consolidation and isolation of the soil on-site by containment within a properly designed barrier;
- Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with appropriate material; or
- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

Remedial options have been assessed for the proposed development as detailed in **Table 5.1** following.

Table 5.1: Remediation Options Assessment Matrix

Remedial Option	Applicability	Assessment
1. On-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	<u>Metals</u> Metals are unable to be destroyed. However, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified inorganic contaminants of concern (e.g. cement stabilisation).	<u>Metals, PAHs, TRH Compounds</u> Not a suitable option Based on the widespread extent of metals impacts in fill soils, methods for onsite treatment, such as 'microencapsulation', would require remediation of a substantial volume of soils. Remediation options are available for PAH contaminants, generally restricted to thermal treatment processes which are energy intensive. These options are not considered consistent with the ESD objectives for the site. Although petroleum hydrocarbons may be destroyed by bioremediation, the co-distribution of heavy metals and PAHs will result in the soils still not being considered suitable for the proposed site use without additional management. As these other constituents are not amenable to attenuation, this strategy is not considered viable. In addition, significant excavation activities would be required to facilitate treatment of the identified impacts, impacting upon items of heritage significance (Aboriginal and European) at the site.
	<u>PAHs</u> Polycyclic aromatic hydrocarbons present in site soils are typically restricted to heavier non-volatile constituents. These can be remediated by thermal processes. However, this requires substantial investment in plant and equipment and substantial energy use, typically involve lengthy pilot testing and regulatory approval processes. Similarly, for heavy metals, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified organic contaminants of concern (e.g., cement stabilisation).	
	<u>TRH</u> Petroleum hydrocarbons reported in soils are restricted to non-volatile fractions and are associated with observed inclusions of bitumen and/or slag and are typically co-distributed with other solid contaminants (i.e. PAHs and heavy metals). These can be remediated by bioremediation and thermal processes. However, for thermal processes, this requires substantial investment in plant and equipment and substantial energy use. In regard to bioremediation, the potential success for the bioremediation of hydrocarbon impacts is limited by the presence of other co-distributed contaminants that are unable to be bioremediated. The presence of these other contaminants will thence be the driver of remediation and as such, this is not a suitable option.	
2. Off-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level, after which the soil is returned to the site.	<u>Metals</u> Metals are unable to be destroyed. However, there are a number of microencapsulation treatment technologies which can reduce the mobility of the identified inorganic contaminants of concern (e.g. cement stabilisation).	<u>Metals/TRH/PAHs Constituents</u> Not a suitable option. Energy/resource use associated with the transport and return of materials is not considered consistent with ESD objectives for the project. In addition, significant excavation activities would be required to facilitate treatment of the identified impacts, impacting upon items of heritage significance (Aboriginal and European) at the site.
	<u>PAHs</u> PAHs present in site soils are typically restricted to heavier non-volatile constituents. These can be remediated by thermal processes. However, this requires substantial investment in plant and equipment and substantial energy use. Similarly, for heavy metals, there are a number of microencapsulation	

Remedial Option	Applicability	Assessment
	treatment technologies which can reduce the mobility of the identified organic contaminants of concern (e.g., cement stabilisation). TRH As above (Option 1), however, additional time, energy and costs are incurred to take soils off site and return them to the site, in addition to there being no currently licensed facilities in close proximity of the site to undertake soil treatment.	
3. On-site in situ management of the soil by physical separation, and ongoing management.	Fill Materials (TRH, PAHs, heavy metals) Fill materials have been found to contain concentrations of compounds that are able to be readily managed at the site. On this basis, the impacted soils are suitable for retention on the site in areas where human/ecological exposures can be restricted.	Fill Materials (TRH, PAHs, heavy metals) **This is the preferred option for the management of impacted fill materials**. The retention of the materials will reduce the waste generation and resource requirements of the remediation of the site, as consistent with the ESD objectives. The proposed redeveloped site will be subject to significant areas of building and pavements which will provide physical separation between users of the redeveloped site and retained fill materials. This will assist with preservation of potential heritage items by reducing/avoiding excavation activities. This option is of highest ranking with respect to the ESD principles as a result of the low waste volumes and energy use, and ranks higher on EPA's remediation and waste hierarchies by avoiding significant off-site disposal.
4. Excavation and off-site removal of the impacted material.	Fill Materials (TRH, PAHs, heavy metals) There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of accepting the identified contaminants within fill materials.	Fill Materials (TRH, PAHs, heavy metals) A potentially applicable option given accessibility of licensed landfills, however constraints at the site, such as the volume of impacted material and heritage values, may limit the applicability of this option. It is noted that the site contains items of high heritage significance (Aboriginal and European), as such, heritage preservation requirements may not allow for excavating large quantities of in-situ soils for remediation. In addition, contamination at the site is considered to be wide-spread in soils and shows no discernible pattern of contaminant distribution. As such, remedial approach of hotspot removal is not likely to be successful without significant excavation and offsite disposal of impacted materials. Whilst this method is viable from a technical and practical viewpoints, as a result of resource consumption and waste generation volume considerations and potential impacts to the archaeological significance of the site, this is not the preferred remedial option available, and would only be implemented as a contingency if any impacted materials are not able to be retained on site.

5.4 Regulatory and Planning Requirements

The following planning requirements for the proposed remedial works are presented.

Environment Planning and Assessment Act 1979/SEPP 55

Due to the state significant development status of the proposed redevelopment, the remediation works are classified as Category 1 Remediation Works as per the meaning provided in SEPP 55 and will require development consent under the *Environmental Planning and Assessment Act 1997*.

The nature of remediation works is relatively straightforward, and as the preferred approach will rely on use of existing and proposed surfaces and structures for capping contaminated soils either in place or by controlled cut and fill, it is considered most appropriate that development applications for remediation works are included with DA documentation for the associated earthworks as ancillary to main development, or otherwise included in an 'early works' development application.

Environment Planning and Assessment Regulation 2000 – Schedule 3 Designated Development

The proposed remediation works do not constitute designated development.

It is anticipated that the proposed remediation works will not incorporate any on-site treatment of soil. However, in the unlikely event that soil is required to be pre-treated prior to off-site disposal, an assessment of potential triggers for the works to be designated development as presented in Schedule 3 – Clause 15 will be required to be completed.

Protection of the Environment Operations Act 1997

All potential discharges from the remediation works will require to be maintained below applicable assessment criteria/threshold guidelines during the remediation works. This would apply to potential emissions in air and water. Levels of discharges are typically assessed at a site boundary.

Site specific environmental management plans, as prepared and maintained by remedial contractors, will require to ensure appropriate controls and monitoring criteria to assess compliance with these aspects.

The proposed remediation/validation activities are not required to be licensed under the *Protection of the Environment Operation Act (1997)*. The site is less than 3 ha in area, does not propose handling of greater than 30,000 m^3 of contaminated fill and hence does not trigger the licensing requirements.

Water Management Act 2000

Dewatering is not required for the proposed redevelopment works and as such, notification and/or approvals are not required to be sought from the NSW Department of Primary Industry - Water (DPI-Water).

Protection of the Environment Operations (Waste) Regulation 2014

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works will not require to be licensed. The regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded. This regulation also details additional tracking requirements for vehicles carrying Special (Asbestos) waste.

Provision is provided in the Regulation and EPA (2014[9]) guidelines for the NSW EPA to approve the immobilisation of contaminants in waste (if required).

[9] Waste Classification Guidelines – Part 1: Classifying Waste. NSW EPA 2014 (EPA 2014)

It is noted that no waste will be received at the site and only VENM, excavated natural material (ENM) or materials covered by a NSW EPA exemption will be imported to the site/site.

Waste Classification Guidelines (EPA 2014)

All wastes generated and proposed to be disposed off-site shall be assessed, classified and managed in accordance with this guideline. Where wastes require immobilisation prior to off-site disposal (to reduce waste classifications) an immobilisation approval shall be sought in accordance with Part 2 of this guideline, or otherwise General Approvals for the immobilisation of wastes in soils as historically issued by the NSW EPA. Immobilisations are only anticipated to be required with unexpected finds.

Based on observations of slag and ash within fill soils (JBS&G 2019), general EPA immobilisation approvals relating to ash and slag contaminated materials will likely apply for most of the fill materials across the site, should surplus fill material require disposal.

Willoughby City Council (2004) 'Contaminated Land Development Control Plan'

The Council contaminated land development control plan (DCP) provides a number of environmental and site management provisions required to be employed during remediation works, including the preparation and submission of a RAP to Council. However, since the site is a State Significant Development the RAP will be issued to NSW Department of Planning.

Work Health and Safety Act 2011 No 10 and Work Health and Safety Regulation 2017

The information and data provided in this RAP should be considered by the Principal/Remediation Contractor in preparation of its health and safety plans for the remedial works.

If asbestos is encountered as an unexpected find, the removal and disposal of asbestos will be managed in accordance with the Work Health and Safety Act (2011) and Work Health and Safety Regulation (2017), *How to Safely Remove Asbestos: Code of Practice* (SafeWork NSW 2019), *How to Manage and Control Asbestos in the Workplace Code of Practice* (SafeWork NSW 2019), the NSW WorkCover Managing Asbestos in or on Soil Guidelines, the NSW EPA (2014) Waste Classification Guidelines, and requirements under the Protection of the Environment Operations (Waste) Regulation (2014) for asbestos waste monitoring.

In the event asbestos impacts are identified, a licensed asbestos removalist and SafeWork notification regarding the scope of the removal works is required. If >10 m^2 non-friable (bonded) ACM is identified at the site, the appointed remediation contractor is required to obtain a site-specific permit approving the asbestos works from SafeWork NSW. A permit will not be granted without a current licence and the permit application must be made at least seven days before the work is due to commence. Removal of non-friable ACM (>10 m^2) is required to be conducted by a contractor holding at least a Class B licence. No friable ACM has been encountered at the site to date, as such asbestos-related works do not require a Class A licence.

5.5 Remedial Scope of Works

The proposed scope of remedial works will be limited to the management of contaminated soils via on-site in situ management of the soil by physical separation, and ongoing management. As such, only materials considered to be surplus to construction requirements will be disposed from the site.

5.5.1 Site Establishment

All safety and environmental controls are to be implemented as the first stage of remediation works, as outlined in **Section 8.2**. It is anticipated that all remedial works will be undertaken concurrently with construction of the site, and will include, but not be limited to:

- Locate and isolate all required utilities in the proximity of the works;
- Assess need for traffic controls;

- Work area security fencing;
- Site signage and contact numbers;
- Sediment fencing (attached to security fencing); and
- Stormwater runoff and bioremediation area sediment controls (hay bales).

5.5.2 In-Situ / Ongoing Soils Management (Physical Separation Remedial Strategy)

The impacted soil on the site can be retained on site with the site development with appropriate physical separation to maintain incomplete exposure pathways subject to ongoing management controls.

The principal of the on-site management approach is to retain materials in-situ by providing physical separation between impacted fill/soil materials and receptors (e.g. site users and workers and flora). The management approach prevents direct contact with and ingestion of contaminated soils via permeant pavements/minimum soil thickness arrangement (i.e. physical separation), and implementation of a long-term EMP to maintain the physical separation arrangements and provide controls for future ground disturbance if required. Ideally material would be maintained in place, either below existing or new surfaces/structures, without disturbance, however some controlled cut and fill during development-related earthworks may be required to facilitate and changes in site levels proposed.

