



Opal Aged Care Pty Ltd
(Principal Healthcare Finance Pty Ltd)
C/O Midson Group Pty Ltd

Remedial Action Plan

Opal Seaside Aged Care
184-194 Garden Street, Warriewood, NSW

3 September 2019

55792/124336 (Rev 0)

JBS&G Australia Pty Ltd

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Abbreviations

Term	Definition
ACM	Asbestos Containing Materials
AEC	Areas of Potential Environmental Concern
AF	Asbestos Fibres
AHD	Australian Height Datum
AMP	Asbestos Management Plan
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soil Management Plan
bgs	Below ground surface
BTEX	Benzene, Toluene, Ethylbenzene , Xylenes
B(a)P	Benz(a)pyrene
CLM Act	Contaminated Land Management Act 1997
COC	Chain of Custody
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
DP	Deposited Plan
DQI	Data Quality Indicators
DQO	Data Quality Objectives
DSI	Detailed Site Investigation
EIL	Ecological Investigation Levels
EMP	Environmental Management Plan
EPA	NSW Environmental Protection Authority
ESLs	Ecological Screening Levels
FA	Friable Asbestos
ha	Hectare
HILs	Health Investigation Levels
HSLs	Health Screening Levels
JBS&G	JBS&G Australia Pty Ltd
LEP	Local Environmental Plan
LOR	Limit of Reporting
NATA	National Accreditation Testing Authority
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
OCP	Organochlorine Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soil
PCB	Polychlorinated Biphenyls
PID	Photoionisation Detector
POEO Act	Protection of Environment Operations Act (1997)
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RPD	Relative Percentage Difference
SAR	State Audit Report
SAS	Site Audit Statement
SEPP55	State Environmental Planning Policy No 55 – Remediation of Land
TCLP	Toxicity Characteristic Leachate Potential
SWA	Safework Australia
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage System
VENM	Virgin Excavated Natural Materials
VOC	Volatile Organic Compounds
WHS	Work, Health and Safety

1. Introduction & Objectives

1.1 Introduction

JBS&G Australia Pty Ltd (JBS&G) was engaged by Midson Group Pty Ltd (Midson) on behalf of Principal Healthcare Finance Pty Ltd (Opal, the client) to prepare a Remedial Action Plan (RAP) for the Opal Aged Care Seaside property, located at 184-194 Garden Street, Warriewood, NSW (the site). The site is legally identified as Lot 2 in Deposited Plan (DP) 595174 and occupies an area of approximately 1.17 hectares (ha). The site location and layout are shown on **Figures 1 and 2**, respectively.

It is understood that the client proposes to undertake redevelopment an existing facility over two stages and construction a new Residential Aged Care Facility including car parking areas and landscaping. Detailed Site Investigation (DSI) has been completed to assess the environmental condition of the site prior to redevelopment and also to fulfil condition no.C22 of the Conditions of Approval¹ (Land and Environment Court proceedings 2017/370138). The environmental condition of the site has been assessed in JBS&G (2019²).

Previous environmental (and geotechnical) investigations completed at the site, namely DP (2017a³), DP (2017b⁴) and JBS&G (2019), identified impacted fill at the site. This impact in fill consisted of fragments of bonded asbestos containing materials (ACM), friable asbestos at one location and lead at one location. Significant inclusions of foreign materials were also identified in fill across the site including building rubble of bricks, concrete, metal, plastic, tyres and timber. It was recommended that remediation was required for the site to be made suitable for the proposed land use as a retirement aged care facility (RACF)

As such, JBS&G has prepared a RAP for the site to guide the remediation and validation of the site as an aged care facility which is equivalent to a land use of residential with gardens and accessible soils (NEPC 2013⁵).

1.2 Objective

The objectives of this RAP are to guide the required remediation to enable the site to be validated as suitable for land use of residential with gardens and accessible soils, pursuant to NEPC 2013.

¹ Conditions of Approval, Section 34 Agreement Between Parties, Land and Environment Court of NSW, Case No. 2017/370138, Filed 2 October 2018.

² *Detailed site Investigation, Opal Seaside Aged Care, 184-194 Garden Street, Warriewood, NSW. JBS&G Australia Pty Ltd. Prepared for Opal Aged Care Pty Ltd. 5 March 2019. 55792/120711 Rev A (JBS&G 2019)*

³ *Report on Preliminary Site Investigation for Contamination with Limited Sampling, Proposed Aged Care Facility. 184 – 194 Garden Street, Warriewood NSW. Prepared for Opal Aged Care. Douglas Partners, March 2017. Project 85505.01 (DP 2017a)*

⁴ *Report on Geotechnical Investigation, Proposed Aged Care Facility. 184 – 194 Garden Street, Warriewood NSW. Prepared for Opal Aged Care Pty Ltd. Douglas Partners, March 2017. Project 85505.00 (DP 2017b)*

⁵ *National Environment Protection (Assessment of Site Contamination Measure) Measure 1999 (As Amended 2013). National Environment Protection Council (NEPC 2013).*

2. Proposed Development Details

Based on the Design Plan provided by the client, included in **Appendix A**, the site is proposed to be developed in two stages with two adjoining buildings providing 127 bedrooms and 147 beds for the aged care facility. An outdoor car parking area with 37 car spaces will be constructed along the southern portion of the site. Remainder of the site will comprise of a combination of landscaping areas and walkways / pavements. Stage 1 will occur in the southern half of the site at the location of the currently unoccupied former independent living area. Stage 2 will occur after Stage 1 construction is complete. Stage 2 is currently active and occupied by an aged care facility.

It is anticipated that the remediation will occur over two stages in alignment with the proposed redevelopment stages and final built form. Therefore, two validation signoffs will be required, one for each stage. A Site Audit Statement and a Site Audit Report will be issued to the consent authority at completion of remediation and validation of each stage.

As shown in the cut-and-fill plan provided by the client (**Appendix A**), Stage 1 developable area with an approximate area size of 5418 m², will be subject to predominantly filling with an estimated 1454 m³ of materials deficit to construction requirements, requiring importation. Whereas Stage 2 developable area with an approximate area size of 5279 m², will be subject to slightly more cutting with an estimated 288 m³ of materials surplus to construction requirements, requiring off-site disposal.

To accommodate the proposed cap/cover remedial strategy, excavated fill/natural materials are proposed to be placed within new building footprints and beneath the engineered concrete slab associated with the overlying built form, or alternatively in areas require filling with an implementation of a physical separation remedial strategy – validated environmentally suitable materials are proposed to be placed above the fill materials in accordance with the requirements of this RAP as discussed in **Section 8.4.4**.

3. Site Condition and Surrounding Environment

3.1 Site Identification

The site location and layout are shown in **Figures 1** and **2**, respectively. Site details are summarised in **Table 3.1** and described in detail in the following sections.

Table 3.1: Summary of Site Details

Lot/DP	Lot 2 DP 595174
Address	184-194 Garden Street, Warriewood, NSW
Local Government Authority	Northern Beaches Council (formed in May 2016 by amalgamation of Manly, Pittwater and Warringah Councils)
Approximate Area size	1.17 ha
Current Zoning	R3 Medium Density Residential (Pittwater Local Environmental Plan (LEP) 2014)
Current Land Use	Vacant unoccupied buildings within the southwestern portion (Stage 1 Developable Area) Active Residential aged care facility within the northwestern portion (Stage 2 Developable Area)
Previous Land Use	Agricultural, market gardens prior to 1980s Residential as aged care facility after 1980s
Proposed Land Use	Residential as ongoing aged care facility

3.2 Site Description

A detailed inspection of the site was conducted on 11 February 2019 by one of JBS&G's trained and experienced environmental scientists. Observations of the current site configuration and potential areas of concern are discussed below.

The site was observed to consist of one occupied (single storey) aged care building at the northwestern portion and one vacant (two storey) aged care building at the southwest portion of the site. The buildings were brick construction. Ground level was constructed on concrete slabs with vinyl/carpet flooring internally. Remaining portions of the site were observed to contain asphalt-paved carpark and open spaced courtyards in between the buildings (i.e. grassed areas and constructed garden beds) with paved access walkways around the perimeter of the site. A leased single storey free standing house occupied the northwest corner. The site appeared to have undergone cut-and-fill balancing to establish the current site levels, and vegetated mounds were also observed along the eastern boundary of the site. Drainage channels and pits were observed across the site and the general down gradient direction of the site was interpreted to be gradually south and southeast. Surface water flowed into the Mullet Creek via constructed drainage lines on site/Garden Street.

The fill/soil profile was noted to comprise brown to grey heterogenous gravely silty sand and gravely sandy clay with anthropogenic inclusions of bricks, concrete boulders, metals, plastic, timber, terracotta pipe fragments, lithic gravels at most locations. No odours or staining were observed in soil at the site. Visible ACM fragments were observed within the fill materials across the site at 17 out of 41 locations with no discernible distribution pattern.

3.3 Surrounding Land Use

The current land uses of adjacent properties or properties across adjacent roadways are summarised below.

- North – The site is bounded by residential properties;
- East – The site is bounded by Garden Street, further afield is Warriewood Wetlands and Mullet Creek;

- South – The site is bounded by a highly vegetated area associated with Mullet Creek, beyond which is Irrawong Road and further, residential properties; and
- West – The site is bounded by residential properties, further afield is Banksia Parade.

3.4 Topography

Review of published regional topographic data via the Spatial Information exchange (Six Maps⁶) indicated that the site lies at an elevation of between 5 m to 10 m Australian Height Datum (AHD).

During the site inspection surrounding roads and neighbouring properties were noted to grade slightly downward to the south and south east, towards the creek. Site levels as confirmed during the site inspection were generally flat, suggesting that the overall profile may have been subject to some filling to create existing levels. Additionally, several raised mounds were evident along the eastern boundary of the site along Garden Street.

3.5 Geology and Soils

Reference to the online ESPADE 2.0 tool hosted by the NSW Office of Environment and Heritage (OEH 2019⁷) and the 1:100 000 Geological Series Sydney Geological Survey of NSW Sheet 9030 (DMR 1991⁸) indicates that the northern portion of the site falls within the Newport and Garie Formations, whilst the southeastern portion of the site is within an area of stream alluvial and estuarine sediment. Relevant details of the two soil formations are summarized below:

- **Geology:**
 - The Newport and Garie Formation comprises interbedded laminite, shale and quartz, to lithic-quartz sandstone.
 - The stream alluvial and estuarine sediment comprises silty to peaty quartz sand, silt and clay with ferruginous and humic cementation in places and common shell layers.
- **Landscape:**
 - 'Warriewood Swamp'; Level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. Local relief <10m, slopes <3%, water table at <2m.
 - 'Watagan Colluvial'; Rolling to very steep hills on fine-grained Narrabeen Group sediments. Local relief 60- 120 m, slopes >25%. Narrow, convex crests and ridges, steep colluvial side-slopes, occasional sandstone boulders and benches.
- **Soils:**
 - 'Warriewood Swamp'; deep (>150 cm), well sorted, sandy Humus Podzols and dark, mottled Siliceous Sands, overlying buried Acid Peats in depressions; deep (>200 cm) Podzols and pale Siliceous Sands (Uc1.2) on sandy rises.
 - 'Watagan Colluvial'; shallow to deep (30-200 cm) Lithosols/Siliceous Sands and Yellow Podzolic Soils on sandstones; moderately deep (100-200 cm) Brown Podzolic Soils, Red Podzolic Soils and Gleyed Podzolic Soils on shales.
- **Limitations:**
 - 'Warriewood Swamp'; localised flooding and run-on, high water tables, highly permeable soil.
 - 'Watagan Colluvial'; mass movement hazard, steep slopes, severe soil erosion hazard, occasional rock outcrop.

⁶ Six Maps website, <https://maps.six.nsw.gov.au/> accessed 24 January 2019

⁷ ESPADE 2.0. NSW Office of Environment and heritage, Accessed 3 January 2019, OEH 2019;

⁸ Penrith Geological Series Sheet 9030 (Edition 1) 1983. Geological Survey of NSW, Department of Mineral and Resources (DMR 1991)

3.6 Hydrology

Review of SIX Maps indicated that the closest down-gradient surface water body is Mullet Creek, located approximately 0.25 km to the south of the site and which generally flows towards South Creek located approximately 1.65 km to the southeast. This system eventually discharges into the South Pacific Ocean.

As discussed in **Section 3.2**, areas external to site structures, pavements and carpark were largely unpaved, particularly the eastern portion of the site along Garden Street. As such, precipitation falling onto the site is expected to infiltrate surface soils at a rate reflective of the permeability of the underlying site soils (**Section 3.5**). In periods of heavy or prolonged rainfall, following surface soil saturation, excess water movement is expected to follow the topographic gradient and be collected by the site's stormwater drainage network and transferred to the regional stormwater network on Garden Street.

3.7 Hydrogeology

Review of the registered bore information identified several registered groundwater bores within 1 km radius of the site. Relevant information is summarised in **Table 3.2** below.

Table 3.2: Registered Groundwater Bore Search Summary

Bore ID	Use	Standing Water Level (m bgs)	Well Depth (m bgs)	Distance from site	Lithology
GW013478	Domestic	Unknown	47.80	800 m to the southwest	Sandstone to 46.02 m, shale to 47.85
GW113169	Monitoring	1.52	4.8	1 km to the southeast	Unknown
GW113170		1.2	5.5		
GW113171		1.53	4.5		
GW106699	Monitoring	Unknown	3.0	850 m to the northeast	Fill to 0.2 m, weathered sandstone to 0.6 m, clayey sand to 1 m, clay to 2 m. clayey sand to 3 m
GW106697	Monitoring	Unknown	3.0	1 km to the northeast	Fill to 1.2 m, clay to 3 m

Based on the reported geology, topography and site observations of the site, groundwater is expected to be encountered at shallow depths (less than 3 m bgs). Groundwater is expected to flow south and southeast into the Mullet Creek, in line with regional topography.

3.8 Acid Sulfate Soils (ASS)

Review of the Hornsby/Mona-Vale Acid Sulfate Soil Risk Map indicates that the site is located within an area of 'High probability of Acid Sulfate Soil Occurrence'. Based on review of geology maps, soil maps, site topography and site observations it is likely that ASS may be present on-site between 1 m bgs to 3 m bgs.

During most recent site investigation works by JBS&G (2019), no indicators of ASS or potential ASS (PASS) were observed in any sample locations. However, DP (2017b) reported presence of PASS within sample locations DPBH4 and DPBH11A from depths of 5 m bgs and 3 m bgs, respectively.

3.9 Meteorology

A review of average climatic data for the nearest Bureau of Meteorology monitoring location (Terrey Hills⁹) indicates the site is located within the following meteorological setting:

- Average minimum temperatures vary from 7.6 °C in July to 18.5 °C in January;

⁹ http://www.bom.gov.au/climate/averages/tables/cw_066059.shtml Commonwealth of Australia, 2013 Bureau of Meteorology, accessed 18 February 2019.

- Average maximum temperatures vary from 16.3 °C in July to 27.0 °C in January;
- The average annual rainfall is approximately 1089.9 mm with rainfall greater than 1 mm occurring on an average of 92.9 days per year; and
- Monthly rainfall varies from 51.1 mm in May to 144.3 mm in June with the wettest periods occurring on average between November and June.

4. Site History

Based on information provided in JBS&G (2019), the site has been utilised for agricultural purposes (market gardening and cropping) until acquisition by Seaside Nursing Home Pty Ltd in 1982. The current buildings were constructed between 1982 and 1986 within the western half of the site with a carpark in the middle of the site and open space in the remaining area, based on the review of historical title records and aerials photographs in JBS&G (2019). The site has remained relatively unchanged in recent years with some changes in the surrounding lands.

JBS&G (2019) reported that EPA searches indicated no notices are present for the site or surrounding properties, and the site is not on the published list of NSW contaminated sites. No dangerous goods storage licences were identified to have been issued for the site or immediately surrounding properties.