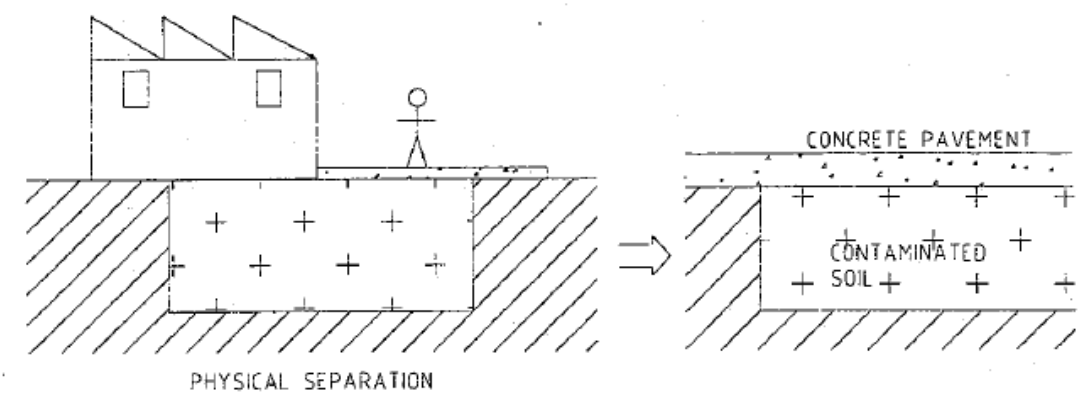
Following the removal of materials considered to be surplus to site requirements, control of vapour intrusion is not required as remaining contaminants generally fall within Groups 1, 2 and 10, as listed in Table 1 (ANZECC 1999[10]). Therefore, implementation of a 'physical separation' strategy as indicated in ANZECC (1999), in conjunction with appropriate control measures, is appropriate with respect to management of the health risk.

The minimum typical requirements in ANZECC (1999) for physical separation include:

- Permanent concrete floor slab or asphalt surfaced pavement or other suitable permanent surface material such as synthetic playing surfaces or paving. New pavement outside of the building/basement footprint shall be underlain by a marker layer, and existing surfaces where retained can be considered the marker layer; or
- A thickness of soil that is unlikely to be penetrated by future users of the site under the intended land use, underlain by a layer of 'marker layer' in areas of exposed site soil (i.e. landscaped beds). A soil cover thickness of 0.5m is commonly adopted however thinner soil cover may be acceptable where site constraints limit separation thickness or where risks can be managed appropriately.

These physical separation approaches are shown schematically below.

[10] *Guidelines for the Assessment of On-site Containment of Contaminated Soil*, Australian and New Zealand Environment and Conservation Council (ANZECC), September 1999 (ANZECC 1999)



Source: ANZECC (1999)

Given the specific development plans, as shown in **Figure 3** (ground floor) (and provided in full in **Appendix B**) and as understood at the time of preparation of this RAP, and the general preference for minor landscaping to include grassed areas and shrubs, the following physical separation arrangements are to be implemented within the extent of the site inclusive of accessible / open space areas (as shown in **Figure 6**):

- Cover of fill materials by new or replacement permanent paved/sealed areas (includes concrete, asphalt, pavers and synthetic grass areas) – installation of a marker layer underlying the depth of the pavement and overlying potentially contaminated material;
- Where existing permanent paved/sealed surfaces are to be retained, these will not require a marker layer, and the base of the surface material (concrete, asphalt, paving, synthetic grass) will be considered the marker layer above contaminated material;
- For new slab on grade buildings, the slab will provide adequate separation without the need for a marker layer, however a marker layer is recommended below building structures that are no slab-on-grade or where there is potential for future penetration of the footprint area (e.g. to facilitate service maintenance, etc);
- Covering of fill materials in landscaped areas;
    - Installation of the marker layer at a minimum depth of between 0.3 and 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), and use of environmentally suitable materials (e.g. topsoil and mulch) placed above to the final levels;
    - Installation of the marker layer at a minimum depth of 0.7m below final finished site levels in areas of new tree planting (or as required for the depth of the plant's root-ball) and use of environmentally suitable materials placed above to the final levels;
    - In areas of existing trees that are to be retained, removal of at least 0.1 m of impacted soils, installation of the marker layer at a minimum depth of 0.1 m, and placement of wet-pour rubber or similar material to the finish level; and
- Within underground services trenches – in the event underground services are to be installed within contaminated soil, the service infrastructure will require to be installed above a marker layer within suitable materials for potential human and/or ecological exposure. The marker layer is to be placed at the base and covering the walls of the trenches to the elevation of the surrounding area marker layer.

Where required to be installed, the marker layer shall consist of contrasting brightly-coloured (e.g. orange) geofabric of suitable tensile strength and durability to ensure it remains intact upon completion of development works and into the future. The specific details of the proposed marker

layer material will require to be approved by the validation consultant prior to application and the details then included in the validation report and long-term EMP documents in addition to survey plans showing the extent of its application both laterally and vertically across the site.

Material above the marker layer extending to the final finished ground level in landscaped areas will be required to be environmentally suitable material for human and/or ecological exposure (as appropriate). These physical separation arrangements shall generally comprise growing media but may potentially comprise material originating from within the site validated as suitable for reuse in accordance the requirements outlined in **Section 5.6**, imported Virgin Excavated Natural Material (VENM) or material certified in accordance with a Resource Recovery Order and Exemption issued by the NSW EPA. Where materials are proposed for beneficial reuse under an NSW EPA exemption (i.e. imported to the site), fill material will need to be further assessed for land use suitability. Sampling densities and analysis for COPC will be dependent on the volume, material type, source and subject to the Environmental Consultant's endorsement and acceptance.

Installation of physical separation arrangements shall be defined by survey as completed by a registered surveyor and/or building as-built drawings sufficient to identify:

- The lateral extent and upper depth height of known environmentally impacted materials (i.e. residual fill materials underlying the cover) within each remediation area/stage;
- The lateral extent and type of cover (e.g. permanent pavement, validated fill material, garden bed, rubber, etc) within the remediation area/stage; and
- Confirmation, by photos or otherwise, of the installation of the 'marker layer' underlying the cover (as required).

5.5.3 Excavation and Off-site Removal of Site Fill Materials

It is anticipated that there will be some excavation of site fill material required to obtain construction sub-grade levels.

Where excavation of fill material is required to achieve construction sub-grade levels, the installation of services, etc; any excess material that cannot be retained on site elsewhere is proposed to be managed via off-site disposal to an appropriately licensed facility. Following identification of the location and extent of excess material to be removed, a review of the existing data will be completed to identify whether a waste classification based on existing available data (from DP 2018 and/or JBS&G 2019a) may be prepared for the material, or alternatively additional sampling and laboratory analysis will be implemented to appropriately characterise the material prior to off-site disposal.

All materials requiring offsite disposal will require to be assessed in accordance with the Waste Classification Guidelines, Part 1: Classifying Waste (NSW EPA 2014) and be disposed at a facility lawfully able to accept such wastes.

The material will be excavated under the supervision of the Remediation Consultant with the material stockpiled on hardstand/durable plastic, placed in a skip bin or alternatively directly loaded onto a haulage vehicle for off-site disposal. The material will be removed from site under a waste classification as per EPA guidance (2014a) for disposal to a facility lawfully able to accept the material.

5.5.4 Asbestos Management (if required)

Based on the absence of observations or detection of asbestos in fill from available site characterisation information as discussed in **Sections 3** and **4**, fill materials within the site are not considered to be contaminated with asbestos. However, in lieu of a positive detection of ACM contamination in soil during the site assessments, the following should be considered in the event of an unexpected asbestos find.

Asbestos contaminated soil (if identified) necessitating management for potential asbestos exposure is defined in *Code of Practice: How to Manage and Control Asbestos in the Workplace*, August 2019, SafeWork NSW 2019 (SafeWork NSW 2019) as:

- Soil that contains visible asbestos as determined by a competent person; or
- Soil that contains asbestos fibres at quantities exceeding trace levels (considered to be the analytical detection limit in lieu of alternate guidance) as reported by analysis undertaken in accordance with AS4964:2004 *Method for the qualitative identification of asbestos in bulk samples*.

Environmental, health and safety management requirements for the handling of these materials will be based on the requirements provided for asbestos-related works in SafeWork NSW (2019). This will include preparation of an asbestos register and associated asbestos removal control/management plan as outlined in SafeWork NSW (2019).

Where sampling and analysis of specific fill materials is completed in conjunction with inspection by a competent person, and the results indicate the material does not fall within the "asbestos contaminated soil" definition, the requirements for management of "asbestos contaminated soils" will not be required to be implemented. The extent of asbestos contaminated soils may be further delineated within a work stage by a similar assessment (i.e. identification of asbestos contamination hotspots).

For the purposes of remediation works within the site, a competent person shall be considered to be a person who holds a tertiary degree in an environmental discipline, has experience in contaminated site assessment and has completed a WorkSafe approved Asbestos Removal Supervisor course.

If areas of the site are unexpectedly found to be affected by gross levels of asbestos impacted soils (considered to be ACM and/or asbestos fines (AF) or fibrous asbestos (FA) exceeding the NEPC (2013) HSL A criteria for the occurrence of asbestos in soils), these soils may be excavated and disposed to an appropriately licensed facility, or may be retained at the site beneath suitable physical separation as per **Section 5.5.2** and appropriately managed. Should asbestos-impacted soils be retained at the site, the impacted materials will be retained beneath the marker-layer and capping, and will be subject to management as part of the long-term Environmental Management Plan (EMP) to be developed for the site via an Asbestos Management Plan (AMP), and the locations and extents of any identified impacts will be entered into an Asbestos Register. Requirements for the validation/management of asbestos impacted soils is outlined in **Section 6.3.4**.

5.6 Materials Importation

In accordance with current EPA policy, only material that does not represent an environmental or health risk at the receiving site may be considered for resource recovery. Imported materials will only be accepted to the site if they meet the restrictions placed on these materials and meet the definition of:

- Virgin Excavated Natural Material (VENM) as defined in the *Protection of the Environment Operations Act* (1997) Schedule 1;
- Excavated Natural Material (ENM) as defined in the ENM Exemption/Order; or
- Resource recovery materials as per an EPA exemption.

All material imported onto the site are required to be accompanied by appropriate documentation that has been verified by the appointed site contamination (environmental) consultant.

Materials proposed to be imported for use under a Resource Recovery Exemption/Order will be subject to review and endorsement by the environmental consultant prior to the importation of

materials to the site. This is to ensure that the materials are fit-for-purpose and appropriate for the sensitive primary educational land use.

5.7 Validation

Validation of the remedial works will be conducted by the Environmental Consultant to demonstrate the remediation objectives have been achieved. Details of the validation program are provided in **Section 6**.

5.8 Site Disestablishment

On completion of the remediation works all plant / equipment and safety / environmental controls shall be removed from the site by the appointed Remediation Contractor. All equipment used during remediation works will need to be appropriately decontaminated or disposed of as waste by the Remediation Contractor, in accordance with relevant waste regulations.

6. Validation Plan

6.1 Overview

Validation data is required to be collected to verify the effectiveness of the remedial works and document the final site conditions as being suitable for the proposed future use(s).

The following sections establish the DQOs to be adopted during validation of the site remediation works.

6.2 State the Problem

The site has historically been used as an orchard and for educational purposes, with ancillary activities (cut and fill, demolition of historical structures), which have resulted in contamination to soils that require remediation so that the site can be considered suitable for use as an education facility.

The potential impacts to site users from these contaminants will require a long-term EMP to be prepared for the site to ensure that the site remains suitable for the proposed land use following validation of the site.

During remediation activities, sufficient validation of the site is required to demonstrate that the identified environmental and health-based risks to future user(s) of the site, as summarised in **Sections 3** and **4.2**, have been adequately managed to render the site suitable for the proposed land use.

6.2.1 Identify the Decision

The decisions which are required to be made for validation of the site are:

1. Have physical separation arrangement layers been installed appropriately and final placement verified in accordance with the RAP requirements?
2. Have materials disposed from the site been appropriately classified and disposed from the site in accordance with the EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* and disposed of at facilities lawfully able to accept such waste?
3. Where unexpected finds were identified, has assessment of potential risks been undertaken in accordance with the RAP and any additional remediation and validation been completed in accordance with the RAP objectives?
4. Are imported soils environmentally suitable for their proposed use?
5. Is the site suitable for the proposed use?

6.2.2 Identify Inputs to the Decision?

Inputs to the decisions are:

- Detailed development plans;
- Waste classification and/or material characterisation data obtained during assessment of fill materials/soils.
- Materials tracking records.
- Importation assessment criteria.
- Disposal dockets and relevant documents in relation to appropriate disposal of material to be removed from site/site as part of the remediation works (landfill dockets, beneficial reuse/recycling dockets).

- Survey data in areas of fill retention, marker layer installation (in areas not capped by a concrete slab and external to basement) to validate physical separation from site users to in-situ/retained fill.
- Data quality indicators as assessed by quality assurance/quality control (QA/QC).

Specifically, sufficient data needs to be collected from each of the identified potentially impacted media (e.g. fill material) across the site for associated COPC.

In addition, the EMP is required to demonstrate that the protective measures for physical separation from in-situ/retained fill are suitable to ensure the suitability of the site for the primary education school land use and has been made legally enforceable.

6.2.3 Define the Study Boundaries

The property is legally identified as Lot 1 in DP 812207 and Lot C in DP 346499and comprises an area of approximately 1.4 ha. A plan showing the location of the site is provided as **Figure 1**, and a plan showing the boundaries of the site is provided as **Figure 2**.

The vertical extent of the works will be the maximum depth of excavation works required to facilitate the construction requirements of the site.

6.2.4 Develop a Decision Rule

Decision rules are provided following for each of the decisions:

- Decision 1: Have physical separation arrangement layers been installed appropriately and final placement verified in accordance with the RAP requirements?
    - Decision Rule: The marker layer where required must be installed to the RAP requirements, as well as the manufacturer's installation requirements. The vertical and lateral extents of the marker layer must be surveyed (**Section 5.5.2**), along with consistent and comprehensive photographic evidence.
    - Where soil material is to be used for physical separation as placed above the marker layer and readily accessible to human users, this material is required to be validated as meeting the health (residential/primary school (HSL/HIL A)– NEPC 2013) and ecological (urban residential and public open space – NEPC 2013) validation requirements for the site in addition to aesthetic requirements.
    - Physical Separation arrangements including areas where a marker layer may not be required are discussed in **Section 5.5.2**.
    - If the marker layer and physical separation arrangements have been installed with the requirements of the RAP, then the answer will be 'Yes'.
    - Otherwise, the decision will be 'No' and additional assessment and/or remediation is required to demonstrate the objectives of the RAP have been achieved.
- Decision 2: Have materials disposed from the site been appropriately classified and disposed from the site in accordance with the *Waste Classification Guidelines, Part 1: Classifying Waste* and disposed of at facilities lawfully able to accept such waste?
    - Decision Rule: If materials have been appropriately assessed against NSW EPA (2014) and appropriate waste classification documentation provided, and waste disposal dockets show materials were disposed of at a facility lawfully able to accept such wastes, then the answer is 'Yes'.
    - Otherwise, the decision is 'No'.

- Decision 3: Where unexpected finds were identified, has assessment of potential risks been undertaken in accordance with the RAP and any additional remediation and validation been completed in accordance with the RAP objectives?
    - Decision Rule: If unexpected finds have been suitably characterised such that determinations on the required remediation/management can be undertaken, and whether the implemented remediation actions have been suitably validation such that the unexpected find does not inhibit the ability to draw conclusions regarding site suitability, then the answer is 'Yes'.

      Otherwise, the decision is 'No'.
- Decision 4: Are imported soils environmentally suitable for their proposed use?
    - Decision Rule: If imported soils are comprised of VENM or ENM or another suitable material covered by a NSW EPA Resource Recovery Order and Exemption, and used in accordance with the relevant exemptions, and analyte levels within the soils meet all the adopted human and ecological criteria (**Section 6.3**) for accessible soils on the site then the decision will be Yes.

      Otherwise the decision will be No.
- Decision 5: Is the site suitable for the proposed use?
    - Decision Rule: Was the answer to any of the above decisions 'No'? If so, were the outstanding issues appropriately addressed by implementation of the EMP?

      Otherwise, the decision will be No and the requirements for further remediation of the site and / or implementation of additional management measures (as documented in an amended EMP) will be required to be documented such that the answer to the decision can be Yes.

6.2.5 Specify Limits of Decision Error

This step is to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits for this project have been adopted in accordance with the appropriate guidance from the NSW EPA, NEPC (2013), appropriate indicators of data quality (DQIs used to assess QA/QC) and standard JBS&G procedures for field sampling and handling.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined DQIs for completeness, comparability, representativeness, precision and accuracy.

The pre-determined Data Quality Indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters), and are shown in **Table 6.1**.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.

- **Representativeness** –expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.
- **Sensitivity** – expresses the appropriateness of the chosen laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted criteria.

If any of the DQIs are not met, further assessment of the data set will be required in order to determine whether the non-conformance has significant effects on the usefulness of the data. Corrective action to correct an adverse impact on the reliability of the dataset may include, but is not limited to, the request of further information from samplers and/or analytical laboratories, downgrading of the quality of the data or alternatively, re-collection of the data.

Table 6.1: Summary of Quality Assurance / Quality Control Program

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Blind duplicates (intra laboratory)	1 / 20 samples	<50% RPD[2], asbestos in agreement
Blind duplicates (inter laboratory)	1 / 20 samples	<50% RPD[2], asbestos in agreement
Laboratory duplicates	1 / 20 samples	<50% RPD[2], asbestos in agreement
Accuracy		
Surrogate spikes	All organic samples	70-130%
Laboratory control samples	1 per lab batch	70-130%
Matrix spikes	1 per lab batch	70-130%
Representativeness		
Sampling appropriate for media and analytes		-[3]
Samples extracted and analysed within holding times.	-	Soil: organics (14 days), inorganics (6 months)
Trip spike	1 per sampling event	70-130% recovery
Storage blank	1 per sampling event	<LOR
Rinsate blank	1 per sampling data where reusable equipment is used	<LOR
Method blank (soil vapour only)[1]	1 per lab batch	<LOR
Equipment blank (soil vapour only) [1]	1 per lab batch	<LOR
Laboratory blanks	1 per lab batch	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All samples[3]
Standard analytical methods used for all analyses	All Samples	All samples[3]
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples[3]
Limits of reporting appropriate and consistent	All Samples	All samples[3]
Completeness		
Sample description and COCs completed and appropriate	All Samples	All samples[3]
Appropriate documentation	All Samples	All samples[3]
Satisfactory frequency and result for QC samples	All QA/QC samples	-[3]
Data from critical samples is considered valid	-	Critical samples valid[3]
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All Samples	All samples

[1] Inclusion of soil vapour DQI in the unlikely event soil vapour data is required to be collected.

[2] If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

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

6.2.6 Optimise the Design for Obtaining Data

The validation sampling design is summarised for each specific type of validation works as follows. The validation/characterisation sampling and analytical program for the site is outlined in **Table 6.2** below.

6.2.6.1 Installation of the Physical Barrier

Installation of physical separation arrangements shall be defined by survey as completed by a registered surveyor and/or building as-built drawings sufficient to identify:

- The lateral extent and upper depth height of known environmentally impacted materials (i.e. residual fill materials underlying the cover) within each remediation area/stage;

- The lateral extent and type of cover (e.g. permanent pavement, soil thickness) within the remediation area/stage; and
- Confirmation, by photos or otherwise, of the installation of the 'marker layer' underlying the cover (as required).

Physical separation arrangement requirements (i.e. thickness etc.) are detailed in **Section 5.5.2**.

It is anticipated the following materials will be used across the site for engineering and growing media purposes will be characterised/validated as per the following for each material type:

Growing Media

Soils to be imported and used as growing media within the site shall be sampled at a rate of at least one sample per 100 m^3 with a minimum of three samples per source/end location. Samples shall be analysed for TRH/BTEXN, PAHs, heavy metals, (including As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), OCPs, PCBs, asbestos and soil pH. The materials shall be further inspected for any aesthetic indicators of contamination.

VENM

VENM shall be as defined under the *Protection of the Environment Operations (POEO) Act 1997* and characterised by at least five samples per source site and one per 1,000 m^3 being collected if more than 10,000 m^3. Samples should be analysed for heavy metals, TRH, BTEX, PAH, OCP, PCB and asbestos. Such sampling and analysis should be completed at the source site prior to importation. Sampling and analysis requirements for verification prior to import may vary for source sites where existing sampling and analysis is considered by the Environmental Consultant to be adequate. Visual inspection at the source site prior to import and at the site upon import is required.

ENM

Sampling and analysis are required to be undertaken as per the ENM Exemption. Asbestos analysis consistent with NEPC (2013) (i.e. 500 mL samples) is also required at a suitable density for all ENM proposed to be imported to the site.

Visual inspection is required prior to and upon import.

6.2.6.2 Waste Classification

Materials sampled for waste classification in accordance with the *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA 2014) shall be sampled at an appropriate rate to characterise the materials prior to office-site disposal.

Sampling of materials as per the ENM Exemption (or similar) requires to be undertaken in accordance with the exemption.

Sampling of site sourced materials as per a VENM classification will require the collection of at least 10 samples with one per 1,000 m^3 being collected if more than 10,000 m^3 has been removed.

Table 6.2: Remediation and Validation Sample Plan

Validation Sample Type & Source	RAP Sampling Frequency	Analytical Suite
Material Importation		
VENM	If adequate source site documentation is available, then no sampling is required, beyond visual inspection when the material arrives to site. In the event that no chemical data is available, or the existing information does not meet the standard required, at least five samples per source site and one per 1,000 m^3 being collected if more than 10,000 m^3	Heavy Metals TRH/BTEX PAHs OCPs/PCBs Asbestos (500 mL)
Material under NSW EPA Resource Recovery Exemptions *(Recycled Materials)*	1 per 70 m^3	Heavy Metals TRH/BTEX PAHs Asbestos (500 mL) In addition to suite as required by exemption
Imported Growing Media *(Accessible Soils)*	1 per 100 m^3 with a minimum of 3 per source site	Heavy Metals TRH PAHs OCPs/PCBs Asbestos (500 mL) pH
Waste Classification		
In-situ materials	No set frequency – sufficient data required to suitably characterise materials for offsite disposal.	No set frequency – sufficient data required to suitably characterise materials for offsite disposal. Likely analytical requirements will include: Heavy Metals TRH/BTEX PAHs Asbestos (500 mL)

6.2.6.3 Stockpile Soil Sampling Methodology

For stockpile sampling, material will be obtained from a minimum depth of 300 mm below the surface of the stockpile at the time of sampling. Following each sample, non-disposable hand tools will be decontaminated as discussed in **Section 6.2.7.4**. Where possible, disturbance to soils prior to sampling should be minimised so as to avoid the potential loss of volatile fractions from soils.

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination will be noted on the field documentation and a PID will be used, as appropriate, to assess the potential occurrence of volatile compounds.

6.2.7 Soil Sampling Methodology

6.2.7.1 Sample Handling

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination shall be noted on field reporting sheets/field logs.