5. Previous Investigations

The following environmental assessment report prepared for the site has been reviewed and summarised in the following section:

- Douglas Partners – Report on Preliminary Site Investigation for Contamination with Limited Sampling, Proposed Aged Care Facility. 184-194 Garden Street, Warriewood NSW. Prepared for Opal Aged Care. Project ID: 85505.01, March 2017, DP (2017a);
- Douglas Partners – Report on Geotechnical Investigation, Proposed Aged Care Facility. 184-194 Garden Street, Warriewood NSW. Prepared for Opal Aged Care. Project ID: 85505.00, March 2017, DP (2017b); and
- JBS&G Australia Pty Ltd – R01 Detailed Site Investigation for Opal Seaside Aged Care, 184-194 Garden Street, Warriewood, NSW, Reference 55792/120711 (Rev A), 5 March 2019, JBS&G (2019).

5.1 Preliminary Site investigation (PSI), Douglas Partners (DP 2017a)

Douglas Partners (DP) was engaged by Planix Projects on behalf of Opal to complete a preliminary site investigation (PSI) with limited sampling in 2017. It was understood the site development was proposed in two stages and the report was to facilitate design and planning of the redevelopment.

The PSI comprised a combined desktop study and limited soil sampling across accessible portions of the site. The intrusive investigation was limited to the collection of twelve (12) soil samples via a combination of drill rig and hand auger within accessible areas of the site, external to building footprints and site structures.

Key findings of the DP PSI are summarised below:

- From before 1951 until 1978, part (northwestern) of the site was used as market gardens, and the southern half remained as bushland. Between 1978 and 1986, redevelopment for construction of the current aged care facility occurred;
- Potential sources of contamination at the site were identified as imported fill, hazardous building materials from former market gardening structures (i.e. asbestos, lead paint) and broadcast pesticides from former market garden use;
- Fill materials comprising clay, sand, gravel and crushed sandstone with anthropogenic inclusions of concrete, ceramic tile, brick, timber, slag, clay pipe fragments and steel were encountered at all locations. Natural material (sand, clayey sand and clay) was encountered at 5 locations (DPBH4, DPBH10, DPBH11A, DPBH12 and DPBH14) at depth ranging from 2.5 m bgs to 3.9 m bgs;
- Two monitoring wells were installed and groundwater was encountered at 1.61 m bgs at DPBH11A and at 2.21 m bgs at DPBH12, respectively;
- Representative soil and groundwater samples were collected and analysed in accordance with site contaminants of potential concern (COPC) and compared against adopted criteria for residential land use as an aged care facility. All results were reported within the adopted criteria, with the exception of elevated copper concentration which exceeded the ecological criterion, and chrysotile asbestos was detected but reported below the formal laboratory LOR in fill materials at sample locations DPBH6 and DPBH14;
- With the presence of asbestos within the fill materials, the site material was preliminarily classified as General Solid Waste & Special Waste (GSW&S);
- DP (2017a) recommended to undertake a DSI to further characterise fill identified across the site, including the footprints of existing buildings (where accessible) with respect to

asbestos impacts identified within site fill materials in accordance with NEPC 2013 protocols, and also to confirm a final waste classification for the general site material;

- DP (2017a) also recommended to undertake a hazardous building materials survey of existing buildings prior to demolition.

5.2 Geotechnical Investigation, Douglas Partner (DP 2017b)

Douglas Partners was engaged by Planix Projects on behalf of Opal to complete a geotechnical investigation in 2017. It was understood that the site development comprised demolition of existing buildings and construction of a new two-storey aged care facility. It was understood there was to be no basement and the ground level will be close to the existing ground level with minor cut and fill activities. The geotechnical investigation was considered to be read in conjunction with the PSI (DP 2017a).

Apart from geotechnical compaction testings, field and laboratory testings for acid sulfate soil (ASS) and potential ASS (PASS) were also conducted and developed in general accordance with the ASSMAC Acid Sulfate Soil Manual.

Vigorous reaction was noted within sample DPBH4 at the depth of 5 m bgs and sample DPBH11A at the depth of 4.0 m bgs. Subsequent laboratory testing confirmed the presence of PASS within these two locations from the depths of 5 m bgs and 3 m bgs, respectively. It was recommended that management would be required should PASS be excavated or disturbed. Liming rates for treatment of ASS/PASS were also provided in laboratory reports.

5.3 Detailed Site Investigation (DSI), JBS&G (JBS&G 2019)

JBS&G was engaged by Midson on behalf of Opal to complete a DSI following recommendation of DP's PSI (2017a) to further characterise the site condition with regards to potential contamination prior to redevelopment, and draw conclusions regarding the suitability of the site for use as an ongoing aged care facility, and if warranted, develop a RAP and/or management plans for contamination that may pose unacceptable risks under the land use of a residential aged care facility, equivalent to Residential A with garden/accessible soil land use in NEPC (2013).

The DSI comprised a desktop assessment and a summary of key historical activities at the site is provided in **Section 3**. Based on the review of historical information for the site, it appears the site was historically utilised for agricultural purposes and market gardens, and currently for an aged care facility. Historical activities at the site would not normally be expected to have the potential for gross or widespread contamination, however there is the potential for impacts associated with pesticides and cut-fill activities.

Site investigation works were undertaken by JBS&G from 11 February 2019 to 15 February 2019. The field program comprised a detailed site inspection, advancement of 41 locations via a combination of excavator, drill rig and hand auger across the site, installation of one new groundwater monitoring well and groundwater sampling at 2 existing and 1 newly installed well locations. Sampling locations and exceedances are shown in **Figure 3** and **Figure 5**, respectively. Sampling and laboratory results are provided in **Appendix B**.

Several types of fill materials were encountered across the site, however the dominant fill consisted of grey/brown heterogenous gravelly silty sand and gravelly sandy clay. Fill material, containing significant amount of anthropogenic inclusions of bricks, concrete boulders, metals, plastic, timber and terracotta pipe fragments and lithic gravels to the depth of 4 m bgs, was encountered at all test pit sample locations. The extent of fill was not determined at some locations due to refusal or groundwater intrusion resulting in testpit collapse. There was no evidence of staining or odours observed in any of new sample locations across the site. This aligned with the previous findings of DP (2017a) PSI report.

Visible ACM fragments with no discernible distribution pattern were observed in 17 out of 41 sample locations with a maximum concentration of 0.993% w/w reported during field asbestos quantification. Laboratory testing reported fibrous asbestos (FA) was at one location, TP18_1.0-2.0, with a concentration of 0.0017%w/w, exceeding the adopted health-based criterion of 0.001 %w/w. Asbestos fibres (AF) was reported at one location, TP20_0-1.0, with a concentration of AF within the adopted health-based criterion of 0.001 %w/w. As such, it is considered the general site fill material is impacted with asbestos, requiring further management/remediation. Locations of asbestos detections in soil are shown on **Figure 6**.

Elevated lead was reported in sample HA01_0.6-0.7 and TP16_2.3-2.4 with a concentration of 810 mg/kg and 320 mg/kg, respectively, exceeding the adopted health-based criterion (HIL-A) of 300 mg/kg. However statistical analyses for lead indicated that the exceedance in sample TP16_2.3-2.4 was not statistically significant with regard to the population data set. Therefore, only the lead exceedance in sample HA01_0.6-0.7 requires managing/remediation.

Elevated zinc was also reported in sample TP16_2.3-2.4 with a concentration of 1,600 mg/kg, exceeding the adopted ecological (EIL) criterion of 400 mg/kg. However, EIL criterion only applies to soil down to a depth 2 m below the current soil surface according to NEPC (2013), while the sample was collected below 2 m bgs and elevated zinc condition was not reported in the shallower sample (TP16_0.1-0.2). Therefore, the zinc exceedance at TP16_2.3-2.4 is not considered to pose an unacceptable ecological risk.

Elevated total recoverable hydrocarbons (TRH) and polycyclic aromatic hydrocarbon (PAHs) were also reported in several samples, exceeding the adopted ecological and/or human health site criterion. However, statistical analyses have indicated that the TRH and PAH exceedances were not statistically significant with regard to the population data set. As such, the exceedances are not considered to pose an unacceptable risk.

Aesthetic impacts were identified across the site within the fill materials to contain visible ACM fragments in 17 out of 41 locations and significant quantities of building/construction rubbles including bricks, concrete, metals, plastic, tyres, timber, terracotta pipe fragments and lithic gravels. The above fill observations pose an aesthetic issue for permissible land uses of the site as an aged care facility.

Groundwater was at reported at a depth of approx. 2m bgs and the flow direction was south towards Mullet Creek, as shown on **Figure 4**. No impact was reported in groundwater.

No other contaminants of concern exceeded the adopted health based or ecological assessment criteria applicable to the proposed residential land use as aged care facility.

Based on the results of the DSI, fill materials were noted to be generally similar across the site and impacted with asbestos. As a conservative approach, all site fill materials were classified as General Solid Waste (non-putrescible) / Special Waste (Asbestos Waste) (GSW&S).

The DSI recommended the development of a RAP to guide the required remediation to enable the site to be considered suitable for the permissible land uses as an ongoing aged care facility. It also recommended a separate Asbestos Management Plan (AMP) and Acid Sulfate Soil Management Plan (ASSMP) should also be prepared to manage and control potential exposure during remediation and/or construction works.

6. Contamination Status / Conceptual Site Model

The conceptual site model (CSM) presented in this Section is based on the assessment and conclusions presented in DP (2017a and 2017b) and JBS&G (2019).

6.1 Areas of Environmental Concern

Based on the review of the site history and of previous investigations, JBS&G's assessment and understanding of site conditions, potential areas/aspects of environmental concern (AEC) and associated contaminants of potential concern (COPC) have been identified as summarised in **Table 6.1**. The actual presence of these constituents is discussed further in the following sections.

Table 6.1 Areas of Environmental Concern and Associated Contaminants of Potential Concerns

Location	Depth (m bgs)	Constituent and Level	Concentration	Criteria Exceeded	
				Aesthetic Impacts	NEPC (2013)
HA01	0.6-0.7	Lead	810 mg/kg	YES	HIL-A
BH03	0-0.1	Benzo(a)pyrene	2.0 mg/kg	YES	ESL-A
TP16	2.3-2.4	Zinc	1,600 mg/kg	YES	EIL-A
TP18	1.0-2.0	FA	0.0017 %w/w	YES	HSL-A
Remainder of Site	Fill materials	Aesthetic Impacts	NA	YES	-
		ACM	0 – 0.993 %w/w (based on asbestos quantification)	YES	HSL-A (17 out of 41 locations)

On the basis of previous investigations and the summary presented in **Table 6.1**, site contaminants are restricted to both friable (FA) and non-friable (bonded) asbestos, lead and aesthetic impacts.

JBS&G note that there is the potential for additional aesthetic impacts and fragments of non-friable (bonded) ACM to be present within fill at the site, and particularly below the footprints of former site structures where assessment was not undertaken. Therefore, this AEC has been considered in the formulation of the remedial strategy for the site.

6.2 Potential for Migration

Contaminants generally migrate away from a site via a combination of windblown dusts, rainwater infiltration, groundwater migration and surface water runoff. The potential for contaminants to migrate is a combination of:

- The nature of the contaminants (solid/liquid and mobility characteristics);
- The extent of the contaminants (isolated or widespread);
- The location of the contaminants (surface soils or at depth); and
- The site topography, geology, hydrology and hydrogeology.

The potential for the migration of contaminants via surface processes including aeolian transport at the site is considered to be substantially mitigated by the nature of the site given the site is currently covered with vegetation and capped with hardstands. Following remediation/validation, contamination sources will have been removed/managed appropriately.

Soil contaminants are generally in a solid form (i.e. asbestos) and are unlikely to represent a risk to groundwater or surface water contamination given their nature.

JBS&G (2019) undertook a limited assessment of the leachability of contaminants from sample HA01_0.6-0.7 which was reported to contain elevated concentrations of lead, exceeding the

adopted human health criterion. The reported concentration in leachate for lead is within the adopted site criterion and therefore the potential for the migration of lead leachate is considered very low.

6.3 Potential Exposure Pathways

Based on the COPCs identified in potentially contaminated media as discussed above, the exposure pathways for the site include:

- Potential dermal and oral contact to impacted soils (lead and asbestos); and
- Potential ingestion and inhalation exposure to impacted air due to generation of airborne fibres (asbestos).

6.4 Receptors

Potential receptors of environmental impact present within the site include:

- Excavation/construction/maintenance workers conducting demolition/redevelopment activities at the site, who may potentially be exposed to COPCs through direct contact with impacted soils present within excavations and/or inhalation of fibres associated with the destruction of fragments of non-friable ACM;
- Future site maintenance/service workers who may come into direct contact with potentially contaminated soils should services/infrastructure be installed in soil underlying the site; and
- Future onsite residents (potential) who may potentially be exposed to COPCs through direct contact with impacted soils.
- Potential ecological receptors within future landscaped site areas if vegetation is planted into site soils.

Exceedances of the adopted ecological criteria (EIL-A) for zinc in sample TP16_2.3-2.4 are not likely to present an unacceptable risks to ecological receptors as the sample was collected below 2 m bgs and EIL criteria only applies to soil down to a depth 2 m below the current soil surface in accordance with *Schedule B5a: Guideline on Ecological Risk Assessment* of NEPC (2013) .

Furthermore, elevated concentrations of benzo(a)pyrene (B(a)P) reported in samples BH10_0.5-0.6 and QC20181102 (duplicate sample of BH03_0-0.1), exceeded the adopted ecological under a residential with accessible land use (ESL-A), are also unlikely to present unacceptable risks to ecological receptors given that NEPC (2013) Schedule B7 guidance¹⁰ notes that plant uptake of anthropogenic PAHs is limited and therefore it is considered that B(a)P ecological exceedances do not represent an unacceptable risk requiring remediation or management.

6.5 Preferential Pathways

A range of preferential pathways are currently present on the site as associated with near surface fill horizons and former/current services present across the site area (i.e. drainage lines, sumps, pits etc.).

Preferential pathways may be created with the proposed development. Future installation of services will occur in shallow soils where remediation works are proposed. Based on the absence of

¹⁰ NEPC (2013) has advised that plants grown on PAH contaminated soil have only limited ability to take up and incorporate anthropogenic PAHs through their roots and into their biomass, especially those PAHs with higher molecular weights including benzo(a)pyrene. Physical and biochemical processes within soil and the soil ecosystem in conjunction with the low solubility of benzo(a)pyrene generally result in benzo(a)pyrene bonding firmly to soil particles or the outside layers of root tissue with uptake rates being very slow and/or non-existent. As such, it was concluded that benzo(a)pyrene ecological exceedances did not represent an unacceptable risk requiring remediation or management.

significant levels of near surface soils and general absence of potential leachable constituents, these potential pathways are not considered to be significant.

Although fill materials are anticipated to have a higher permeability than the underlying natural soil and/or bedrock, JBS&G consider that given the solid (non-soluble) nature of the contaminants identified at the site, there is limited capacity for the migration of contaminants along preferential pathways.

7. Remedial Options

7.1 Remedial Objectives

The remediation objectives are as follows:

- Removal of unacceptable risks to human health and aesthetic issues associated with the identified impacts;
- Addressing any unexpected finds as may arise during the remedial works;
- Validate the remedial works in accordance with the relevant NSW EPA guidelines and with reference to the RAP requirements; and
- Document the validation process.

This RAP has been prepared with reference to the following guidelines:

- *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land.* Department of Urban Affairs and Planning 1998 (DUAP 1998);
- *Sampling Design Guidelines.* NSW EPA 1995 (EPA 1995);
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.* NSW Office of Environment and Heritage 2011 (OEH 2011);
- *Contaminated Site: Guidelines for NSW Site Auditor Scheme (3rd Edition).* NSW Environmental Protection Authority 2017 (NSW EPA 2017);
- *National Environment Protection (Assessment of Site Contamination Measure) Measure 1999 (As Amended 2013).* National Environment Protection Council (NEPC 2013).
- *Work Health and Safety Regulation 2011.* NSW Government Legislation. (WHS Act 2011);
- *How to Safely Remove Asbestos - Code of Practice.* NSW Government, Safe Work NSW, 2016 (SWA 2016a);
- *How to Manage and Control Asbestos in the Workplace - Code of Practice.* NSW Government Safe Work Australia, 2016 (SWA 2016b);
- *Management of Asbestos in the Non-occupational Environment.* enHealth Council, 2005 (enHealth 2005); and
- *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.* WA Department of Health, 2009 (WA DoH 2009).

7.2 Extent of Remediation

As discussed in **Section 5** and **Section 6**, impacted soils identified at the site require remediation / management for the site to be considered suitable for residential with accessible soils land uses.

The following areas, as shown on **Figure 7**, have been identified as requiring remediation to ensure that the site will be suitable for residential with gardens and accessible soils:

- Lead impacted materials at HA01;
- Asbestos impact as FA in fill at TP16;
- Asbestos impact as ACM in general site fill; and
- Aesthetic impacts within the site fill materials including bricks, concrete boulders, metals, plastic, timber and terracotta pipe fragments and lithic gravels.

7.3 Consideration of Possible Remedial Options

7.3.1 EPA (2017) Guidance

NEPC 2013 (Vol 1, s6 (16)) presents the following hierarchy of options for soil remediation and management approaches. This hierarchy is followed in NSW (EPA 2017, s4.3.2):

- *On-site treatment of the contamination so that it is either destroyed or the associated risk is reduced to an acceptable level;*
- *Off-site treatment of excavated soil so that the contaminant is destroyed, or the associated risk is reduced to an acceptable level, after which the soil is returned to the site; or*

If the above are not practicable,

- *Consolidation and isolation of the soil on site by containment with a properly designed barrier;*

or,

- *Removal of contaminated material to an approved 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.*

Consideration of each of the approaches, is presented in **Table 7.1**.

7.3.2 WA DOH (2009) Guidance

WA DOH (2009) provides specific guidance for the remediation and management of asbestos impact and is called up into NEPC (2013). WA DOH (2009) note the following considerations as important when assessing the acceptability of any remediation:

- Minimisation of public risk;
- Minimisation of contaminated soil disturbance; and
- Minimisation of contaminated material/soil moved to landfill.

Consideration of each of the WA DOH (2009) guidance is presented in **Table 7.1**, taking into account the proposed future reuse of the site.

Table 7.1 - Remedial Options

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.	Lead Impacted Soil 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). FA Only Impacted Soil There are no known methods for destruction/treatment of asbestos ACM Only Impacted soil There are no known methods for destruction/treatment of asbestos Aesthetic Impacts (Building Rubble) Building rubble can be removed from impacted soils either by hand-picking or by mechanical screening. Mechanical screening should not be undertaken in areas of co-located asbestos impact. The unsuitable building rubble can be disposed/recycled offsite in accordance with waste regulations and exemptions.	Lead Impacted Soil Not a Suitable Option Metals are unable to be destroyed, so this is not an option which is able to be considered. Microencapsulation is not considered necessary given the absence of identified groundwater impacts requiring remediation. FA Only Impacted Soil Not a Suitable Option ACM Only Impacted Soil Not a Suitable Option Aesthetic Impacts (Building Rubble) 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.	Lead Impacted Soil 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). FA Only Impacted Soil There are no known methods for destruction/treatment of asbestos Asbestos Only Impacted Soils There are no known methods for destruction/treatment of asbestos Aesthetic Impacts (Building Rubbles) The waste poses an aesthetics issue that cannot be treated offsite and returned.	Lead Impacted Soil Not a Suitable Option FA Only Impacted Soil Not a Suitable Option ACM Only Impacted Soils Not a Suitable Option Aesthetic Impacts (Building Rubbles) Not a Suitable Option
3. Excavation and off-site removal of the impacted material.	Lead Impacted Soil Excavation and offsite disposal of impacted material is the fastest method of remediating the site suitable for proposed use.	Lead Impacted Soil <i>The Preferred Option</i> This is the preferred option given the relatively limited volume of fill requiring remediation and short duration required to achieve validation.

Remedial Option	Applicability	Assessment
	FA Only Impacted Soil Offsite disposal is a suitable remedial option for areas where FA impact is present above a threshold. ACM Only Impacted Soils Offsite disposal is a suitable remedial option for areas where ACM impact is present above a threshold. Applicability may be limited by inability to effectively separate included ACM due to soil type and building rubble concentration. Aesthetic Impacts (Building Rubble) Offsite disposal to suitably licenced receiving facility. Applicability is limited by presence of ACM and capacity to separate building rubble inclusions from fill matrix.	FA Only Impacted Soil <i>The Preferred Option</i> This is the preferred option given the relatively limited volume of fill requiring remediation and short duration required to achieve validation. ACM Only Impacted Soils Due to amount of ACM impacted fill materials to be excavated, it is likely not commercially feasible to dispose all asbestos impacted soil offsite and import significant amount of clean validated material to establish site final level. Considered to be a suitable contingency option for fill that is surplus to construction requirements. Aesthetic Impacts (Building Rubble) The environmental impact of waste processing, transport of materials and resource use in identifying and importing materials to re-instate the two-stages of Developable Area to final levels is considered to be non-sustainable. The presence of asbestos will trigger a more stringent waste classification Considered to be a suitable contingency option if unable to effectively remove bonded ACM due to soil type and building rubble concentration. A potentially applicable option but inferior to on-site placement (Option 4).
4 On-site in-situ management of the soil by capping and cover, and ongoing management.	Lead impacted soil Lead impacted soil may be located under less sensitive areas such as beneath a building, however this will result in detailed material tracking and additional detailed survey of a relatively small amount of materials. FA Only Impacted Soil FA impacted soil may be located under less sensitive areas such as beneath a building, however this will result in detailed material tracking and additional detailed survey of a relatively small amount of materials. ACM and Aesthetic Impacted Soil The amount of material able to be contained onsite will be dependent upon final design levels and the total volumes of fill materials required. On this basis, the	Lead impacted soil A suitable option if unable to remediate onsite or dispose off-site. FA Only Impacted Soil A suitable option if unable to remediate onsite or dispose off-site. ACM and Aesthetic Impacted Soil <i>The Preferred Option</i>

Remedial Option	Applicability	Assessment
	impacted fill materials are considered suitable for retention on site in areas where human/ecological exposures can be restricted with appropriate capping layer. However, consideration of the practical implications of an ongoing site management plan is required prior to implementation.	The retention of the materials will reduce the waste generation and resource requirements of the remediation of the site. The site will be subject to significant areas of building footprint and pavements which will provide physical separation between site users and retained fill materials. Consideration of the practical implications of an ongoing site management plan is required prior to implementation.

7.4 Preferred Remedial Strategy

A number of potential remedial options have been outlined in **Table 7.1**. The preferred remedial strategies for the site are presented in **Table 7.2** and are summarised as follows:

- Offsite disposal of material impacted with lead;
- Offsite disposal of material impacted with FA; and
- Cap/Cover Remedial Strategy for remaining site fill materials impacted with bonded asbestos (ACM) and aesthetics (i.e. significant amount of construction / building rubbles).

Table 7.2 - Soil Contamination and Remedial Methodology

Location	Depth of Remediation (m bgs)	Constituent	Remedial Strategy
HA01	0-0.7	Lead	Excavate/Offsite Disposal
BH03	0-0.1	B(a)P	No Remediation Required
TP16	2.3-2.4	Zinc	No Remediation Required
TP18	0-2.0	FA	Excavate/Offsite Disposal
Remainder of Site	Reduced Level as per design plans, also meeting the requirements of capping layer	Aesthetic Impacts	On-site retention
		ACM	

8. Remediation Plan

8.1 Regulatory and Planning Requirements

This RAP has been prepared with reference to the following guidelines and legislation. Details regarding regulatory approvals/licensing requirements are presented below.

8.1.1 Environment Planning and Assessment Act 1979 / SEPP 55

The remediation works are classified as Category 2 Remediation Works as per the meaning provided in SEPP 55 and will not require specific development consent under the *Environmental Planning and Assessment Act 1997*, given the works are not considered/proposed to be:

- Designated development; or
- Carried out on land declared to be a critical habitat; or
- Likely to have a significant effect on a critical habitat or a threatened species, population or ecological community; or
- Development for which another State environmental planning policy or a regional environmental plan requires development consent; or
- Carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:
 - Coastal protection;
 - Conservation or heritage conservation;
 - Habitat area, habitat protection area, habitat or wildlife corridor,
 - Environment protection;
 - Escarpment, escarpment protection or escarpment preservation;
 - Floodway;
 - Littoral rainforest;
 - Nature reserve;
 - Scenic area or scenic protection;
 - Wetland; or
- Carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated (or if the land is within the unincorporated area, the Western Lands Commissioner).

With regards to floodway, it was advised by client's environmental planner that a small area to the southern extremity of the site is affected by high hazard flooding in the Probable Maximum Flood (PMF) and '1 in 100 year ARI Flood Fringe' and the site is not classified as a 'floodway' pursuant to the Pittwater LEP 2014. Based on the client's design plans (**Appendix A**), the southern boundary of the site will be subject to minor cutting and predominantly filling.

Notification of remediation works will be required to be given to council at least 30 days prior to commencement, and council requires notification within 30 days from completion of remediation works, consistent with SEPP 55 requirements and Council's Contaminated Land Policy.

It is noted by JBS&G that Section 5.2 of Council's Contaminated Land Policy states that Council require copies of any preliminary investigation, detailed investigation and RAP for the subject site.

Following the completion of remedial works at the site, Council must also be notified within 30 days after the completion of remediation works and supply Council with copies of validation report(s) and other relevant records.

8.1.2 Environment Planning and Assessment Regulation 2000 – Schedule 3 Designated Development

The proposed remedial strategy is not considered to be 'Designated Development' under Schedule 3 of the EP&A Regulation (2000) given the expected works will not:

- Incinerate more than 1,000 m³ per year of contaminated soil;
- Treat otherwise than incineration and store more than 30,000 m³ of contaminated soil; or
- Disturb more than an aggregate area of 3 hectares of contaminated soil.

8.1.3 Protection of the Environment Operations (POEO) Act 1997

The proposed remediation / validation activities are not required to be licensed under the *POEO Act 1997*.

8.1.4 Water Management Act 2000

Depth to groundwater is approx. 2 mbgs. The redevelopment does not require deep excavation for construction of basements or other major infrastructure. Dewatering is not required to facilitate remedial works or construction at the site and therefore provisions of the Water Management Act (2000) do not apply.

8.1.5 Protection of the Environment Operations (Waste) Regulation 2014

The regulations make requirements relating to non-licensed waste activities and waste transport. The proposed remedial works on the site do not require a separate license. Section 48 of the Reg. requires that wastes are stored in an environmentally safe manner. It is also stipulated that vehicles used to transport waste must be appropriately licensed and covered when loaded with impacted materials. This regulation also details additional transport and tracking requirements for vehicles carrying Special (asbestos) waste if material is identified to contain asbestos following waste classification activities (Part 7, p44).

Provision is provided in the Regulation and EPA (2014) guidelines for the NSW EPA to approve the immobilisation of contaminants in waste (if required with unexpected finds).

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. Immobilisations may only be required with unexpected finds.

8.2 Approvals, Licences and Notifications

SEPP55 and Council's Contaminated Land Policy requires Council to be notified 30 days prior to Category 2 remediation works commencing, and within 30 days of completion. It is noted by JBS&G that Section 5.2 of Council's Contaminated Land Policy states that Council require copies of any preliminary investigation, detailed investigation, the Remediation Action Plan (this document) and copies of validation report(s) and other relevant records following the completion of remedial works at the subject site.

The WHS Regulation (2017) and SafeWork NSW regulations require all works pertaining to the removal of greater than 10 m² of non-friable (bonded) asbestos impacted materials and friable asbestos impacted materials to be notified and approved prior to commencement. In these

instances, works are required to be undertaken by a SafeWork NSW 'Class A (friable and non-friable) Asbestos Removalist' licence holder or 'Class B (non-friable) Asbestos Removalist' licence holder.

Given the current site condition at the time of reporting, the general site fill materials are considered to be impacted with bonded ACM fragments and location TP18 reported an elevated concentration of FA, exceeded the site adopted human health criterion, requiring remediation/management. Therefore a Class A (friable and non-friable) asbestos removal contractor shall be engaged to complete the remedial works.

8.3 Site Establishment

The extent of remediation is summarised in **Section 7** and visually shown on **Figure 7**. The remedial contractor shall secure the site to ensure that all safety and environmental controls are implemented. These controls will include, but not be limited to:

- Locate and isolate all required utilities in the proximity of the works;
- Work area security fencing;
- Site signage and contact numbers;
- Stabilised site entry gate;
- Appropriate decontamination areas for personnel and plant, if required;
- Sediment fencing (attached to security fencing); and
- Stormwater runoff and sediment controls (e.g. silt fences and hay bales).

8.4 Remedial Scope of Works

It is envisaged that remedial and validation works will be potentially conducted over two stages in alignment with the proposed redevelopment of the site. Within each proposed stage, remediation works will comprise the following actions.

8.4.1 Site Establishment

For each stage of remediation works the boundary will be defined (via survey) and secured as appropriate to ensure that all safety and environmental controls are implemented, including necessary contractor briefings and inductions for the remediation workforce. A summary of the controls is provided in **Section 11**.

Areas requiring remediation are discussed in **Section 6** and shown on **Figure 7**.

8.4.2 Removal of Lead Impacted Soils (HA01)

The following procedure should be undertaken for the remediation of soils impacted with lead, identified in **Section 6** and shown on **Figure 7**:

- The former hand auger location (HA01) will be located by the field scientist utilising a hand-held Trimble GPS with sub-metre accuracy;
- The excavation will be required to be advanced to at least 0.5 m below the depth of identified contamination, that is to 1.2 m bgs, and to a minimum lateral extent of 5 m x 5 m, or as delineated by the JBS&G field scientist. The excavation will be advanced in an 'inside-out' approach, so as to minimise the volume of spoil generated and requiring remediation;
- Disposal of the material to an appropriately licensed waste facility according to waste classification;
- Excavations are to be validated as per **Section 9.2.7**. Should validation fail the failed wall/s or base of the excavation will be excavated a further 0.3 m in the direction of the failure, and the validation process repeated until validation is achieved; and

- Following validation of the excavation as outlined in **Section 9.2.7**, the excavations generated by the removal of impacted soil will be backfilled using general site fill material and/or validated materials in accordance with **Section 9.2.7**.

8.4.3 Removal of FA Impacted Soils (TP18)

The following procedure should be undertaken for the remediation of soils impacted with FA, identified in **Section 6** and shown on **Figure 7**:

- The former test pit location (TP18) will be located by the field scientist utilising a hand-held Trimble GPS with sub-metre accuracy;
- The excavation will be required to be advanced to at least 0.5 m below the depth of identified contamination, that is to 2.5 m bgs, and to a minimum lateral extent of 5 m x 5 m, or as delineated by the JBS&G field scientist. The excavation will be advanced in an 'inside-out' approach, so as to minimise the volume of spoil generated and requiring remediation;
- Disposal of the generated spoil to an appropriately licensed waste facility according to waste classification;
- Excavations are to be validated as per **Section 9.2.7**. Should validation fail, the failed wall/s or base of the excavation will be excavated a further 0.3 m in the direction of the failure, or as otherwise indicated by visual observations and field screening, and the validation process repeated until validation is achieved; and
- Following validation of the excavation as outlined in **Section 9.2.7**, the excavations generated by the removal of impacted soil will be backfilled using fill material validated in accordance with **Section 9.2.7**.