Collected soil samples shall be immediately transferred to sample containers of appropriate composition (glass jars) fitted with Teflon sealed lids. Where asbestos analysis is required samples shall be collected and placed in new 500 mL zip lock bags. Sample labels shall record sample

identification number and date and time of sampling. Sample containers shall be transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form shall be completed and forwarded with the samples to the testing laboratory, containing the following information:

- Sample identification;
- Signature of sampler;
- Date of collection;
- Type of sample;
- Number and type of container;
- Inclusive dates of possession; and
- Signature of receiver.

6.2.7.2 PID Screening

Should PID screening of soils be required, soil samples obtained for PID screening will be placed in a sealed plastic bag for approximately 5 minutes to equilibrate, prior to a PID being attached to the bag. Readings will then be monitored for a period of approximately 30 seconds or until values stabilise and the stabilise/highest reading will be recorded on the field sample forms. The PID will be calibrated prior to the commencement of field works and then check readings will be completed on a daily basis during the field program using suitable calibration gas. If required, the PID will be re-calibrated during the field program in accordance with manufacturer's instructions.

6.2.7.3 Field Duplicate and Triplicate Preparation

Field soil duplicate and triplicate samples for the validation assessment will be obtained during sampling using the procedures outlined above at a frequency of 1 in 20 primary samples for both field intra-laboratory duplicates and field inter-laboratory duplicates. The soil samples will be divided laterally into three samples with minimal disturbance to reduce the potential for loss of volatiles and placed in three clean glass jars and/or plastic bags. All jars will be filled with no headspace to reduce the potential for loss of volatiles and separately labelled as the primary, duplicate and triplicate samples before being placed in the same chilled esky for laboratory transport.

6.2.7.4 Decontamination of Sampling Equipment

The following procedure will be used to clean non-disposable equipment, including the trowel, prior to the collection of each sample:

- Scrubbing with a wire brush to remove excess material;
- Pressure spray with Decon 90 detergent and potable water mix;
- Pressure spray rinse with potable water; and
- Air drying.

Rinsate samples will be obtained during the field decontamination procedures at regular intervals during validation sampling activities that do not utilise disposable sample equipment. Each rinsate sample will be obtained by rinsing the trowel (or other equipment) with laboratory grade demineralised water following the decontamination procedure. The water sample will be appropriately preserved and stored with the site soil samples prior to and during transport to the laboratory for chemical analysis.

6.2.8 Laboratory Analysis

NATA accredited laboratories shall be used for all analysis of samples. Appropriate methods and LORs are required for comparison to relevant criteria.

6.3 Validation Criteria

6.3.1 Accessible Soils/Exposed Natural Soils

Based on the proposed development details, in accordance with the decision process for assessment of urban redevelopment sites (EPA 2017), and with consideration of JBS&G (2019a), only imported materials will be utilised in areas with accessible soils, for example, landscape areas or planter boxes constructed above a marker layer.

Soils proposed to be utilised in areas of accessible soils will require to comprise VENM (NSW EPA 2019), ENM, or another suitable material subject to an NSW EPA Resource Recovery Exemption and Order. Analytical data for materials used in areas of accessible soils (growing media) shall be compared against adopted criteria as follows:

- Site specific ecological investigation levels (EILs) derived through the methodology outlined in NEPC (2013);
- Ecological Screening Levels (ESLs) for TRH fractions, BTEX and benzo(a)pyrene in coarse grained soil for residential land use (NEPC 2013);
- HILs/HSLs for residential with accessible soils, as per NEPC (2013) – HIL/HSL A.

Consideration to requirements of **Section 6.3.3** is also required for imported media.

6.3.1.1 Application of Soil Assessment Criteria

For soils to be considered as meeting the health/ecological based assessment criteria (i.e., not posing an unacceptable risk), the following criteria will be adopted:

Either:

- All contaminant concentrations were less than the adopted site assessment criteria,

Or:

- The upper 95% confidence limit on the average concentration for each analyte (calculated for samples collected from consistent soil horizons, stratigraphy or material types) was below the adopted criterion;
- No single analyte concentration exceeded 250% of the adopted criterion; and
- The standard deviation of the results was less than 50% of the criterion.

6.3.2 Material Characterisation for Off-site Disposal

Where contaminated fill/soil is not suitable for onsite management or is surplus to construction requirements, materials are proposed to be remediated by off-site disposal. Materials shall be classified in accordance with EPA (2014) *Waste Classification Guidelines* or an appropriate exemption as created under the *Protection of the Environment Operations (Waste) Regulation 2014*.

Given the identification of ash and slag inclusions in fill material samples with elevated total PAH and metal concentrations, the widespread occurrence of ash and further observations of some slag inclusions are concluded to be a significant source of these contaminants. On this basis, it is appropriate to apply the associated NSW EPA general immobilisation approvals (POEO (Waste) 2014) when consideration is given to evaluating a waste classification(s) for material required to be excavated during the remedial works.

Material will require to be removed to a facility lawfully able to receive it.

6.3.3 Imported Materials

In accordance with current EPA policy, only material that does not represent an environmental or health risk at the receiving site may be considered for resource recovery. Imported materials will only be accepted to the site if they meet the restrictions placed on these materials and meet the definition of:

- Virgin Excavated Natural Material (VENM) as defined in the *Protection of the Environment Operations Act* (1997) Schedule 1;
- Excavated Natural Material (ENM) as defined in EPA (2014); or
- Resource recovery materials as per an EPA exemption.

All material imported onto the site are required to be accompanied by appropriate documentation that has been verified by the appointed site contamination (environmental) consultant.

6.3.4 Validation of Marker Layer and Physical Barrier

For all other site soils, validation of the marker layer and capping will require to satisfy the requirements of **Section 5.5.2**, as summarised below:

- Cover of fill materials by marker layer and permanent paved areas, or in areas not covered by permanent structures, installation of a marker layer underlying the depth of the pavement and overlying potentially contaminated material. As-built survey of structures and marker-layer placement is required;
- Covering of fill materials in landscaped areas – installation of the marker layer at a minimum depth of between 0.3 and 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs) and a minimum of 0.7 m below final finished site levels in areas of new tree planting (or as required for the root-ball of proposed plants), with environmentally suitable materials placed above to the final levels. In areas of retained trees, marker layer should be installed 0.15m below the finished level, with the remaining depth to finish site levels to be covered with wet-pour rubber. Survey of marker-layer depth and top of growing media demonstrating satisfaction of minimum requirements; and
- Within underground services trenches – in the event underground services trenches are to be installed, the service infrastructure will require to be installed above a marker layer within suitable materials for potential human and/or ecological exposure. Survey of marker-layer depth and of completed trenches required to demonstrate satisfaction of minimum requirements.

Soils which are to be moved to another area of the site will be subject to the following data recording process for future reference purposes, and will be included in the Validation Report to be prepared following remediation:

- A location plan of the placed materials with co-ordinates based on an agreed grid system (e.g., GPS or relative to the lot boundaries);
- The levels in m AHD of the base of the placement location(s) prior to the material placement;
- The levels in m AHD of the placement locations once all materials have been placed;
- The levels in m AHD of any defining layers and capping layers; and
- Subsequently, the total placed volume of materials.

6.4 Reporting

At the completion of site remediation works, a validation report will be prepared in general accordance with EPA (2017) and OEH (2011) *Guidelines for Consultants Reporting on Contaminated Site* (or as updated), documenting the works as completed.

This report will contain information including:

- Details of the remediation works conducted;
- Present all sampling field notes and laboratory data including calibration certificates for field monitoring equipment, environmental monitoring etc.;
- Undertake an assessment of QA/QC of analytical data generated by the works and identify data that is reliable for use in characterising the site;
- Sort data into data sets as required by the decision rules;
- Assess whether sufficient data has been obtained to meet required limits on decision error;
- Undertake assessment to the decision rules and identify any environmental data which causes decision rules to be failed;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Results of all environmental monitoring undertaken during the course of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents;
- Verification of regulatory compliance;
- Provide a summary of waste disposal activities and volumes of waste removed from the Site including supply of all waste disposal dockets confirming final waste disposal/landfill destination;
- Provide a summary of material importation activities (general fill soil/crushed rock, growing media, earthworks aggregates, drainage backfill etc), including material source, type, assessment of suitability, approximate quantities, date of importation and final placement location;
- Identify the requirements for the EMP (where appropriate) including inclusion of a survey clearly identifying the extent of the retained impacted material and associated capping; and
- Provide a comment on the suitability of the Site (or portions thereof) for the proposed use and requirements for any ongoing monitoring/management (where applicable).

The report will serve to document the remediation works for future reference.

6.5 Environmental Management Plan

The validation of the site as suitable for the proposed mixed-use redevelopment will be contingent upon the implementation of an EMP to manage residual risks posed by contaminated material to future site users.

Where required, the EMP shall contain the following elements:

- A statement of the objectives of the EMP – i.e., to ensure continued suitability of the site after it has been remediated;

- Identification of residual environmental contamination issues at the site that require ongoing management/monitoring to meet the EMP objectives, including the type of contamination and location within the site (including survey plans);
- Documentation of environmental management measures which have been implemented to address the identified environmental issues at within the site;
- Description of management controls to limit the exposure of the site users to known areas of contamination to acceptable levels;
- Description of responsibilities for implementing various elements of the provisions contained in the EMP;
- Timeframes for implementing the various control/monitoring, etc. elements outlined in the EMP;
- Environmental monitoring and reporting requirements (if required) for the future management of environmental impact underlying the site;
- Corrective action procedures to be implemented where EMP assessment criteria are breached.

7. Contingency Plan

A review of the proposed contamination-related aspects of the works associated with development the site has been undertaken and has identified a number of potential risks, outlined in the following sections that required the development of contingencies to ensure that the objectives of this RAP are met.

The Contingency Plan is required to be part of the CEMP, as described in **Section 8**, below, and part of the Work Health and Safety Plan (WHSP), as described in **Section 8**.

7.1 Unexpected Finds

The possibility exists for hazards that have not been identified to date to be present within fill materials or underlying existing pavements/building on the site. The nature of hazards which may be present and which may be discovered at the site are generally detectable through visual or olfactory means, for example:

- The presence of significant aggregates of friable asbestos materials (visible) as opposed to minor occurrences of fragments or fibre bundles in soil; and/or
- Excessive quantities of Construction/Demolition Waste (visible); and/or
- Hydrocarbon impacted materials (visible/odorous); and/or
- Drums, waste pits, former pipework or USTs (visible); and/or
- Oily Ash and/or oily slag contaminated soils/fill materials (visible/odorous); and/or
- Tarry like impacted soil/fill material (visible/odorous); and/or
- Potential chlorinated hydrocarbon impact (sweet odour soils).

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances (or any other unexpected potentially hazardous substance) be identified, the procedure summarised in **Figure 7.1** is to be followed.

An enlarged version of the Unexpected Finds Protocol, suitable for use on the site, should be posted in the Site Office and referred to during the site-specific induction by the Principal Contractor.

The sampling strategy for each “unexpected find” shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance/materials shall meet the minimum requirements outlined in EPA (1995).

7.1.1 Change in Development Plans

In the event that the development plans are changed from those available at the time of preparation of this RAP, particularly where significant amendment of the extent of permanent paving at the site and/or alterations to the retention design, consideration of the suitability of the proposed remedial strategy will be required.

7.1.2 Material Storage Breach

In the event that any materials storage containment controls are breached, and stockpiled materials classified as asbestos contaminated soil or otherwise have escaped (or have the potential to escape), then the management controls shall be rectified and investigations undertaken to review the adequacy of the controls and any improvements implemented. The CEMP (**Section 8.1**) shall include a documented process for identifying and responding to such incidents.