8.4.4 Cap/Cover Remedial Strategy

Remaining fill material across the site is considered to be impacted with non-friable (bonded) asbestos as ACM fragments were observed across the site with no discernible pattern. Previous investigations (DP 2017a and JBS&G 2019) reported that all other contaminants of concerns (except lead impacts discussed above) were reported within the human-health based criteria except asbestos. Although minor ecological exceedances were reported in JBS&G (2019) at two locations (BH03, TP16, see **Table 7.2**) it is considered that those exceedances do not pose an unacceptable ecological risk.

Given that the contaminants in fill materials are in solid form (i.e. asbestos) and were demonstrated to be non-leachable or having low leachability and no groundwater or vapour contaminations were identified across the site, it is considered that the general site fill material is suitable to be retained on site if placed within areas of restricted exposure for human and ecological receptors, and managed in accordance with an ongoing long term environmental management plan.

This retainment will include the placement of fill materials below the engineered concrete slab associated with the overlying built form (i.e. new aged care facility building) and so will be inaccessible and identified as not representing an unacceptable human health or ecological risk.

Alternatively, where this placement is not possible due to structural stability or final design levelling issues identifies that the material is not suitable for placement below the building footprint, implementation of a physical separation remedial strategy is proposed. This includes:

- Removal of existing fill material to an additional depth of 0.5 m for grass/shrubs and/or 1.5m for trees and/or reduced levels to accommodate future pavements and carpark;
- Placement of marker layer (orange woven, free draining geotextile fabric) above retained fill material;

- Placement of at least 0.5 m of chemically suitable fill material above marker layer for grass/garden areas (refer to **Section 9**);
- Placement of at least 1.5 m of chemically suitable fill material above marker layer for tree areas (refer to **Section 9**; and/or
- Establishment of sub-grade layer (environmentally suitable soils, refer to **Section 9**) for pavement and carparks above marker layer.

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. building engineered concrete slab or permanent pavement/asphaltic hardstands or constructed garden beds) within each remediation area/stage; and
- Confirmation, by photos or otherwise, of the installation of the 'marker layer' underlying the cover (as required).

Adoption of a physical separation remedial strategy within these portions of the site will require development and implementation of a long-term EMP which will be discoverable and legally enforceable.

Given the specific development plans as understood at the time of preparation of the RAP, the following capping and cover procedures are to be implemented:

- Cover of fill materials by buildings – installation of a marker layer overlying potentially contaminated material to denote the extent of retained fill. The engineered concrete floor slab shall act as a physical barrier;
- Cover of fill materials by permanent paved areas beyond building footprints – installation of a marker layer overlying potentially contaminated material followed by sub-grade material validated as environmentally suitable materials for human/ecological exposure (where required) and then the permanent pavement and hardstands for carparks (i.e. concrete, asphalt, pavers, etc.);
- Capping of fill materials in landscaped areas – installation of the marker layer at a minimum depth of 0.5 m below final finished site levels in areas of shallow planting (for grasses and shrubs), or a minimum of 1.5 m below final finished site levels in areas of tree planting, with environmentally suitable materials placed above to the final levels; 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.

Generic “typical cross-sections” of the abovementioned capping arrangements were conceptually presented in **Figure 8**. Furthermore, given that the topography of the site slopes towards Mullet Creek to the south, possibilities for erosion or undermining should be taken into account by geotechnical engineers when installing respective capping.

8.5 Off-Site Disposal

Impacted fill materials are proposed to be disposed off-site to appropriately licensed facilities. Fill materials shall be classified in accordance with *Waste Classification Guidelines Part 1: Classifying Waste, November 2014, NSW EPA* (EPA 2014) or an appropriate exemption as created under the *Protection of the Environment Operations (Waste) Regulation 2014*.

On a conservative approach, general site fill materials were preliminary classified as GSW&S(Asbestos), however, additional waste classification sampling might be required to further classify the waste. Material will require transport and disposal according to regulations to a facility lawfully able to receive it.

The remedial contractor must be aware of and conduct all waste disposal in accordance with all relevant regulations. All waste tracking documentation including disposal dockets must be maintained by the remedial contractor and must be provided to the engaged environmental consultant for inclusion in the validation report.

8.6 Materials Importation

Materials imported to the site for the reinstatement of the excavation area, if required, are required to be validated and approved by JBS&G prior to importation to the site, as per **Section 9.2.7**.

8.7 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 9**.

8.8 Site Disestablishment

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

9. Validation Plan

9.1 Overview

Validation data is required to be collected to verify the effectiveness of the remediation works and document the condition of the site as being suitable for the proposed future uses.

Validation activities will be required for the following aspects:

- Collection of appropriate environmental data from excavations formed by the removal of contaminated soils;
- Collection of appropriate environmental data from residual soils underneath stockpiles where excavated contaminated material may be stored;
- Collection of appropriate environmental data from soils to be disposed of off-site or imported to the site;
- Tracking the movement of all soil and fill material on site;
- Tracking the movement of waste materials requiring off-site disposal;
- Assessment of materials imported to site; and
- Validation of any unexpected finds.

9.2 Data Quality Objectives

DQOs were developed for the validation program, as discussed in the following sections.

9.2.1 State the Problem

Soils at the site were identified to contain elevated concentrations of lead, asbestos and aesthetic impacts that potentially pose an unacceptable risk to human health and preclude the site from being considered suitable for a land use consistent with residential with gardens and accessible soils, pursuant to the *National Environmental Protection Measure* (NEPC 2013). As such, the site is required to be remediated and sufficient data collected to demonstrate that the site can be considered suitable for the proposed land use.

9.2.2 Identify the Decision

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

1. Are there any unacceptable risks to onsite or offsite receptors from any residual soil contamination?
2. Are there any remaining aesthetic issues at the site following remediation works?
3. Have the works been completed in accordance with the RAP, or where variations to the works were required, have these met the objectives of the RAP?
4. Is an EMP required to address management of any residual potential contamination?
5. Is the site considered suitable for the proposed use?

During the remediation activities, sufficient validation of site activities is required to demonstrate that the identified environmental and health based risks to future use(s) of the site have been adequately managed to render the site suitable for the proposed land use.

9.2.3 Identify Inputs to the Decision

The inputs to the decision are:

- Field observations in relation to inspection of all excavation bases, walls and stockpiles for odours, sheen, discolouration, and other indicators of potential contamination;
- Soil validation analysis data collected from the base and walls of the remedial excavations;
- Waste classification and material characterisation data obtained during assessment of fill material prior to and during remediation works;
- Field observations, sampling and analytical data for imported materials;
- Field observations, sampling and analytical data of any unexpected finds;
- Disposal dockets and relevant documents in relation to appropriate disposal of material to be removed from site as part of the remediation works (landfill dockets, beneficial reuse / recycling dockets, trade waste disposal, etc.);
- Relevant guideline criteria for validation and waste classification; and
- Data quality indicators (DQIs) as assessed by quality assurance / quality control (QA/QC).

9.2.4 Define the Study Boundaries

The lateral and vertical extents of areas subject to remediation are detailed in **Table 9.1** below and are shown on **Figure 7**.

Table 9.1 - Remedial Extents

Area	Contaminant	Vertical Extent (depth)	Remedial Strategy
HA01	Lead	0-0.7 m bgs	Excavation and off-site disposal
TP18	FA	0-2.0 m bgs	
Site Wide	ACM	NA	Cap/Cover Remedial Strategy (Section 8.4.4)

In practice, the lateral and vertical extent shall be determined by validation samples / data that satisfy the adopted validation criteria (**Section 9.4**).

Due to the nature of potential contaminants identified temporal variables will not require assessment as part of this investigation. The temporal boundaries of this investigation will be limited to the period of field validation assessment works.

9.2.5 Decision Rules

The decision rules adopted to answer the decisions identified in **Section 9.2.2** are discussed in **Table 9.2** below.

Table 9.2 - Summary of Decision Rules

Decision Required to be Made	Decision Rule
1. Are there any unacceptable risks to onsite or offsite receptors from any residual soil contamination?	Soil analytical data will be compared against EPA endorsed criteria as established in the RAP. For the validation sample sets, statistical analysis of the data will be undertaken in accordance with relevant guidance documents, as appropriate, to facilitate the decisions. The following statistical criteria will be adopted with respect to soils: Either: the reported concentrations will be below the site criteria; Or: the average site concentration for each analyte will be below the adopted HILs / EILs criterion; no single analyte concentration will exceed 250% of adopted health / ecological based site criterion; and the standard deviation of the results will be less than 50% of the adopted health / ecological based criterion. And: the 95% UCL of the average concentration for each analyte will be below the adopted health / ecological based site criterion. If the statistical criteria stated above is satisfied, the answer to the decision will be No.

Decision Required to be Made	Decision Rule
	If the statistical criteria are not satisfied, the answer to the decision will be Yes .
2. Are there any aesthetic issues remaining following remediation works?	If there are any remaining unacceptable odours, soil inclusions or soil discolouration, the answer to the decision will be Yes . Otherwise, the answer to the decision will be No .
3. Have any remedial works <u>not</u> been completed in accordance with the RAP, or where variations to the works were required, have these <u>not</u> met the objectives of the RAP?	Evaluation of the RAP requirements and completed scope of works will be undertaken on a qualitative basis. If the completed works are inconsistent with the stated RAP objectives, the answer will be Yes . Otherwise the answer to the decision is No .
4. Is an EMP required to address management of any residual potential contamination?	Was the answer to any of the above decisions Yes? If Yes , the issues are required to be documented within the EMP to be prepared for this site to address outstanding contamination issues. If No , an EMP is not required to be prepared for the site area to address outstanding issues.
5. Is the site considered suitable for the proposed use?	Was the answer to any of the above decisions Yes? If Yes , are the outstanding issues appropriately addressed by implementation of an Environmental Management Plan (EMP)? If the issues are appropriately addressed by the EMP, the answer to the decision will be Yes , subject to ongoing 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.

9.2.6 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 quality assurance / quality control) 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 to precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters). The acceptable limit on decision error is 95% compliance with DQIs.

The pre-determined DQIs established for the project are discussed below in relation to the PARCC parameters, and are shown in **Table 9.3**.

- **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 (RPD¹¹) 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

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

¹¹

Where C₀ is the analyte concentration of the original sample
C_d is the analyte concentration of the duplicate sample

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; and 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 site assessment criteria.

Table 9.3: Summary of Data Quality Indicators

Data Quality Indicators	Frequency	Data Quality Criteria
Precision		
Split duplicates (intra laboratory)	1 / 20 samples	<50% RPD ¹
Blind duplicates (inter laboratory)	1 / 20 samples	<50% RPD ¹
Laboratory Duplicates	1 / 20 samples	<50% RPD ¹
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	All samples	..2
Samples extracted and analysed within holding times.	All samples	Soil: organics (14 days), inorganics (6 months) Water: organics (7 days to extract and 14 days to analyses). Metals (6 months)
Laboratory Blanks	1 per lab batch	<LOR
Trip spike	1 per lab batch	70-130% recovery
Storage blank	1 per lab batch	<LOR
Rinsate sample	1 per sampling event/media	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All Samples
Standard analytical methods used for all analyses	All Samples extracted and analysed within holding times	NATA accreditation
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples ²
Limits of reporting appropriate and consistent	All Samples extracted and analysed within holding times	All samples ²
Completeness		
Sample description and COCs completed and appropriate	All Samples	All samples ²
Appropriate documentation	All Samples	All samples ²
Satisfactory frequency and result for QC samples		95% compliance
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted Site assessment criteria	All samples	LOR<= Site assessment criteria

(1) 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.

(2) A qualitative assessment of compliance with standard procedures and appropriate sample collection methods will be completed during the DQI compliance assessment.

9.2.7 Optimise the Design for Obtaining Data

The purpose of this step is to identify a resource-effective field validation sampling design that generates data that are expected to satisfy the decision performance criteria, as specified in the preceding steps of the DQO process. The output of this step is the sampling design that will guide development of the field sampling and analysis plan. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.

The remediation validation and subsequent laboratory analysis program as outlined in the following sections will need to be implemented during site remediation activities to demonstrate the successful completion of works in compliance with the RAP goals. The validation and

characterisation sampling and analytical program for the site is outlined in **Table 9.4** and **Table 9.5** below, respectively.

Table 9.4: Characterisation / Remediation and Validation Sampling Program

Item	RAP Sampling Frequency			Analytical Suite
Off-Site Disposal				
If fill materials for off-site disposal are to be classified in accordance with NSW EPA (2014)	Soils requiring additional classification for off-site disposal will be sampled by the engaged environmental consultant as per the sampling density for stockpiled materials in NEPC (2013) i.e. 1 per 25 m ³ , minimum 3 samples, up to 250 m ³ , assessment by highest concentration of analyte. Minimum 10 samples if classification by 95% UCL of average concentration of analyte. If greater than 250 m ³ , minimum 10 samples and classification by 95% UCL of average concentration of analyte Maximum stockpile size, 2000 m ³			Heavy metals TRH/BTEX PAH Asbestos (presence/absence) TCLP (heavy metals and PAHs)
Remedial Excavation				
	Excavation Floors	Excavation Walls	Materials	
Excavation formed by the removal of the lead impacted fill	1 / 25 m ²	1 / 5 m lineal (from each distinct horizon / material type / 1 m vertical soil profile)	N/A	Lead
Excavation formed by the removal of the FA impacted fill	1 / 25 m ²	1 / 5 m lineal (from each distinct horizon / material type / 1 m vertical soil profile)	N/A	Asbestos
Materials Importation				
Imported VENM	Minimum of 3 samples per source site / material type to 500 m ³ then 1 sample per 500 m ³ thereafter			TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos
Quarry VENM Materials (e.g. blue metal, sandstone, shale)	Confirmation that the material is quarried rock (VENM) with a VENM certificate provided by the quarry prior to importation, and visual confirmation.			Site Inspection required.
Recycled Materials under the NSW EPA Exemptions	Minimum of 3 samples per source site then 1 / 70 m ³ thereafter (Materials will need to be imported within 3 weeks of sampling date)			TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos

Table 9.5: Characterisation of Unexpected Finds / Importation

Validation Sample Type	RAP Sampling Frequency	Analytical Suite
Additional Fill Characterisation (where fill is considered to be materially different from that described in Section 5) and requiring off-site disposal	1 / 25 m ³ , minimum of 3 samples per frequency state above.	heavy metals TRH / BTEX PAHs OCPs / PCBs Asbestos (presence/absence) TCLP (heavy metals and PAHs)
Unexpected Finds	Base: 1 / 25 m ² Walls: 1 / 5 m lineal	As appropriate, depending on the location and characteristics of the unexpected find

The nominated sampling densities and analytical program have considered sample density guidance provided in EPA made and endorsed guidelines.

9.3 Soil Sampling Methodology

9.3.1 Validation of Excavation(s)

Samples will need to be collected by an appropriately trained and experienced environmental scientist / engineer by the use of a hand trowel or from the bucket of mechanical excavation equipment, at the required densities to meet the project DQOs presented in **Section 9.2**. In any event, samples will need to be obtained from at least 100 mm behind the excavation face to minimise the potential for loss of volatile contaminants as a result of disturbance.

Prior to collection of each sample, hand tools will need to be thoroughly decontaminated using phosphate free detergent and distilled water as per **Section 9.3.6**.

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination will need to be noted on the field documentation and a photo-ionisation detector (PID) used where possible, to assess the potential occurrence of volatile compounds as per **Section 9.3.3** below.

9.3.2 Stockpile Sampling

For stockpile sampling, material will be obtained from a minimum depth of 0.3 m below the surface of the stockpile at the time of sampling. Appropriate decontamination activities shall be followed following the collection of each sample.

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.

9.3.3 Field PID Screening

Soil characterisation / validation samples will be screened on site during works using a PID to assess the presence of VOCs including petroleum hydrocarbons. Samples obtained for PID screening will be placed in a sealed plastic bag for a period of approximately one minute to equilibrate prior to a PID being attached to the bag. Readings will then be monitored for a period of approximately one minute or until values stabilised and the stabilised / highest reading recorded.

9.3.4 Sample Handling

Collected samples will be immediately transferred to sample containers of appropriate composition (glass jars for chemical analysis, plastic bags for asbestos). Sample labels recorded: job number; sample identification number; and date of sampling.

Sample containers will be transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form will be completed and forwarded with the samples to the testing laboratory.

9.3.5 Soil Duplicate and Triplicate Sample Preparation and QA/QC Requirements

Field duplicate and triplicate samples for the characterisation / 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 samples will be divided laterally into 3 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.

Trip spike, storage blank and rinsate samples will be collected as per **Table 9.3**.

9.3.6 Soil Sampling Equipment Decontamination

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

- Scrubbing with a wire brush to remove gross contamination;
- 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 characterisation / validation sampling activities. Each rinsate sample will be obtained by rinsing the trowel with laboratory grade demineralised water following the decontamination procedure. The water sample will be appropriately preserved and stored with the site samples prior to transport to the laboratory for chemical analysis.

9.3.7 Laboratory Analyses

JBS&G propose to use Eurofins MGT Pty Ltd at Lane Cove, NSW as the primary laboratory for the required analyses. The secondary laboratory to be contracted for the works will be Envirolab Services Pty Ltd (Envirolab) at Chatswood, NSW. All laboratories are National Association of Testing Authorities (NATA) registered for the relevant analyses. In addition, the laboratories are required to meet JBS&G's internal QA/QC requirements.

Laboratory analysis methods for relevant soil contaminants are identified in **Table 9.6**.

Table 9.6 Soil Laboratory Analysis Methods (all units in mg/kg unless stated)

Analyte	Limit of Reporting	Laboratory Method
Metals		
Arsenic	4.0	ICP-AES (USEPA 200.7)
Cadmium	1.0	ICP-AES (USEPA 200.7)
Chromium (total)	1.0	ICP-AES (USEPA 200.7)
Chromium (VI)	1.0	Alkali leach colorimetric (APHA3500-Cr/USEAP3060A)
Copper	1.0	ICP-AES (USEPA 200.7)
Lead	1.0	ICP-AES (USEPA 200.7)
Nickel	1.0	ICP-AES (USEPA 200.7)
Zinc	1.0	ICP-AES (USEPA 200.7)
Mercury (inorganic)	0.1	Cold Vapour ASS (USEPA 7471A)
TRH		
C ₆ – C ₉ Fraction	25	Purge Trap-GCMS (USEPA8260)
C ₁₀ – C ₃₆ Fraction	250	Purge Trap-GCFID (USEPA8000)
BTEX		
Benzene	1.0	Purge Trap-GCMS (USEPA8260)
Toluene	1.0	Purge Trap-GCMS (USEPA8260)
Ethylbenzene	1.0	Purge Trap-GCMS (USEPA8260)
Total Xylenes	3.0	Purge Trap-GCMS (USEPA8260)
PAHs		
Benzo(a)pyrene	0.05	GCMS (USEPA8270)
Total PAHs	1.55	GCMS (USEPA8270)
PCBs		
PCBs (total)	0.7	GCECD (USEPA8140,8080)
OCPs		
Aldrin + Dieldrin	0.2	GCECD (USEPA8140,8080)
Chlordane	0.1	GCECD (USEPA8140,8080)
DDT + DDD + DDE	0.3	GCECD (USEPA8140,8080)
Endosulfan	0.3	GCECD (USEPA8140,8080)
Endrin	0.1	GCECD (USEPA8140,8080)
Methoxychlor	0.1	GCECD (USEPA8140,8080)

Analyte	Limit of Reporting	Laboratory Method
Heptachlor	0.1	GCECD (USEPA8140,8080)
Other		
Asbestos	Presence/ 0.1 g/kg	PLM / Dispersion Staining as per AS4964:2004

9.4 Validation Criteria

The following is a discussion of validation criteria to be adopted during remediation works within the site.

9.4.1 Soil Validation Criteria and Rationale

The site is proposed to be redeveloped by the client and is required to be validated as suitable for ongoing use as aged care facility, equivalent to residential land use with garden/accessible soil, pursuant to the NEPC (2013). As such, health based criteria for “residential with garden/access to soils” (HIL-A) will be adopted for remedial excavation / site validation. The criteria are based on NSW EPA endorsed investigation levels which, while being used as clean-up levels instead of site-specific criteria derived through a process of risk assessment, are considered adequately conservative for the purposes of characterising and validating the site.

Based on the land-use zoning and potential future use of the site, the concentrations of contaminants in the soil will be compared against published levels, sourced from the following:

- Health Investigation Levels (HILs) for Residential-A use presented in the ASC NEPC: HIL-A;
- Direct contact Health Screening Levels (HSLs) for high density residential use presented in Friebel & Nadebaum (2011): HSL-A;
- Ecological Investigation Levels (EILs) for urban residential use - calculated from site specific concentrations (as presented in the ASC NEPC); and
- Ecological Screening Levels (ESLs) for coarse grained soils presented in the ASC NEPC for urban residential use.

9.5 Groundwater/Leachate Assessment Criteria

The groundwater data was compared against adopted criteria, namely:

- ANZAST (2018¹²) 95% Trigger Values for Fresh Water Aquatic Ecosystems; and
- HSLs for vapour intrusion for low-high density residential land uses for coarse grained soils (sand).

It is noted that guideline values for the protection of fresh water ecosystems have been adopted noting the proximity of the site to Mullet Creek as part of the Warriewood Wetlands. Water hardness factors as per *Table 3.4.4 of ANZAST (2018)* are also applied to soft water trigger values for selected metals in freshwaters of varying water hardness.

Australian Drinking Water Guidelines were not considered to be applicable to groundwater as the aged care facility has reticulated water supply, and there is no known beneficial drinking use in the area. Water discharging to Mullet Creek flows towards the South Creek then eventually discharged into South Pacific Ocean, as discussed in **Section 3.6**.

9.6 Statistical Analysis of Data

Where sufficient data sets are available, statistical criteria as nominated following will apply:

Either:

¹² Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australia and New Zealand and Australian State and Territory Governments, August 2018 (ANZAST 2018)

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

Or:

- The upper 95% confidence limit of the average concentration (95% UCL) 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.

In addition to the numerical criteria, the following observations will also supplement the validation process:

- Soils shall not emit recognisable odours, be discoloured as a result of contamination and / or have any significant additional aesthetic concerns with respect to future site users.

9.6.1 Offsite Disposal Criteria

Contaminated soils requiring disposal off-site shall be assessed in accordance with EPA (2014) *Waste Classification Guidelines Part 1: Classifying Waste*.

9.6.2 Imported Soil Criteria

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; or
- Materials under an NSW EPA exemption.

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

Sampling of materials as per an EPA exemption (recycled products) is required to be undertaken by the facility in accordance with the exemption. In addition, 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 by JBS&G for land use suitability. Sampling densities and analysis for COPC will be dependent on the volume, material type, source and in accordance with **Table 9.4**.

9.6.3 Validation of Soil Placement Areas (Capped Soil)

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 detailed in a Material Tracking Plan:

- 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
- Subsequently the total placed volume of materials.

9.7 Validation Reporting

9.7.1 Validation Report

The validation report shall be prepared by the remediation consultant written in general accordance with EPA (2017) and (OEH 2011) *Guidelines for Consultants Reporting on Contaminated Site*, documenting the works as completed. The validation report will be submitted to the client and the NSW EPA accredited Site Auditor at the completion of remedial works at the site. A Site Audit Statement will require to be procured at the completion of validation activities.

This report will contain information including:

- Details of the remediation works conducted;
- The results and findings of the previous investigations as per **Section 5**;
- Information demonstrating that the objectives of this RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined DQO and the remediation acceptance (validation) criteria;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Results of asbestos 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;
- Details on waste classification, tracking and off-site disposal including landfill dockets;
- Clear statement of the suitability of the site (or part of the site) that is the subject of the validation report, for the proposed use(s); and
- Other information as appropriate, including details of EMPs (if required) that will apply to the part of the site that is the subject of the validation report.

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

9.8 Long Term Environmental Management Plan

Where required, the Long Term 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/within the site including:
 - Appropriate monitoring locations and depth within and down-gradient of any residual contamination;
 - Relevant assessment criteria to be used in evaluating monitoring results;
 - The regulatory authorities involved and the management inputs required from each;
 - The integration of environmental management and monitoring measures for soil;
 - Health and safety requirements for particular activities;
 - A program of review and audits;
 - The provisions in the EMP are feasible and practical (i.e. able to be implemented) and able to be legally enforceable (i.e., a mechanism exists, such as development consent conditions, to give the plan a basis in law); and
 - The relevant consent authority is satisfied that the inclusion of a development consent condition relating to the implementation of the EMP is acceptable;
- Corrective action procedures to be implemented where EMP assessment criteria are breached.

The EMP will be provided to the appointed Site Auditor for review and approval prior to preparation of the Site Audit Statement (SAS) and Site Audit Report (SAR).

10. Contingency Plan

A review of remediation works has been undertaken to identify potential risks to meeting the specified site validation criteria which has resulted in the identification of a number of potential risks. These are listed following with contingencies that will be implemented to ensure that validation criteria are met.

Additionally, the associated remedial works health and environmental risks / hazards and their minimisation / mitigation are further discussed in **Section 11**.

10.1 Unexpected Finds Protocol

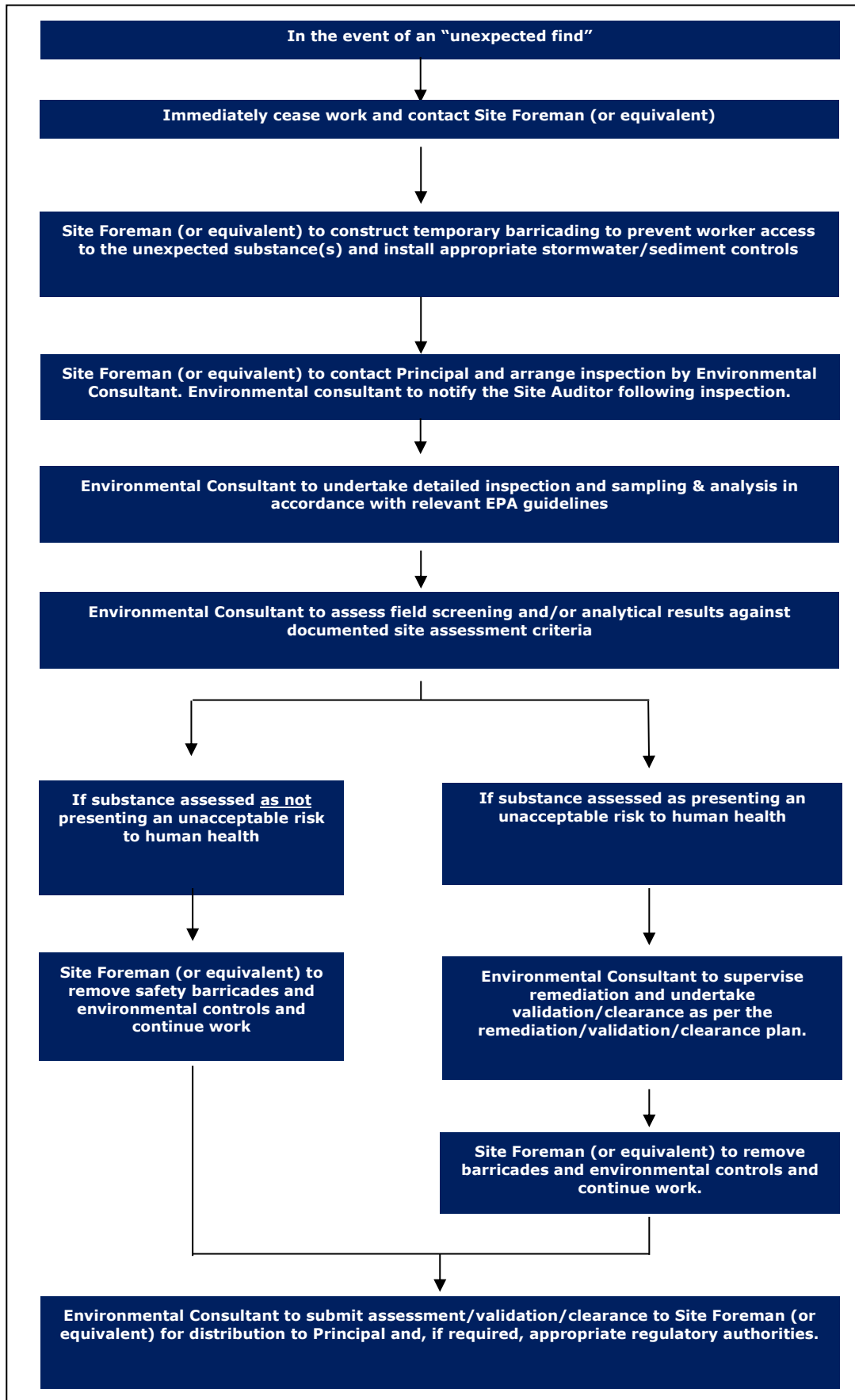
It is acknowledged that previous investigations of the site have been undertaken to assess the identified contaminants of potential concern in selected parts of the site. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations during remediation. The nature of any residual hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- Ash and/or slag and/or tar contaminated soils / fill materials (visible);
- Significant amounts of fragments of ACM and/or AF/FA impacted materials;
- Petroleum contaminated soils (odorous, staining / discolouration visible);
- Bottles / containers of chemicals (visible);
- VOC contaminated soils (odorous) and vapours; and
- Underground Petroleum Storage Systems (UPSS) and associated infrastructures.

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances be identified (or any other unexpected potentially hazardous substance), the procedure summarised in **Flowchart 10.1** is to be followed.

An enlarged version of the unexpected finds protocol, suitable for use onsite, should be posted in the Site Office and referred to during the site-specific induction by the Contractor.

Flowchart 10.1 – Unexpected Finds Protocol



10.2 Contingency Scenarios

10.2.1 Material Storage Breach

In the event any stockpiled materials escape (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.

Materials at the site should be transported directly from the excavation to an awaiting truck, and where this is not possible materials will require to be stockpiled. Controls should be emplaced to mitigate the potential for sediment run-off and aeolian transport of particulates.

10.2.2 Complaints

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

- Odour emissions arising from excavation or exposing of site fill materials and underlying PASS/ASS, material handling, transport, placement and capping;
- Dust emissions arising from soil excavation, material handling, transport, placement and capping; and
- Noise and vibration from excavation.

Monitoring of all potential environmental emissions shall be undertaken as detailed in **Section 11** and appropriate actions taken to further control emissions following receipt of a complaint. Such additional controls may include the following actions:

- Disturbance of soils during meteorologically favourable periods (minimal wind conditions) only; and / or
- Increasing environmental controls including covering and / or wetting down soils which are generating dust, or use of odour suppressants to control odours.

Where odour complaints occur, the following will be undertaken:

- Installation of an odour screening / masking system at the remediation area boundaries; and / or
- Disturbance of soils during meteorologically favourable periods only; and / or
- The use of odour suppressant additives to water used to keep impact soils / stockpiles moist; and / or
- Covering of impacted soils.

10.2.3 Severe Weather

Weather will be monitored on a daily basis via checking an internet based weather service provider. Should severe weather be forecast, especially strong winds, works will stop until safe to re-commence. All site management controls will be implemented to the extent practicable as outlined in **Section 11** prior to any severe weather events.

11. Site Management Plan

This section contains procedures and requirements that are to be implemented as a minimum requirement during the remedial works at the site.