7.1.3 Emissions Complaints

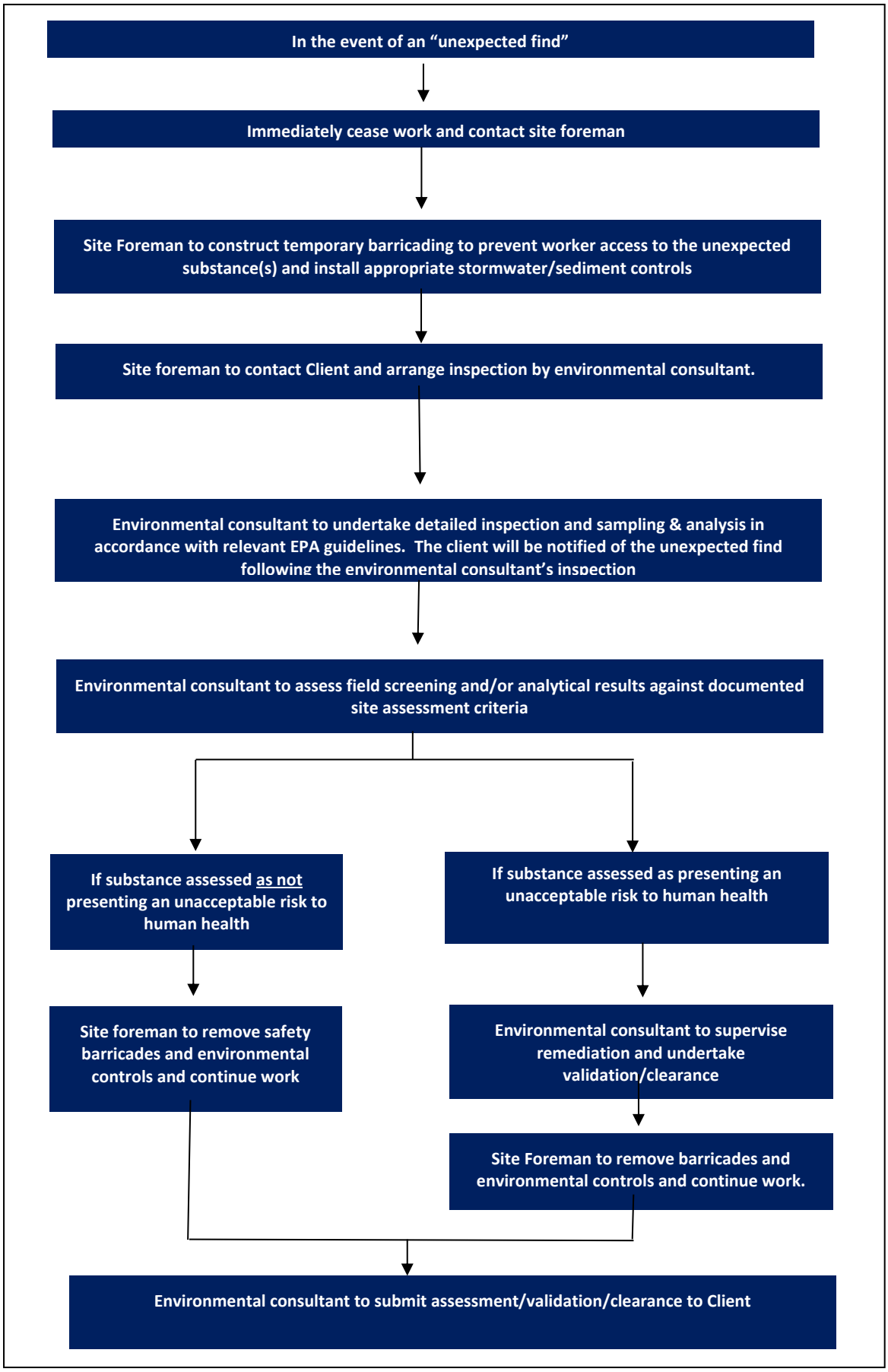
Due to the nature of the activities and type of contaminants identified within the site, there is a potential for complaints to be received from members of the public and/or occupants of surrounding properties relating to environmental emissions including:

- Odour emissions arising from handling of malodorous soil;
- Noise and vibration arising from excavation, piling and other works;
- Dust emissions arising from excavation, material handling and placement; and
- Visibly impacted water quality in surface water discharge from the site.

Monitoring of all environmental emissions shall be undertaken during the works as detailed in the CEMP (discussed in **Section 8.1**) and appropriate actions taken to further control emissions following receipt of a complaint. The CEMP shall contain provision for contingency actions where excessive emissions occur, however it is anticipated that one or more of the following actions will be considered:

- Increased application of odour screening/masking chemicals on odorous materials;
- Disturbance of soils during meteorologically favourable periods only; and/or
- Covering of impacted soils.

Figure 7.1 - Unexpected Finds Protocol



8. Other Remediation Documents

8.1 Environmental Management

8.1.1 Preparation of a Construction Environmental Management Plan (CEMP)

Prior to commencement of remediation works, a CEMP shall be prepared by the Principal Contractor or the Principal Contractors Remediation Contractor, which documents the environmental monitoring and management measures required to be implemented during the remediation and construction related activities associated with the construction of the site.

The CEMP shall address each of the nominated items in **Section 8.1.2** and shall include the Contingency Plan, referred to in **Section 7**, above. Additional environmental management requirements may be required as part of development consent.

8.1.2 Required Elements/Procedures

An assessment of the proposed activities and the associated elements required to be incorporated into the CEMP is provided in **Table 8.1**. The REMP is required to address each of the required elements and procedures in full detail and to include detailed monitoring processes and procedures, corrective actions and reporting requirements.

Table 8.1 Required Elements of the REMP

Element	Specific Minimum Requirements to be included in CEMP
1. Dust Control	Provisions for dust control if required.
2. Flora and Fauna	N/A
3. Heritage/Archaeological	N/A
4. Visual Impacts	N/A
5. Emergency Response	As appropriate. Procedures required for spill incident response including material storage breach.
6. Noise Control	Hours of operation. Boundary monitoring at commencement of work site activities with potential for environmental noise emissions. Potential noise monitoring at nearest receptors. Procedures for control and management of noise emissions, as appropriate (e.g., restricted hours).
7. Traffic	Controls on vehicle movements on public roads. Controls on transport in asbestos exclusion zones (if required)
8. Protection of Adjoining Structures	N/A
9. Odour Control	Procedures for management of potentially odorous works.
10. Handling of Contaminated Soil and Groundwater	Soil and water (if encountered) management (stockpiling, site access, excavation pump out, reinstatement).
11. Soil Storage/Placement Areas	Soil and water management (stockpiling, site access, excavation pump out, reinstatement). Bunding. Heavy vehicle/personnel decontamination. Interim storage requirements for materials requiring later treatment. Site drainage requirements, incorporating clean/dirty areas and modifications to existing surface water and drainage controls beneath retained pavements. Monitoring as required.
12. Sediment Control	Bunding. Collection/treatment/handling impacted sediments.
13. Operation of Site Office	As appropriate.
14. Asbestos Works (if required)	Required notifications, permits, signage and exclusion zones. Required personal (e.g. Class A or B removalist). PPE and decontamination. Staging of asbestos and non-asbestos works.

Element	Specific Minimum Requirements to be included in CEMP
15. Environmental Monitoring	Monitoring of dusts, noise, odour and fibres (if required). Monitoring as required for vibration and water releases. Inspection checklists and field forms.
16. Environmental Criteria	Soil criteria as sourced from RAP.
17. Material Classification	As detailed in this RAP.
18. Waste Management	All waste materials classified in accordance with the RAP are required to be disposed of at a licensed waste facility that are lawfully able to accept such materials. Material tracking in the form of disposal dockets will be required for the purposes of satisfying the validation report.
19. Community Relations Plan	Client to provide project specific communication protocols, incorporating nomination of specific contact persons & details and requirements for communications/response register.
20. Incident Reporting	As appropriate, including standard form/checklist.
21. Security and Signage	Secure site perimeter. Site boundary signage. Remediation exclusion zone signage where required.
22. EMP Review	As appropriate.
23. Training	As appropriate. Contamination awareness training for all workers.
24. Contact Details	Company/personnel details, including names/phone numbers for: - Principal Contractor - Site Auditor (if involved) - Environmental Consultant - Contractor - OH&S Compliance - Environmental Compliance

8.2 Health and Safety

8.2.1 Work Health and Safety Management Plan

A WHSP shall be prepared by the Remediation Contractor prior to commencement of remediation works. The Plan shall contain procedures and requirements that are to be implemented as a minimum during the works, in addition to the Contingency Plan, referred to in **Section 7.1**.

The objectives of the WHSP are:

- To apply standard procedures that minimises risks resulting from the works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards, mandatory safety practices and procedures;
- Monitoring of potential hazards and implementation of corrective measures; and
- Provision for contingencies that may arise while operations are being conducted within the site.

8.2.2 Asbestos Works

In the event that asbestos impacts be identified during the course of remediation and/or construction, all associated works shall be undertaken in accordance with the Work Health and

Safety Regulation (2019), SafeWork NSW (2019) Code of Practice: How to Safely Remove Asbestos, and SafeWork NSW (2019) How to Manage and Control Asbestos in the Workplace.

During the remedial works and only following the positive detection of asbestos impact present in site soils, perimeter asbestos in air monitoring will be conducted at each applicable remedial works area boundary when soil with asbestos are being disturbed. Air monitoring will be conducted on a daily basis at relevant locations whilst disturbance of asbestos contaminated areas takes place.

Air monitoring will be conducted during any ground disturbance activities within (asbestos) impacted soil within the site to verify that implementation of appropriate control measures have been successful at managing the risk of airborne fibre generation. Air monitoring will be undertaken in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes, in particular the *Guidance note for the estimation of airborne asbestos dust* [NOHSC 3002:2005].

8.2.3 Additional Consideration of Chemical Contaminants

In addition to general assessment of the potential for exposure to chemical contaminants the WHSP should also include specific consideration of additional contaminants such as heavy metals and PAHs distributed throughout fill materials.

As a precautionary measure, the WHSP should include the requirement for the plan to be revised in the event of an unexpected find of contaminated material during remediation and/or construction.

When working with contaminated materials in general, care needs to be taken to ensure that the contamination is not introduced to the worker via ingestion, inhalation or absorption. The WHSP must detail the PPE and decontamination requirements to be followed to control the risks posed by potential exposure to chemical contaminants at/within the site.

9. Conclusions and Recommendations

9.1 Conclusions

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of the *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (EPA 2017) because they are: technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW EPA.

Subject to the successful implementation of the measures described in this RAP it is concluded that the site can be made suitable for use as a primary educational facility and that the risks posed by contamination can be managed in such a way as to be adequately protective of human health and the environment.

9.2 Recommendations

It is recommended that the processes outlined in this RAP be implemented and that the following documentation be developed and implemented to ensure the risks and impacts during remediation works are controlled in an appropriate manner:

- A CEMP, to document the monitoring and management measures required to control the environmental impacts of the works and ensure the validation protocols are being addressed; and
- A WHSP to document the procedures to be followed to manage the risks posed to the health of the remediation workforce.

Upon completion of the remediation works, the Validation Report is required to be prepared to verify remedial works were completed in accordance with the RAP.

10. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

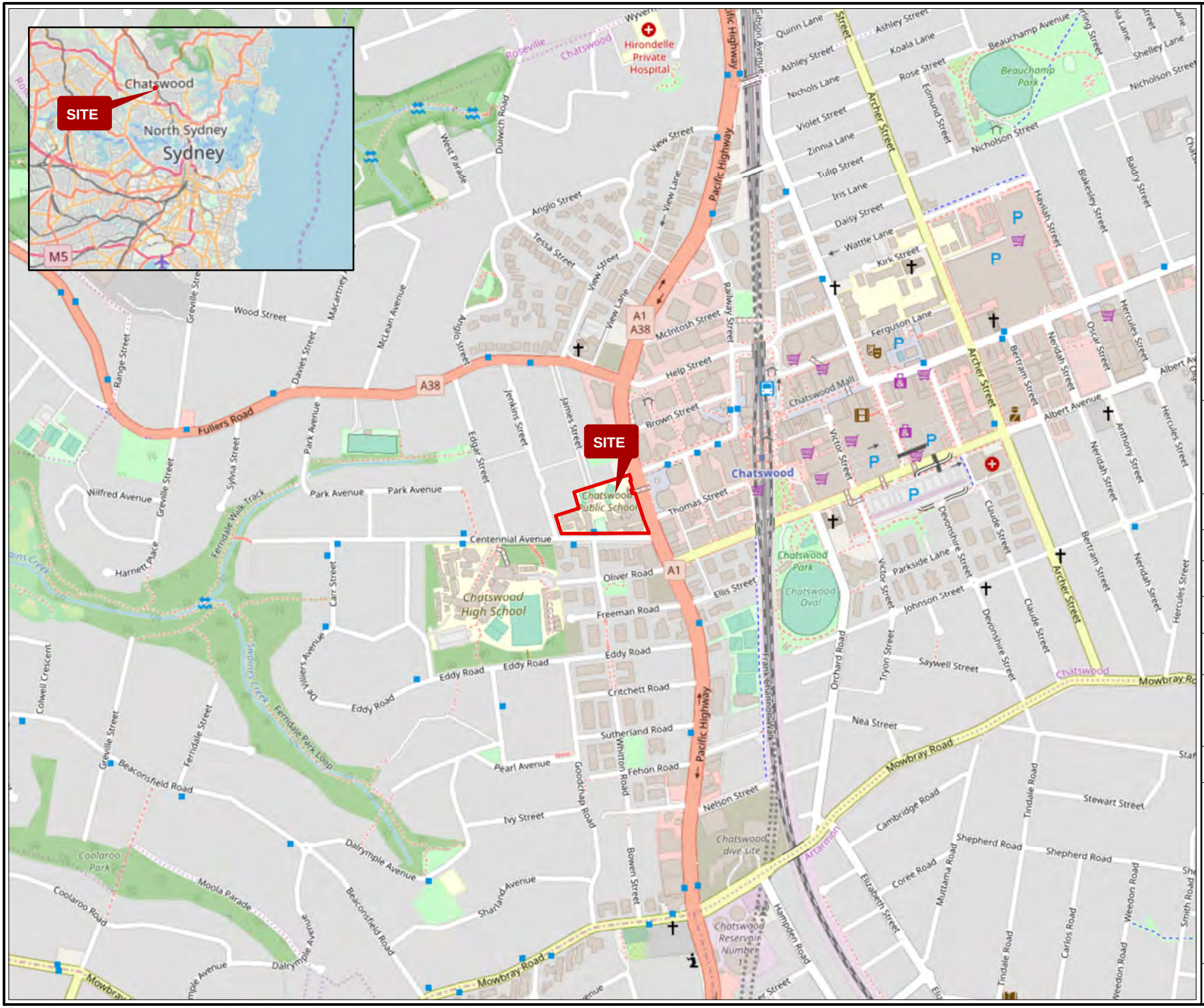
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the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

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

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

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

Figures



Legend:

Approximate Site Boundary

JBS&G

Job No: 55579	
Client: Pells Sullivan Meynik	
Version: R05 Rev A	Date 30/01/2020
Drawn By: AS	Checked By: SG

Scale 1:10,000

0 150 300

metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue
Chatswood, NSW

Public School

SITE LOCATION

FIGURE 1

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Pells Sullivan Meynink\55579 Chatswood Education Precint\GIS\Maps\R05 Rev A\55579_01_SiteLocation.mxd

Legend:

- Approximate Site Boundary
- Demountable Buildings

JBS&G

Job No: 55579	
Client: Pells Sullivan Meynik	
Version: R05 Rev A	Date 30/01/2020
Drawn By: AS	Checked By: SG
Scale 1:850	

0 10 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue
Chatswood, NSW

Primary School

SITE LAYOUT

FIGURE 2

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Pells Sullivan Meynik\55579 Chatswood Education Precint\GIS\Maps\R05 Rev A\55579_02_SiteLayout.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020

Legend:

- Approximate Site Boundary
- Proposed Tree Locations
- Existing Buildings to be retained
- Proposed Buildings
- Proposed Circulation Node
- Proposed Outdoor Space

JBS&G

Job No: 55579

Client: Pells Sullivan Meynik

Version: R05 Rev A	Date 20/02/2020
Drawn By: AS	Checked By: SG

Scale 1:850

0 10 20

metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue
Chatswood, NSW

Primary School

PROPOSED
SITE LAYOUT

FIGURE 3

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Pells Sullivan Meynink\55579 Chatswood Education Precinct\GIS\Maps\R05 Rev A\55579_03_ProposedSiteLayout.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020

Legend:

- Approximate Site Boundary
- Historical Sample Locations (DP 2018)
- Sample Locations (JBS&G 2019)

JBS&G

Job No: 55579	
Client: Pells Sullivan Meynik	
Version: R05 Rev A	Date 30/01/2020
Drawn By: AS	Checked By: SG
Scale 1:850	

0 10 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue
Chatswood, NSW

Primary School

HISTORICAL SOIL SAMPLE LOCATIONS

FIGURE 4A

File Name: N:\Projects\Pells Sullivan Meynik\55579 Chatswood Education Precint\GIS\Maps\R05 Rev A\55579_04a_SampleLocations.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020

Legend:

- Approximate Site Boundary
- Existing Buildings to be retained
- Proposed Buildings
- Proposed Circulation Node
- Proposed Outdoor Space
- Proposed Tree Locations
- Historical Sample Locations (DP 2018)
- Sample Locations (JBS&G 2019)

JBS&G

Job No: 55579	
Client: Pells Sullivan Meynik	
Version: R05 Rev A	Date 20/02/2020
Drawn By: AS	Checked By: SG
Scale 1:850	

0 10 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

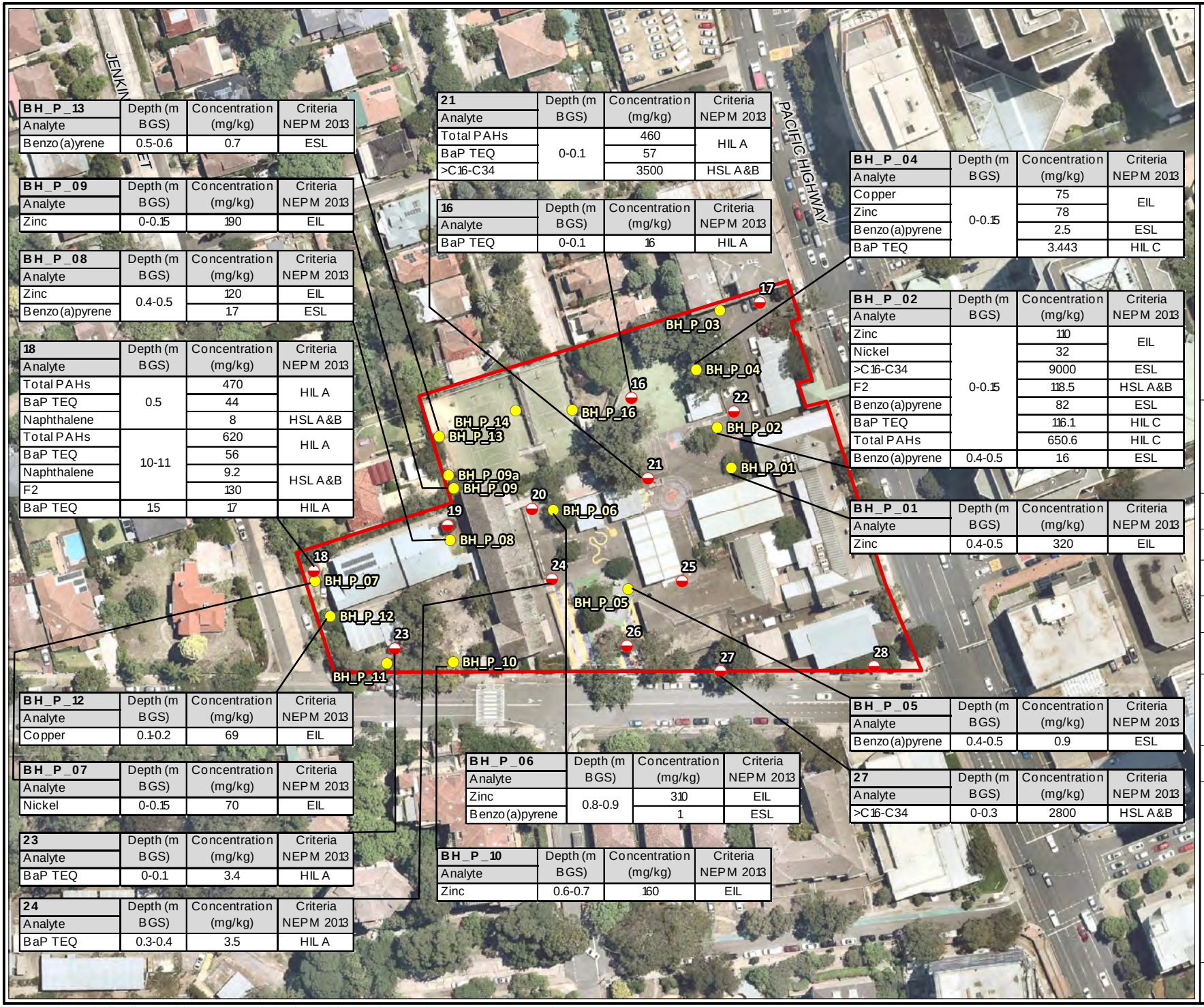
5 Centennial Avenue
Chatswood, NSW

Primary School

HISTORICAL SOIL SAMPLE LOCATIONS (PROPOSED SITE LAYOUT)

FIGURE 4B

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Pells Sullivan Meynik\55579 Chatswood Education Precinct\GIS\Maps\R05 Rev A\55579_04b_SampleLocationsProposedSiteLayout.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020



BH_P_13	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Benzo(a)yrene	0.5-0.6	0.7	ESL

BH_P_09	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0-0.15	190	EIL

BH_P_08	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0.4-0.5	120	EIL
Benzo(a)pyrene		17	ESL

18	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Total PAHs	0.5	470	HIL A
BaP TEQ		44	
Naphthalene		8	HSL A&B
Total PAHs	10-11	620	HIL A
BaP TEQ		56	
Naphthalene		9.2	HSL A&B
F2		130	
BaP TEQ	15	17	HIL A

BH_P_12	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Copper	0.1-0.2	69	EIL

BH_P_07	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Nickel	0-0.15	70	EIL

23	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
BaP TEQ	0-0.1	3.4	HIL A

24	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
BaP TEQ	0.3-0.4	3.5	HIL A

21	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Total PAHs	0-0.1	460	HIL A
BaP TEQ		57	
>C16-C34		3500	HSL A&B