11.1 Hours of Operation

It is understood that the hours of operation for remedial works will be conducted in accordance with the recommended site hours suggested by the EPA¹³, however hours may vary from typical hours of operation which will be subject to approval.

Typical hours of operation for remedial works are:

- Monday to Friday: 7 am to 5.30 pm.
- Saturday: 8 am to 2 pm.
- Sunday and public holidays: No work permitted.

11.2 Soil and Water Management

All works shall be conducted in general accordance with Landcom (2004) (Blue Book) guidance, which outlines the general requirements for the preparation of a soil and water management plan.

All remedial works shall be conducted in accordance with a soil and water management plan, which is to be kept onsite and made available to council officers on request. All erosion and sediment measures must be maintained in a functional condition through the remediation works by the remedial contractor.

To prevent the migration of impacted soil off site, silt fences shall be constructed at the down-gradient site boundaries by the remedial contractor. Any material which is collected behind the sediment control structures shall be removed off site to a licensed waste facility subsequent to waste classification.

In storm or extended rainfall event, the structures located on site for sediment control shall be monitored and replaced or altered if necessary by the contractor. Collected material shall be managed in accordance with remediation works by the contractor.

11.3 Stockpile Management

All materials stockpiled onsite will be managed by the remedial contractor. Unique numbers will be provided for each stockpile, the source of the stockpile, its estimated volume, material characterisation and its location onsite recorded. A material tacking plan is recommended.

The following procedures will be implemented by the remedial contractor:

- No stockpiles of soil or other materials shall be placed on footpaths or nature strips unless prior Council approval has been obtained;
- All stockpiles of soil or other materials shall be placed away from drainage lines gutters or stormwater pits or inlets;
- All stockpiles of soil or other materials likely to generate dust or odours shall be covered (where practical);
- All stockpiles of contaminated soil shall be placed on plastic sheeting to limit cross contamination of the underlying soils and stored in a secure area.
- Different materials shall be stockpiled separately, and separation shall be maintained.

¹³ *Interim Construction Noise Guideline*. Department of Environment & Climate Change NSW. DECC 2009/265. July 2009.

11.4 Site Access

All vehicle access to the site shall be stabilised to prevent the tracking of sediment onto the roads and footpaths. All materials must be removed from the roadway on a daily basis or as required. As a conservative approach, any personnel, equipment, plant or vehicles that enter an asbestos works zone must be appropriately decontaminated prior to exiting.

11.5 Excavation Pump-out

Any excavation pump out water shall be sampled by the environmental consultant for analysis for total suspended solid concentrations, turbidity, pH and the identified contaminants of concern prior to release to stormwater with appropriate documentation indicating that the discharged water is compliant with the ANZAST (2018) toxicity trigger values (TTVs) for the 95% Protection of Fresh Water Ecosystems. If not, appropriate waste disposal practices with a suitably licensed and experienced waste contractor.

Excavation pump out from trenches is not anticipated with the general remediation works given the general remedial plan of minimising ground disturbance and groundwater being undisturbed. Pump out following accumulation of surface water is the most likely scenario for water disposal.

11.6 Landscaping / Rehabilitation

All exposed soils shall be progressively stabilised as remedial works progresses.

11.7 Noise

Remediation work shall not give rise to 'offensive noise' as defined in the *POEO Act 1997*. All equipment and machinery associated with the remediation work shall be operated by the Contractor in accordance with the *POEO Act 1997* and its *Noise Control Regulations 2000*.

The remediation works shall comply with the NSW EPA's environmental noise guidance (DECC 2009 and EPA 2013) for the control of noise from construction sites which specifies that:

- For recommended standard hours, all feasible and reasonable work practices should be employed to meet the noise affected level, described by DECC (2009) as the L_{Aeq} (15 minute) rating background noise level (RBL) plus 10dB(A) (noise affected), and there should be no exceedance of the highly noise affected level of 75 dB(A).

All machinery and equipment used on site will be in good working order and with the fitted with appropriate silencers when necessary.

11.8 Vibration

The use of plant and machinery by the remedial contractor shall not cause vibrations to be felt or capable to be measured at any premises.

11.9 Air Quality

11.9.1 Air Monitoring

During the remedial works, perimeter air monitoring for asbestos will be conducted on each of the site boundaries on days when asbestos works are undertaken. Additional downwind monitoring locations may be included in the air monitoring program as required. Air monitoring should be completed independently of the licensed remediation contractor, under the supervision of a Licensed Asbestos Assessor.

Air monitoring will be conducted 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]

11.9.2 Dust Control

During the remediation of asbestos, dust levels will be monitored and minimised by using mist sprays as necessary. It is also recommended that asbestos air fibre monitoring be completed in the vicinity of asbestos removal works. Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access point.

Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access and all equipment have dust suppressors fitted by the remedial contractor.

During all remedial works, dust screens will be erected around the perimeter of the site by the remedial contractor. Where significant fugitive emissions are observed from specific site areas, these areas shall be wetted and/or covered by the remedial contractor.

Meteorological conditions will be monitored by the environmental consultant and remedial contractor. Remedial work will be stopped or modified where meteorological conditions are adverse (i.e., dry conditions and strong winds towards sensitive receptors).

Plant and vehicles should limit their speed when working within asbestos exclusion zones and only traverse wetted haul roads. Only essential vehicles are permitted to traverse the asbestos exclusion zone.

11.9.3 Odour / Volatile Emissions Control

No odours should be detectable at the site boundary and volatile emissions of other potentially volatile substances shall be controlled. Appropriate actions will be taken by the remedial contractor to reduce the odours, which may include: increasing the amount of covering of excavations / stockpiles; mist sprays; odour suppressants; and maintenance of equipment.

Records of volatile emissions and odours shall be kept by the remedial contractor. Equipment and machinery will be adequately maintained to minimise exhaust emissions. No materials shall be burnt on the site.

Volatile emissions may be encountered during remediation of the former transformer bunded area.

11.10 Transport of Material Offsite

Trucks will be loaded in a designated area. The Contractor shall ensure that there is no material tracked out onto the street and that the load is securely covered. In addition, all site vehicles must leave the site in a forward direction.

The Contractor shall also log truck movements and approximate volume, via registration number and consignment number (where applicable), into and out of the site.

All appropriate road rules shall be observed and state roads will be selected as far as practicable over local roads when deciding on the transport route to the off-site material disposal location.

Plant and vehicles should limit their speed when working within asbestos exclusion zones and only traverse wetted haul roads.

11.11 Hazardous Materials

Hazardous and / or intractable wastes arising from the remediation work shall be removed and disposed of in accordance with the requirements of NSW EPA, SafeWork NSW and the relevant regulations by the Contractor.

In particular, any hazardous wastes will be transported by an NSW EPA licensed transporter.

11.12 Disposal of Contaminated Soil

All soils will be classified, managed and disposed in accordance with the Waste Classification Guidelines (EPA 2014). Documentary evidence for all soil disposal shall be kept for inclusion in the Validation Report/s.

In addition, the *proximity principle*, under POEO Reg 2014, makes it an offence to transport waste generated in NSW by motor vehicle for disposal more than 150 kilometres from the place of generation, unless the waste is transported to one of the two nearest lawfully disposal facilities to the place of generation.

11.13 Imported Fill

Any materials imported on site by the remedial contractor to re-establish ground levels in remediated areas must be validated as environmentally suitable material (i.e. VENM and materials under an EPA exemption) in accordance with **Table 9.4**.

11.14 Groundwater

It is anticipated no groundwater dewatering will be required for the remediation works. If dewatering is required as part of the remediation works, a licence shall be applied for from the Department of Primary Industry (previously the NSW Office of Water) for approval to extract groundwater.

11.15 Site Signage and Contact Numbers

A sign/s shall be displayed adjacent to the site access point/s throughout the duration of the works with the contact details of the remedial contractor and project manager as provided and maintained by the remedial contractor.

11.16 Site Security

The remedial areas shall be secured against unauthorised access by means of an appropriate fence or barricade by the remedial contractor. All persons working in asbestos remedial areas must be inducted, have undertaken required training and don appropriate person protective equipment (PPE). The access gates will be locked at all times when remedial works are not occurring.

11.17 Community Consultation

Owners and / or occupants of adjacent premises and across the road from the site will be notified at least seven days prior to the commencement of preparation for the remediation works. As a minimum, the notification shall include the details of an appropriate contact person.

The client will be responsible for all community consultation prior to, during and after remediation, as required.

12. Conclusions and Recommendations

12.1 Conclusions

Subject to the successful implementation of the measures described in this RAP and the limitations in **Section 13**, it is concluded that the risks posed by contamination can be managed in such a way as to be adequately protective of human health and the environment, and that the site can be made suitable for use as an ongoing aged care facility with implementation of an ongoing long term EMP, consistent with a residential land use with garden/accessible soils (NEPC 2013).

The preferred remedial strategy is use of cap and cover of impacted fill materials in alignment with the final built form of engineered concrete slabs of buildings, permanent hardstand pavements of car parks and roadways and landscaping of garden and open space areas. Surplus fill and two identified hot spot areas will be classified and disposed to appropriately licenced landfill.

It is anticipated that the remediation will occur over two stages in alignment with the proposed redevelopment stages and final built form. Therefore, two validation signoffs will be required, one for each stage. A Site Audit Statement and a Site Audit Report will be issued to the consent authority at completion of remediation and validation of each stage.

12.2 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:

- Preparation of an Asbestos Management Plan (AMP) to manage identified asbestos impacts within fill materials across the site;
- Preparation of a Material Tracking Plan (MTP) to ensure all excavated material are identified and appropriately tracked. Documentation will be provided as part of the validation report to demonstrate where suitable material has been reused, unsuitable material has been disposed of from the site to and material imported from; and
- Preparation of an Acid Sulfate Soil Management Plan (ASSMP) to manage existing ASS/Potential ASS on site (if exposed).

Upon completion of the works, or within various specific areas, validation report(s) are required to be submitted by the Remediation Consultant to the Site Auditor for certification that the site, or relevant portion(s) are suitable for the proposed uses.

13. 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 enquires.

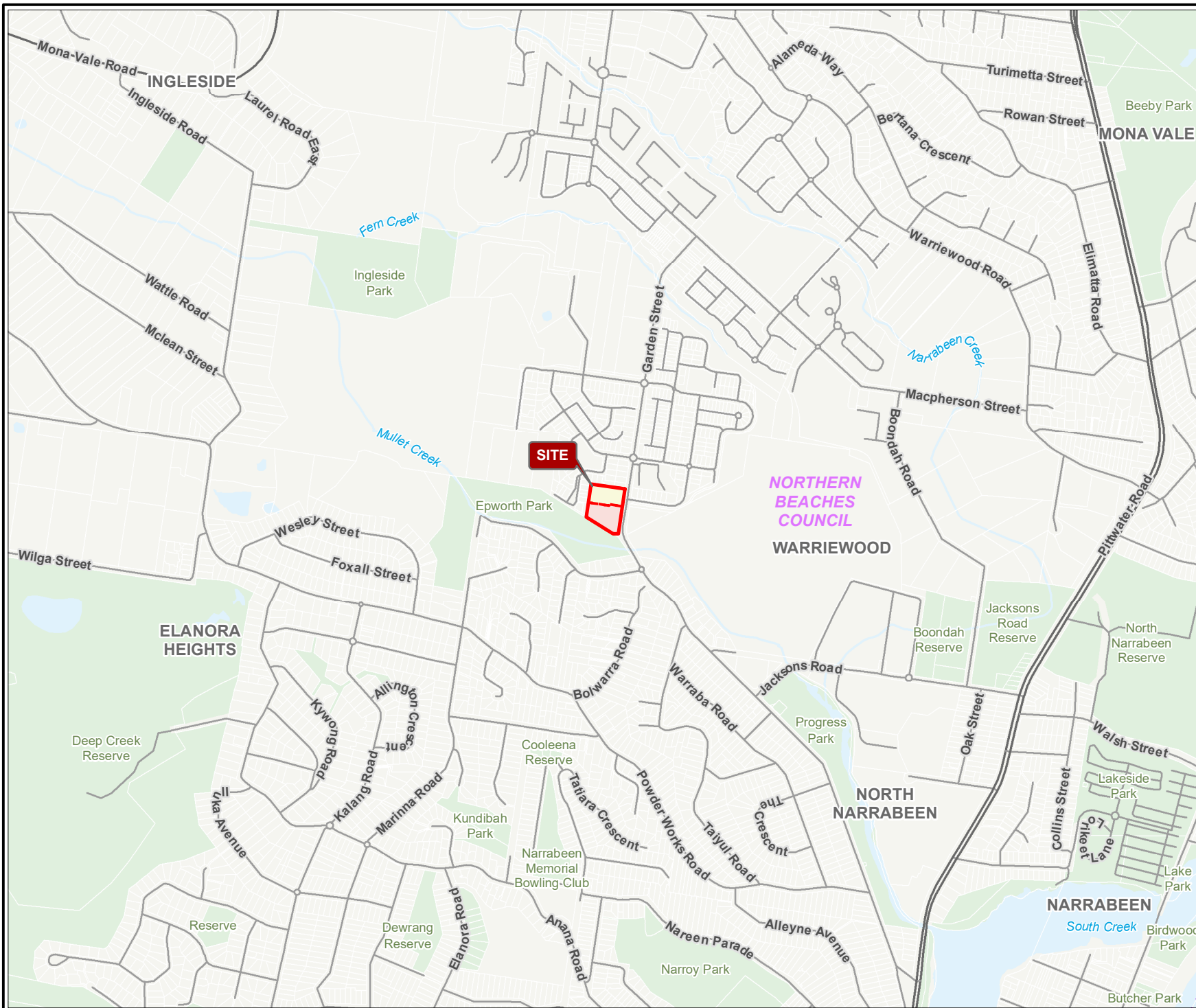
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the 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**
- Site Boundary
 - Stage Boundary
 - Stage 1 Area (under redevelopment)
 - Stage 2 Area (operational)



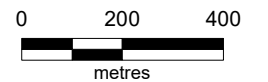
Job No: 55792

Client: Opal

Version: R02 Rev A Date 15/03/2019

Drawn By: RF Checked By: KY

Scale 1:15,000



Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

SITE LOCATION

FIGURE 1



Legend

-  Site Boundary
-  Stage Boundary
-  Stage 1 Area (under redevelopment)
-  Stage 2 Area (operational)



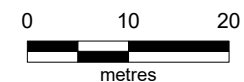
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Client: Opal

Version: R01 Rev A Date 15/03/2019

Drawn By: RF Checked By: KY

Scale 1:750



Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

SITE LAYOUT

FIGURE 2



- Legend**
- Site Boundary
 - Stage Boundary
 - Stage 1 Area (under redevelopment)
 - Stage 2 Area (operational)

- Sample Locations**
- Existing Borehole (DP 2017)
 - Existing Well (DP 2017)
 - Borehole (JBS&G 2019)
 - Borehole and Monitoring Well (JBS&G 2019)
 - ▲ Hand Auger (JBS&G 2019)
 - ✕ Test Pit (JBS&G 2019)



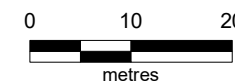
Job No: 55792

Client: Opal

Version: R02 Rev A Date 15/03/2019

Drawn By: RF Checked By: KY

Scale 1:750



Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

**HISTORICAL AND CURRENT
SAMPLE LOCATIONS**

FIGURE 3



- Legend**
- Site Boundary
 - - - Stage Boundary
 - Stage 1 Area (under redevelopment)
 - Stage 2 Area (operational)
- Sample Locations**
- Existing Well (DP 2017)
 - ⊕ Borehole and Monitoring Well (JBS&G 2019)
 - Groundwater Elevation (mAHD)
 - Inferred Groundwater Flow Direction



Job No: 55792

Client: Opal

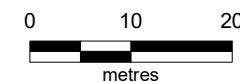
Version: R02 Rev A

Date 15/03/2019

Drawn By: RF

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Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

**INFERRED GROUNDWATER
FLOW AND CONTOURS**

FIGURE 4



BH03	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
B(a)P	0.0-0.1	2	ESL
B(a)P TEQ	0.0-0.1	3.3	HIL A

HA01	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Lead	0.6-0.7	810	HIL A

BH10	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
B(a)P	0.5-0.6	16	ESL

TP18	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos in Soil	10-2.0	0.0017	HSL

BH06	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos in Soil	0.2-0.5	0.0704	HSL

BH08	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
TRH >C16-C34	0.5-0.6	340	ESL
TRH >C10-C16	0.5-0.6	270	ESL/HSL A,B

DPBH14	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Copper	10-145	740	EIL

TP16	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Lead	2.3-2.4	320	HIL A
Ziinc	2.3-2.4	1600	EIL

Legend

- Site Boundary
- Stage Boundary
- Stage 1 Area (under redevelopment)
- Stage 2 Area (operational)

Sample Locations

- Existing Borehole (DP 2017)
- Existing Well (DP 2017)
- Borehole (JBS&G 2019)
- Borehole and Monitoring Well (JBS&G 2019)
- Hand Auger (JBS&G)
- Test Pit (JBS&G 2019)

Job No: 55792

Client: Opal

Version: R02 Rev A	Date 15/03/2019
Drawn By: RF	Checked By: KY

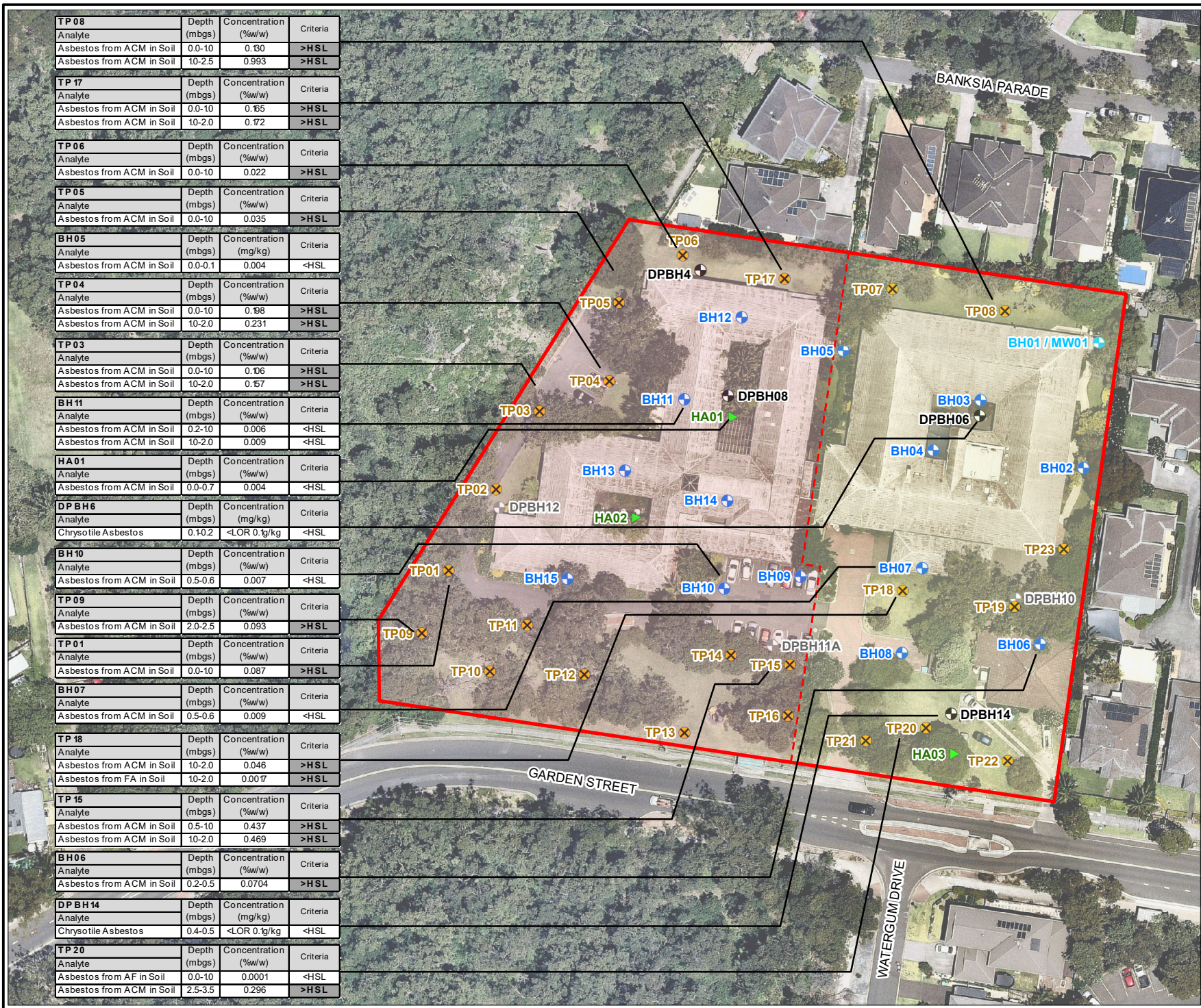
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Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

EXCEEDANCES IN SOIL

FIGURE 5



TP 08	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.130	>HSL
Asbestos from ACM in Soil	10-2.5	0.993	>HSL

TP 17	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.165	>HSL
Asbestos from ACM in Soil	10-2.0	0.172	>HSL

TP 06	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.022	>HSL

TP 05	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.035	>HSL

BH 05	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-0.1	0.004	<HSL

TP 04	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.188	>HSL
Asbestos from ACM in Soil	10-2.0	0.231	>HSL

TP 03	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.106	>HSL
Asbestos from ACM in Soil	10-2.0	0.167	>HSL

BH 11	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.2-10	0.006	<HSL
Asbestos from ACM in Soil	10-2.0	0.009	<HSL

HA 01	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-0.7	0.004	<HSL

DP BH 6	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Chrysotile Asbestos	0.1-0.2	<LOR 0.1g/kg	<HSL

BH 10	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.5-0.6	0.007	<HSL

TP 09	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	2.0-2.5	0.093	>HSL

TP 01	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.0-10	0.087	>HSL

BH 07	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.5-0.6	0.009	<HSL

TP 18	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	10-2.0	0.046	>HSL
Asbestos from FA in Soil	10-2.0	0.0017	>HSL

TP 15	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.5-10	0.437	>HSL
Asbestos from ACM in Soil	10-2.0	0.469	>HSL

BH 06	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from ACM in Soil	0.2-0.5	0.0704	>HSL

DP BH 14	Depth (mbgs)	Concentration (mg/kg)	Criteria
Analyte			
Chrysotile Asbestos	0.4-0.5	<LOR 0.1g/kg	<HSL

TP 20	Depth (mbgs)	Concentration (%w/w)	Criteria
Analyte			
Asbestos from AF in Soil	0.0-10	0.0001	<HSL
Asbestos from ACM in Soil	2.5-3.5	0.296	>HSL

Legend

- Site Boundary
- Stage Boundary
- Stage 1 Area (under redevelopment)
- Stage 2 Area (operational)

Sample Locations

- Existing Borehole (DP 2017)
- Existing Well (DP 2017)
- Borehole (JBS&G 2019)
- Borehole and Monitoring Well (JBS&G 2019)
- Hand Auger (JBS&G 2019)
- Test Pit (JBS&G 2019)

Job No: 55792

Client: Opal

Version: R02 Rev A	Date 15/03/2019
Drawn By: RF	Checked By: KY

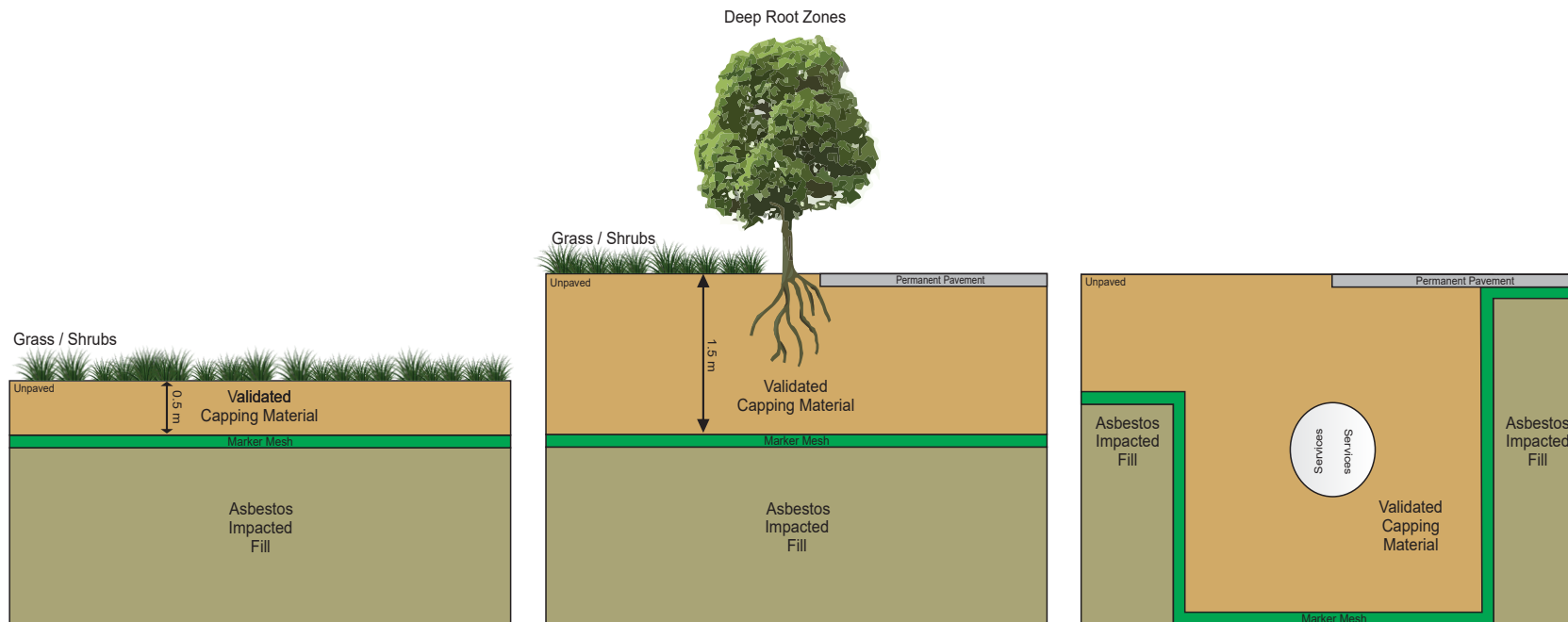
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Coord. Sys. GDA 1994 MGA Zone 56

**184-194 Garden Street
Warriewood, NSW**

ASBESTOS DETECTS

FIGURE 6



Legend



Job No: 55792

Client: Opal

Version: R02 Rev 0

Date 15/03/2019

Drawn By: RF

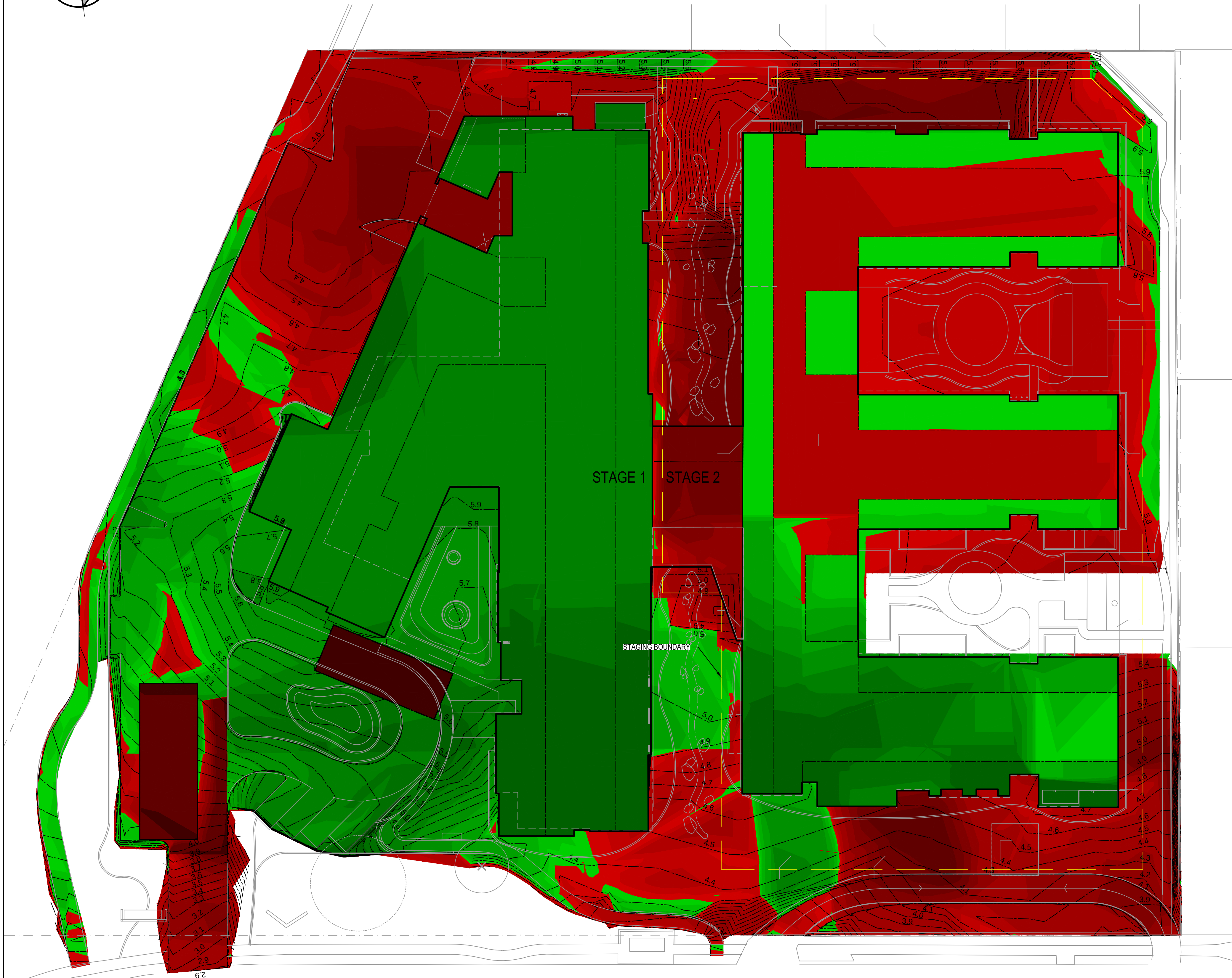
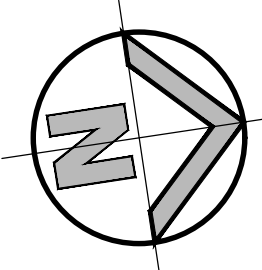
Checked By: KY

184-194 Garden Street
Warriewood, NSW

CONCEPTUAL CAPPING REQUIREMENTS

FIGURE 8

Appendix A Design Plans



GARDEN

STREET

BULK EARTHWORKS PLAN

SCALE 1:250



SCALE 1:250

**SURVEY
INFORMATION**

SURVEYED BY
Bee & Lethbridge Pty Ltd
DATUM: A.H.D.
ORIGIN OF LEVELS: S.S.M. 43671 RL 3.493

REVISION	AMENDMENT	DRAWN	DESIGNED	DATE	REVISION	AMENDMENT	DRAWN	DESIGNED	DATE
05	ISSUED FOR CC/TENDER	JK	IA	26.02.2019					
04	ISSUED FOR CC/TENDER	JK	IA	08.02.2019					
03	ISSUED FOR CC/TENDER	JK	IA	19.06.2018					
02	ISSUED FOR CC/TENDER	JK	IA	28.02.2018					
01	ISSUED FOR DA	MC	RP	21.02.2017					