16	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
BaP TEQ	0-0.1	16	HIL A

BH_P_06	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0.8-0.9	310	EIL
Benzo(a)pyrene		1	ESL

BH_P_10	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0.6-0.7	160	EIL

BH_P_04	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Copper	0-0.15	75	EIL
Zinc		78	
Benzo(a)pyrene		2.5	ESL
BaP TEQ		3.443	HIL C

BH_P_02	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0-0.15	110	EIL
Nickel		32	
>C16-C34		9000	ESL
F2		118.5	HSL A&B
Benzo(a)pyrene		82	ESL
BaP TEQ		116.1	HIL C
Total PAHs		650.6	HIL C
Benzo(a)pyrene	0.4-0.5	16	ESL

BH_P_01	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Zinc	0.4-0.5	320	EIL

BH_P_05	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
Benzo(a)pyrene	0.4-0.5	0.9	ESL

27	Depth (m BGS)	Concentration (mg/kg)	Criteria NEPM 2013
Analyte			
>C16-C34	0-0.3	2800	HSL A&B

Legend:

- Approximate Site Boundary
- Sample Locations (JBS&G 2019)
- Historical Sample Locations (DP 2018)

Note - F2= >C10-C16 less naphthalene

JBS&G

Job No: 55579

Client: Pells Sullivan Meynik

Version: R05 Rev A | Date 30/01/2020

Drawn By: AS | Checked By: DD

Scale 1:1,500

0 25 50
metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue Chatswood, NSW

Primary School

SOIL EXCEEDANCES

FIGURE 4C

File Name: N:\Projects\Pells Sullivan Meynik\55579 Chatswood Education Precint\GIS\Maps\R05 Rev A\55579_04c_Exceedances.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020

Legend:

- Approximate Site Boundary
- Proposed Tree Locations
- Existing Buildings to be retained
- Proposed Buildings
- Containment Required

JBS&G

Job No: 55579	
Client: Pells Sullivan Meynik	
Version: R05 Rev A	Date 20/02/2020
Drawn By: AS	Checked By: SG
Scale 1:850	

0 10 20

metres

Coord. Sys. GDA 1994 MGA Zone 56

5 Centennial Avenue
Chatswood, NSW

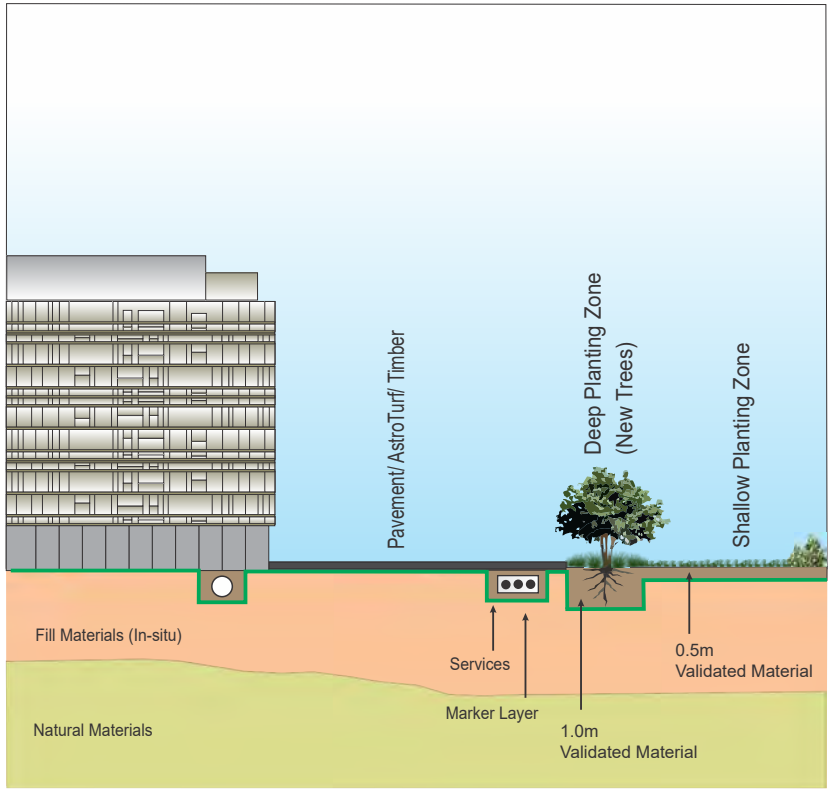
Primary School

MANAGEMENT AREAS

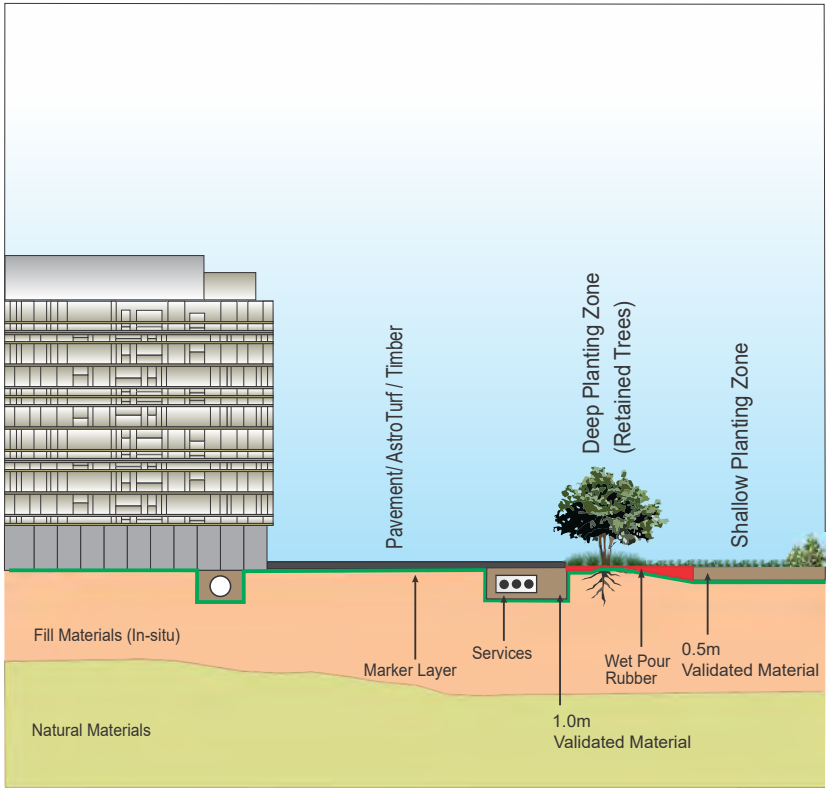
FIGURE 5

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Pells Sullivan Meynik\55579 Chatswood Education Precinct\GIS\Maps\R05 Rev A\55579_05_ManagementAreas.mxd
Reference: Nearmap - nearmap.com.au - Imagery 21-01-2020

Capping Layer Layout with New Trees



Capping Layer Layout Retaining Trees



NOTE: Schematic representation of capping requirements only. The diagram is not true to proposed site design features.

Legend:

- General Solid Waste Special
- Natural Materials
- Validated Materials
- Wet Pour Rubber
- Marker Layer

JBS&G

Job No: 55579

Client: Pells Sullivan Meynik

Version: R05 Rev A	Date: 30/01/2020
Drawn By: AS	Checked By: SG

Not to Scale

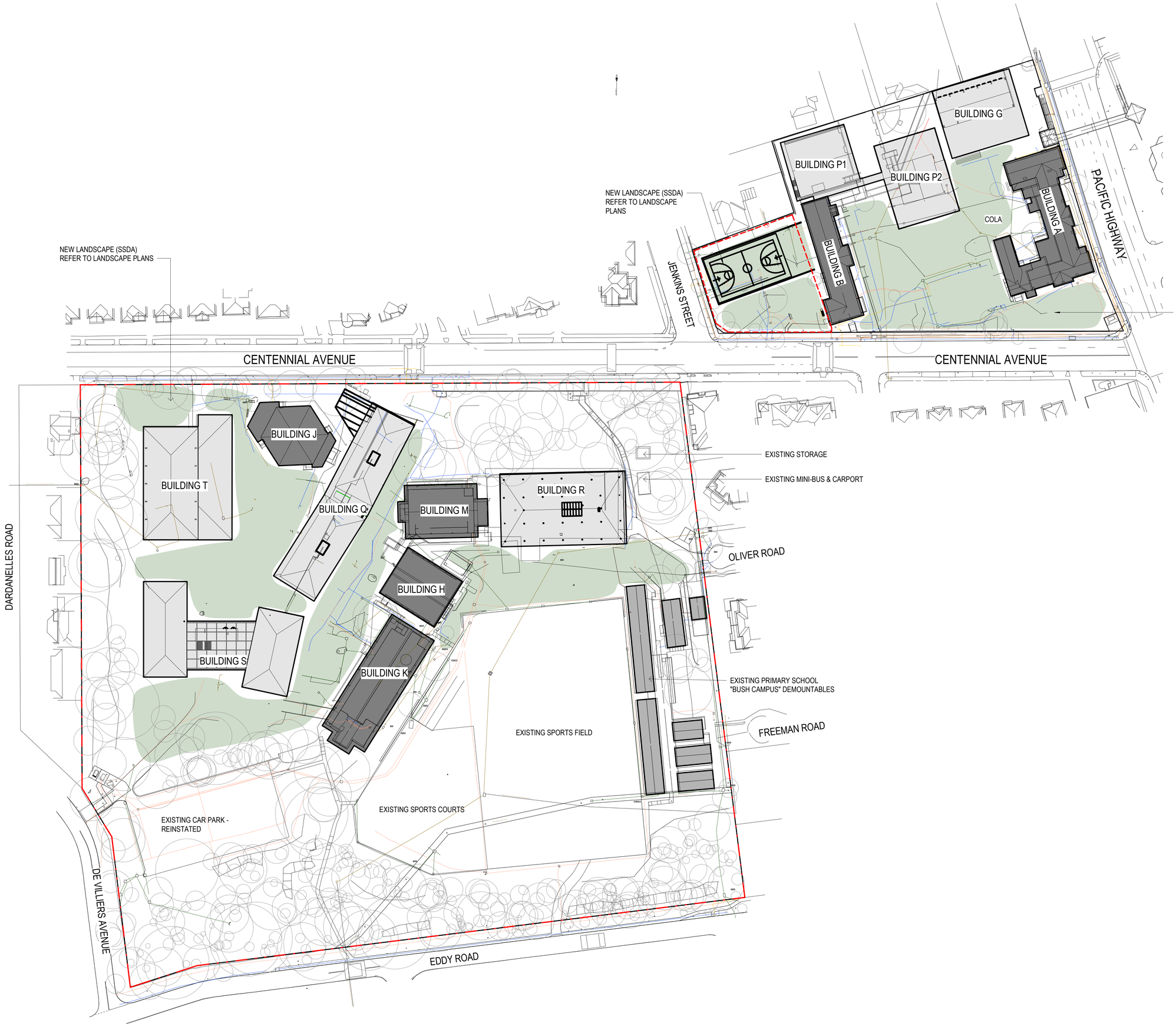
5 Centennial Avenue
Chatswood, NSW

Primary School

CAPPING LAYER ARRANGEMENTS

FIGURE 6

Appendix A Proposed Redevelopment Plans



Nominated Architect
Ray Brown, NSWARB 6359

Do not scale drawings. Verify all dimensions on site

issue	amendment	date
A	SSDA ISSUE	18/12/2019
B	ISSUE FOR SSDA COORDINATION	14/02/2020

NSW GOVERNMENT | Education

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sydney@architectus.com.au
ABN 90 131 245 684

project

Upgrades to Chatswood Public School & Chatswood High School, Centennial Avenue

drawing

SSDA - Combined Proposed Site Plans

scale	1 : 750@A1
drawn	AC
checked	AC
project no	180326.00

drawing no. **DA-AX-A0031**

issue **B**

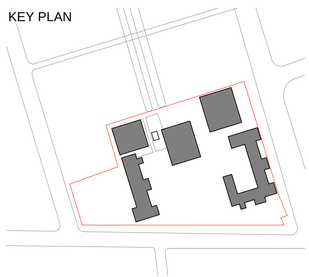
14/02/2020 3:30:39 PM

Nominated Architect
Ray Brown, NSWARB 6359

Do not scale drawings. Verify all dimensions on site

issue	amendment	date
A	100% SD ISSUE	17/04/2019
B	Issue for Civil Coordination	14/12/2019
C	SSDA ISSUE	18/12/2019

KEY PLAN



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ABN 90 131 245 684

project

Upgrades to Chatswood Public School and Chatswood High School Pacific Highway Site

drawing

Site Plan Proposed (Final)

scale	1 : 500@A1
drawn	MR
checked	AC
project no	180326.00
drawing no.	**DA-BX-A0030**
issue	**C**

19/12/2019 12:29:27 AM

Appendix B Summary Tables

Table A: Primary School Chemisty Analytical
Project Number: 55579
Project Name: Upgrades to Chatswood Primary School

			Metals & Metalloids								TPHs (NEPC 1999)					TRHs (NEPC 2013)						
			Arsenic (Total)	Cadmium	Chromium (Total)	Copper	Lead	Mercury (Inorganic)	Nickel	Zinc	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 Fraction (Total)	>C10-C16 Fraction	>C16-C34 Fraction	>C34-C40 Fraction	>C10-C40 Fraction (Total)	>C10-C16 less Naphthalene (F2)	C6-C10 Fraction	C6-C10 less BTEX (F1)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			2	0.4	1	1	1	0.1	1	1	20	20	50	50	50	50	100	100	50	50	20	20
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL A																						
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																						
NEPM 2013 Soil HIL A			100	20	100	6000	300	40	400	7400												
NEPM 2013 Soil HSL A - Sensitive Setting																				110		45
Sample ID	**Date**	**Report Number**																				
BH_P_01 0.4-0.5	23-Jan-19	637818	8.2	<0.4	15	<5	16	<0.1	<5	320	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20
BH_P_02 0-0.15	23-Jan-19	637818	2.1	0.7	29	44	100	<0.1	32	110	<40	<20	6400	3900	10,300	120	9000	2200	11,320	118.5	<40	<40
BH_P_03 1-1.1	23-Jan-19	637818	4.1	<0.4	14	<5	23	<0.1	<5	6.3	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20
BH_P_04 0-0.15	23-Jan-19	637818	3.8	<0.4	12	75	58	<0.1	8.3	78	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_05 0.4-0.5	23-Jan-19	637818	4.4	<0.4	14	8.8	19	<0.1	8.5	14	-	-	-	-	-	-	-	-	-	-	-	-
QA20190123RC_01	23-Jan-19	210425	<4	<0.4	10	14	19	<0.1	4	35	<25	<50	<100	<100	-	<50	<100	<100	<50	<50	<25	<25
QC20190123RC_01	23-Jan-19	637848	4.6	<0.4	9.7	8.6	11	<0.1	7.3	14	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20
BH_P_06 0.8-0.9	23-Jan-19	637818	4.5	0.4	11	34	98	0.1	6.7	310	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20
BH_P_07 0-0.15	22-Jan-19	637818	<2	<0.4	42	55	<5	<0.1	70	55	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_08 0.4-0.5	24-Jan-19	637818	4	<0.4	9.1	18	180	<0.1	6	120	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_09 0-0.15	24-Jan-19	637818	2.7	<0.4	5.1	15	14	<0.1	<5	190	<20	<20	54	120	174	<50	130	<100	130	<50	<20	<20
BH_P_10 0.6-0.7	24-Jan-19	637818	4.9	<0.4	13	20	32	<0.1	<5	160	-	-	-	-	-	-	-	-	-	-	-	-

Data Comments
#1 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 ESDAT Combined.

Table A: Primary School Chemisty Analytical
Project Number: 55579
Project Name: Upgrades to Chatswood Primary School

			BTEXN							Polycyclic Aromatic Hydrocarbons																				
			Benzene	Ethylbenzene	Toluene	Xylene (o)	Xylene (m & p)	Xylene (Total)	Naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(b,j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Carcinogenic PAHs as B(a)P TEQ	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	PAHs (Total)	Pyrene	Total Positive PAHs
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			0.1	0.1	0.1	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.05	0.5	0.5	0.5	0.5	0.1	0.5	0.1	0.1		0.1	0.1	0.1	0.1	0.5	0.1	0.05
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL A																														
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																														
NEPM 2013 Soil HIL A					160										3	3	3											300		
NEPM 2013 Soil HSL A - Sensitive Setting			0.5	55				40	3																					
Sample ID	**Date**	**Report Number**																												
BH_P_01 0.4-0.5	23-Jan-19	637818	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
BH_P_02 0-0.15	23-Jan-19	637818	<0.2	<0.2	<0.2	<0.2	<0.4	<0.6	0.7 - 1.5	1	1.7	7.2	47	82	120	120	120	55	41	59	48	11	116.1[#1]	96	1	61	29	650.6	110	-
BH_P_03 1-1.1	23-Jan-19	637818	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
BH_P_04 0-0.15	23-Jan-19	637818	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	1.5	2.5	3.2	3.4	3.7	1.9	0.8	1.9	1.5	<0.5	3.443[#1]	2.6	<0.5	1.4	1	18	2.9	-
BH_P_05 0.4-0.5	23-Jan-19	637818	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	0.6	0.9	1.2	1.4	1.7	0.5	<0.5	0.7	0.5	<0.5	1.408[#1]	1.3	<0.5	0.7	0.9	7.5	1.4	-
QA20190123RC_01	23-Jan-19	210425	<0.2	<1	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.5	<0.5	<0.5	-	0.1	-	0.2	<0.1	-	0.2	<0.1	0.1	<0.1	-	0.3	1.5
QC20190123RC_01	23-Jan-19	637848	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
BH_P_06 0.8-0.9	23-Jan-19	637818	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	0.6	1	1.3	1.6	1.8	0.9	<0.5	1	0.7	<0.5	1.56[#1]	1.1	<0.5	0.5	<0.5	7	1.2	-
BH_P_07 0-0.15	22-Jan-19	637818	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
BH_P_08 0.4-0.5	24-Jan-19	637818	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	1.3	1.7	2.2	2.5	2.7	1.2	0.6	1.5	1.1	<0.5	2.457[#1]	2.5	<0.5	0.9	1.5	14.8	2.5	-
BH_P_09 0-0.15	24-Jan-19	637818	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
BH_P_10 0.6-0.7	24-Jan-19	637818	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#4]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-

Data Comments
#1 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 ESDAT Combined.

Table A: Primary School Chemisty Analytical
Project Number: 55579
Project Name: Upgrades to Chatswood Primary School

			Organochlorine Pesticides																								Polychlorinated Biphenyls							
			4,4-DDE	Aldrin	Aldrin + Dieldrin (Sum of Total)	alpha-BHC	alpha-Chlordane	beta-BHC	Chlordane	DDD	DDT	Dieldrin	DDT+DDE+DDD (Sum of Total)	delta-BHC	Endosulfan alpha	Endosulfan beta	Endosulfan sulphate	Endrin	Endrin aldehyde	gamma-Chlordane	Endrin ketone	Heptachlor	Heptachlor Epoxide	Lindane	Methoxychlor	Toxaphene	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	PCBs (Total)
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL			0.05	0.05	0.05	0.05	0.1	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL A																																		
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																																		
NEPM 2013 Soil HIL A					6				50				240					10				6			300	20								1
NEPM 2013 Soil HSL A - Sensitive Setting																																		
Sample ID	**Date**	**Report Number**																																
BH_P_01 0.4-0.5	23-Jan-19	637818	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH_P_02 0-0.15	23-Jan-19	637818	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	-	-	-	-	-	-	-	-
BH_P_03 1-1.1	23-Jan-19	637818	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	-	-	-	-	-	-	-	-
BH_P_04 0-0.15	23-Jan-19	637818	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_05 0.4-0.5	23-Jan-19	637818	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QA20190123RC_01	23-Jan-19	210425	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
QC20190123RC_01	23-Jan-19	637848	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH_P_06 0.8-0.9	23-Jan-19	637818	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH_P_07 0-0.15	22-Jan-19	637818	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_08 0.4-0.5	24-Jan-19	637818	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH_P_09 0-0.15	24-Jan-19	637818	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<1	-	-	-	-	-	-	-	-
BH_P_10 0.6-0.7	24-Jan-19	637818	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Data Comments
#1 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 ESDAT Combined.

Table A: Primary School Chemisty Analytical
Project Number: 55579
Project Name: Upgrades to Chatswood Primary School

			Chlorinated Benzenes	Asbestos																	Other		EPA VIC - IWRG621	
			Hexachlorobenzene	Approx. Sample Mass	Asbestos from ACM in Soil	Asbestos from FA & AF in Soil	Mass ACM	Mass Asbestos in ACM	Mass FA	Mass Asbestos in FA	Mass AF	Mass Asbestos in AF	Mass Asbestos in FA & AF	Asbestos ID in Soil	ACM - Comment	AF - Comment	FA - Comment	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment	% Moisture 103oC	Moisture	Organochlorine Pesticides EPAVic	Other Organochlorine Pesticides EPAVic
			mg/kg	g	%w/w	%w/w	g	g	g	g	g	g	g	Comment	Comment	Comment	Comment	Comment	Comment	Comment	%	%	mg/kg	mg/kg
EQL			0.05																		1	0.1	0.1	0.1
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL A					0.01																			
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL						0.001																		
NEPM 2013 Soil HIL A			10																					
NEPM 2013 Soil HSL A - Sensitive Setting																								
Sample ID	**Date**	**Report Number**																						
BH_P_01 0.4-0.5	23-Jan-19	637818	<0.05	488	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	20	-	<0.1	<0.1
BH_P_02 0-0.15	23-Jan-19	637818	<0.05	697	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	2.9	-	<0.1	<0.1
BH_P_03 1-1.1	23-Jan-19	637818	<0.05	685	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	14	-	<0.1	<0.1
BH_P_04 0-0.15	23-Jan-19	637818	-	818	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	8.4	-	-	-
BH_P_05 0.4-0.5	23-Jan-19	637818	-	643	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	8.8	-	-	-
QA20190123RC_01	23-Jan-19	210425	<0.1	630	<0.1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	18	-	-
QC20190123RC_01	23-Jan-19	637848	<0.05	668	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	9.1	-	<0.1	<0.1
BH_P_06 0.8-0.9	23-Jan-19	637818	<0.05	544	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	16	-	<0.1	<0.1
BH_P_07 0-0.15	22-Jan-19	637818	-	789	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	6.4	-	-	-
BH_P_08 0.4-0.5	24-Jan-19	637818	-	618	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	17	-	-	-
BH_P_09 0-0.15	24-Jan-19	637818	<0.05	608	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	5.7	-	<0.1	<0.1
BH_P_10 0.6-0.7	24-Jan-19	637818	-	706	0	0	0	0	0	0	0	0	0	-	Nil	Nil	Nil	Org fibres det.	No resp. fibres det.	Nil	15	-	-	-

Data Comments
#1 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 ESDAT Combined.

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