Client

OPAL AGED CARE

Architect

GROUP GSA PTY LTD

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Web
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Project

**PROPOSED AGED CARE FACILITY
184-194 GARDEN STREET, WARRIEWOOD NSW**

Title

BULK EARTHWORKS - CUT AND FILL PLAN

Drawn

K.S.Rom

Checked

I.Ahmed

Designed

I.Ahmed

Date

JAN 2018

Scale

1:250 @ A1

Revision

05

16940_CC_BE01

LEGEND

----- EXISTING BOUNDARY
----- 4.60 ----- CONTOURS BE

COMPACTION REQUIREMENTS

- PREPARATION FOR PAVEMENT:
CLEAR SITE, STRIP TOP-SOIL, CUT AND FILL AND PREPARATIONS OF SUB-GRADE SHALL BE AS DESCRIBED IN "SUBGRADE PREPARATION".
- SUB-GRADE SHALL BE COMPACTED TO 98% STANDARD DRY DENSITY RATIO AT OPTIMUM MOISTURE CONTENT $\pm 2\%$ IN ACCORDANCE WITH AS 1289 5.1.1, TOP 300MM TO 100% SDD.
- LOWER BASE COURSE SHALL BE CONSTRUCTED FROM CRUSHED SANDSTONE COMPACTED TO 100% STANDARD DRY DENSITY RATIO AT OPTIMUM MOISTURE CONTENT $\pm 2\%$ IN ACCORDANCE WITH AS 1289 5.1.1 OF THICKNESS NOTED ON DRAWINGS.
- BASE COURSE SHALL BE CONSTRUCTED FROM FINE CRUSHED ROCK COMPACTED TO 100% STANDARD DRY DENSITY RATIO AT OPTIMUM MOISTURE CONTENT $\pm 2\%$ IN ACCORDANCE WITH AS 1289 5.1.1 OF THICKNESS NOTED ON DRAWINGS.
- WEARING SURFACE SHALL BE ASPHALTIC CONCRETE TO STANDARD SPECIFICATION, MINIMUM THICKNESS = 30mm U.N.O.
- TESTING OF THE SUBGRADE AND PAVEMENT LAYERS SHALL BE CARRIED OUT BY APPROVED N.A.T.A. REGISTERED LABORATORY.

BULK EARTHWORKS GENERAL NOTES

REFER TO GEOTECHNICAL INVESTIGATION REPORT PREPARED BY DOUGLAS PARTNERS (REF No. 85505.00.R.001.REV 0 - 29 JULY 2016), FOR INFORMATION RELATING TO EXISTING GROUND CONDITIONS, SITE TREATMENT AND SUPERVISION.

THE LOCATIONS OF UNDERGROUND SERVICES SHOWN ON THESE DRAWINGS HAVE BEEN PLOTTED FROM SURVEY AND AUTHORITY INFORMATION. THE SERVICE INFORMATION HAS BEEN PREPARED ONLY TO SHOW THE APPROXIMATE POSITIONS OF ANY KNOWN SERVICES AND MAY NOT BE AS CONSTRUCTED OR ACCURATE.

HENRY AND HYMAS PTY LTD CANNOT GUARANTEE THAT THE SERVICES INFORMATION SHOWN ON THESE DRAWINGS, ACCURATELY INDICATES THE PRESENCE OR ABSENCE OF SERVICES OR THEIR LOCATION AND WILL ACCEPT NO LIABILITY FOR INACCURACIES IN THE SERVICES INFORMATION SHOWN ARISING FROM ANY CAUSE WHATSOEVER. CONTRACTORS ARE TO CONTACT THE RELEVANT SERVICE AUTHORITY PRIOR TO COMMENCEMENT OF EXCAVATION. FOR COMMENCEMENT OF WORKS ON SITE, SEARCH RESULTS ARE TO BE KEPT ON SITE AT ALL TIMES.

ALL SERVICES ARE TO BE LOCATED AND CUT OFF PRIOR TO THE COMMENCEMENT OF EXCAVATION AND FILLING OPERATIONS.

ALL TOP SOIL, ORGANIC MATTER AND FILL MATERIAL SHALL BE REMOVED FROM ALL AREAS UNDER BUILDING AND CARPARK LOCATIONS TO THE SATISFACTION OF THE GEOTECHNICAL ENGINEER. AREAS TO BE FULLY STRIPPED OF EXISTING FILL AND DARK BROWN BLACK UPPER ORGANIC ALLUVIUM.

UPON COMPLETION OF STRIPPING AND PRIOR TO PLACEMENT OF FILL THE ENTIRE SITE SHALL BE PROOF ROLLED WITH A MINIMUM OF 6 PASSES OF A VIBRATOR PADFOOT ROLLER OF NOT LESS THEN 9 TONNE MINIMUM DEAD WEIGHT OR AS SPECIFIED IN THE GEOTECHNICAL REPORT. ANY SOFT OR HEAVING AREAS SHALL BE REMOVED TO THE SATISFACTION OF THE GEOTECHNICAL ENGINEER TO A MINIMUM DEPTH OF 500mm AND THEN BACKFILLED WITH APPROVED MATERIAL IN 200mm THICK LOOSE LAYERS COMPACTED TO 98% OF STANDARD MAX. DRY DENSITY AND TO WITHIN $\pm 2\%$ OF STANDARD OPTIMUM MOISTURE CONTENT. APPROVED BACKFILL MATERIAL MAY BE CRUSHED ROCK OR SANDY LOAM WITH A PLASTICITY INDEX LESS THAN 15%.

IMPORTED FILLING:
THE CONTRACTOR WILL IMPORT SUITABLE FILL FROM AN EXTERNAL SOURCE. EXCAVATION MATERIALS MEETING THE REQUIRED SPECIFICATION MAY BE USED AS FILL. THIS MAY INCLUDE RECYCLED MATERIALS IF THEY ARE SUITABLY BLENDED/CONDITIONED TO MEET MATERIALS SPECIFICATIONS.

NOTES:

- PAVEMENT THICKNESS ALLOWANCE :
 - BUILDING STRUCTURAL SLAB ON GROUND. REFER TO STRUCTURAL DRAWINGS FOR SLAB THICKNESS.
 - CARPARK PAVEMENT. REFER TO 16940_CC_C500 FOR PAVEMENT THICKNESS.
 - LANDSCAPE AREA - 225mm SETDOWN

CUT & FILL DEPTH RANGE				Colour
Lower_value	Upper_value			
-3.0	to	-2.0	m	
-2.0	to	-1.8	m	
-1.8	to	-1.6	m	
-1.6	to	-1.4	m	
-1.4	to	-1.2	m	
-1.2	to	-1.0	m	
-1.0	to	-0.8	m	
-0.8	to	-0.6	m	
-0.6	to	-0.4	m	
-0.4	to	-0.2	m	
-0.2	to	0.00	m	
0.000	to	0.2	m	
0.2	to	0.4	m	
0.4	to	0.6	m	
0.6	to	0.8	m	
0.8	to	1.0	m	
1	to	1.2	m	
1.2	to	1.4	m	
1.4	to	9999	m	

**STAGE 1
EARTHWORKS QUANTITIES**

TOTAL AREA (5418 m²)

CUT	1032 m ³
FILL	2509 m ³
EXCESS OF FILL OVER CUT	1454 m ³
ASSUMED DEPTH OF 100mm EXISTING STRIPPING. TOTAL VOLUME = 542 m ³	

**STAGE 2
EARTHWORKS QUANTITIES**

TOTAL AREA (5279m²)

CUT	890 m ³
FILL	602 m ³
EXCESS OF CUT OVER FILL	288 m ³
ASSUMED DEPTH OF 100mm EXISTING STRIPPING. TOTAL VOLUME = 528 m ³	

**OVERALL
EARTHWORKS QUANTITIES**

TOTAL AREA (10697 m²)

CUT	1922 m ³
FILL	3111 m ³
EXCESS OF FILL OVER CUT	1166 m ³
ASSUMED DEPTH OF 100mm EXISTING STRIPPING. TOTAL VOLUME = 1,070 m ³	

NOTE:

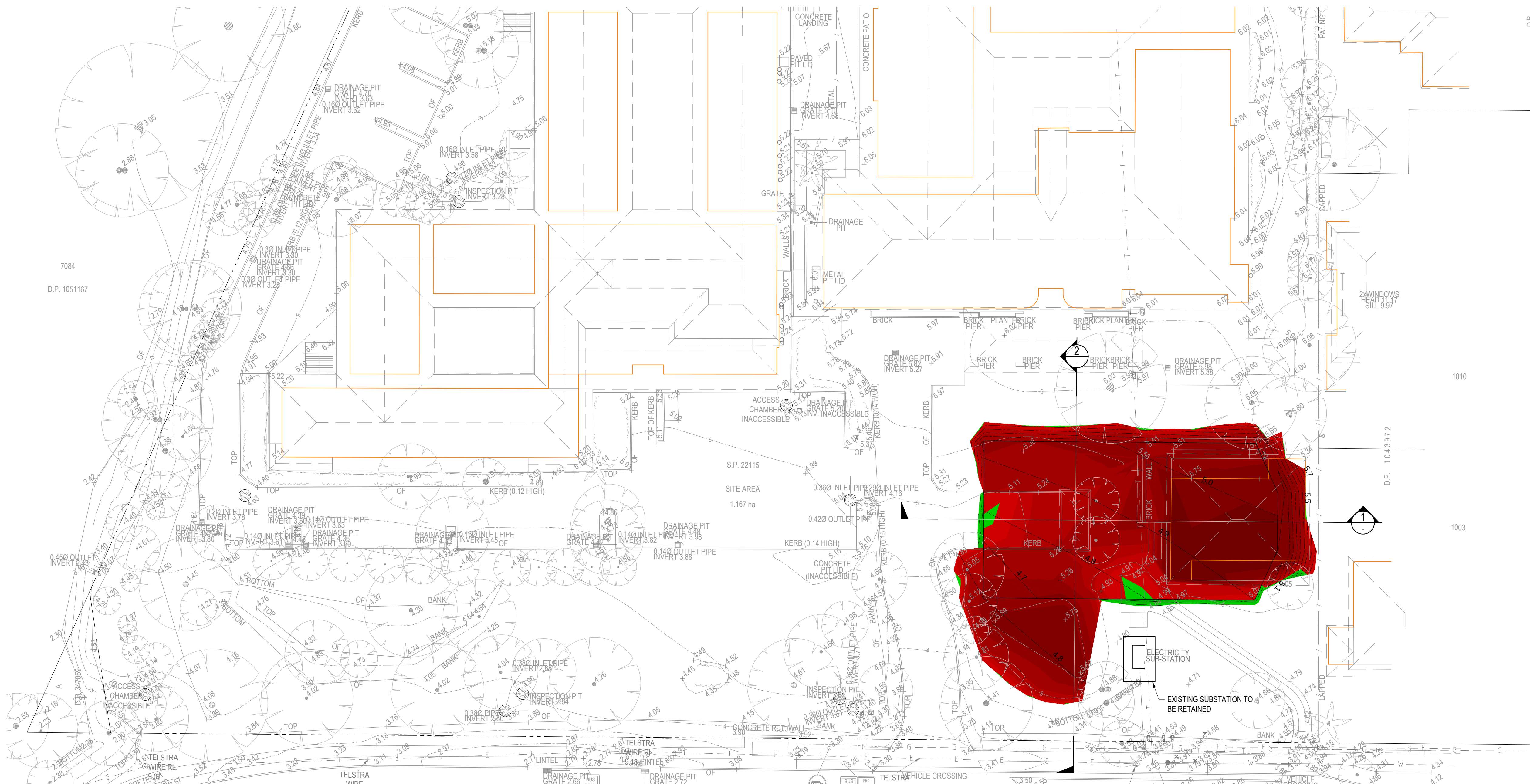
REFER TO DRAWING 16940_CC_BE02 FOR TEMPORARY CUT AND FILL PLAN.

NOTE:

THE EARTHWORKS QUANTITIES DO NOT INCLUDE REMOVAL OF CONTAMINATED MATERIALS.

FOR CC/TENDER

Drawn	Designed	Date
K.S.Rom	I.Ahmed	JAN 2018
Checked	Approved	Scale
I.Ahmed	A.Francis	1:250 @ A1
Drawing number	Revision	
16940_CC_BE01	05	



LEGEND

- EXISTING BOUNDARY
--- 4.60 CONTOURS BE
--- DENOTES AREA OF CUT AND FILL FROM STAGE 1

EARTHWORKS QUANTITIES

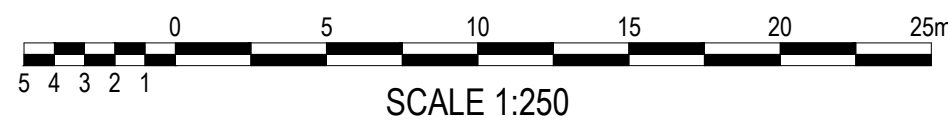
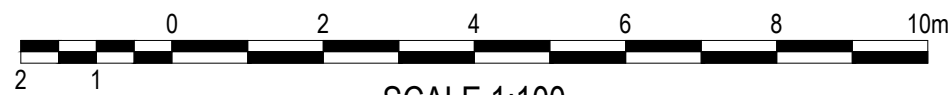
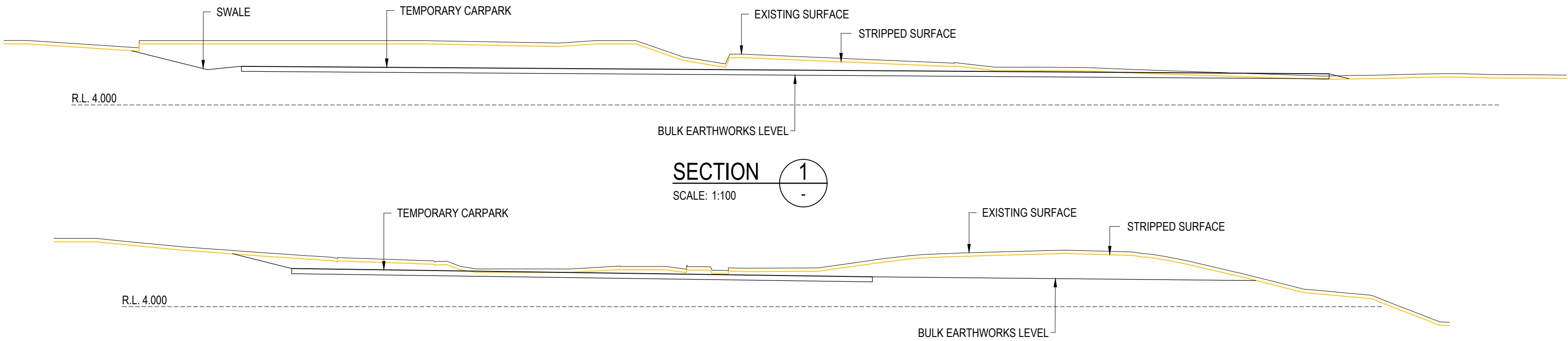
CUT	325 m³
FILL	2m³
EXCESS OF FILL OVER CUT	323m³

NOTE:

THE QUANTITY DOES NOT INCLUDE SLAB THICKNESS

BULK EARTHWORKS - TEMPORARY CUT AND FILL OPTION

SCALE: 1:250



FOR CC/TENDER

Drawn K.S.Rom	Designed I.Ahmed	Date JAN 2018
Checked I.Ahmed	Approved A.Francis	Scale AS SHOWN @ A1

Drawing number
16940_CC_BE02

Revision
02

Client
OPAL AGED CARE
Architect
GROUP GSA PTY LTD

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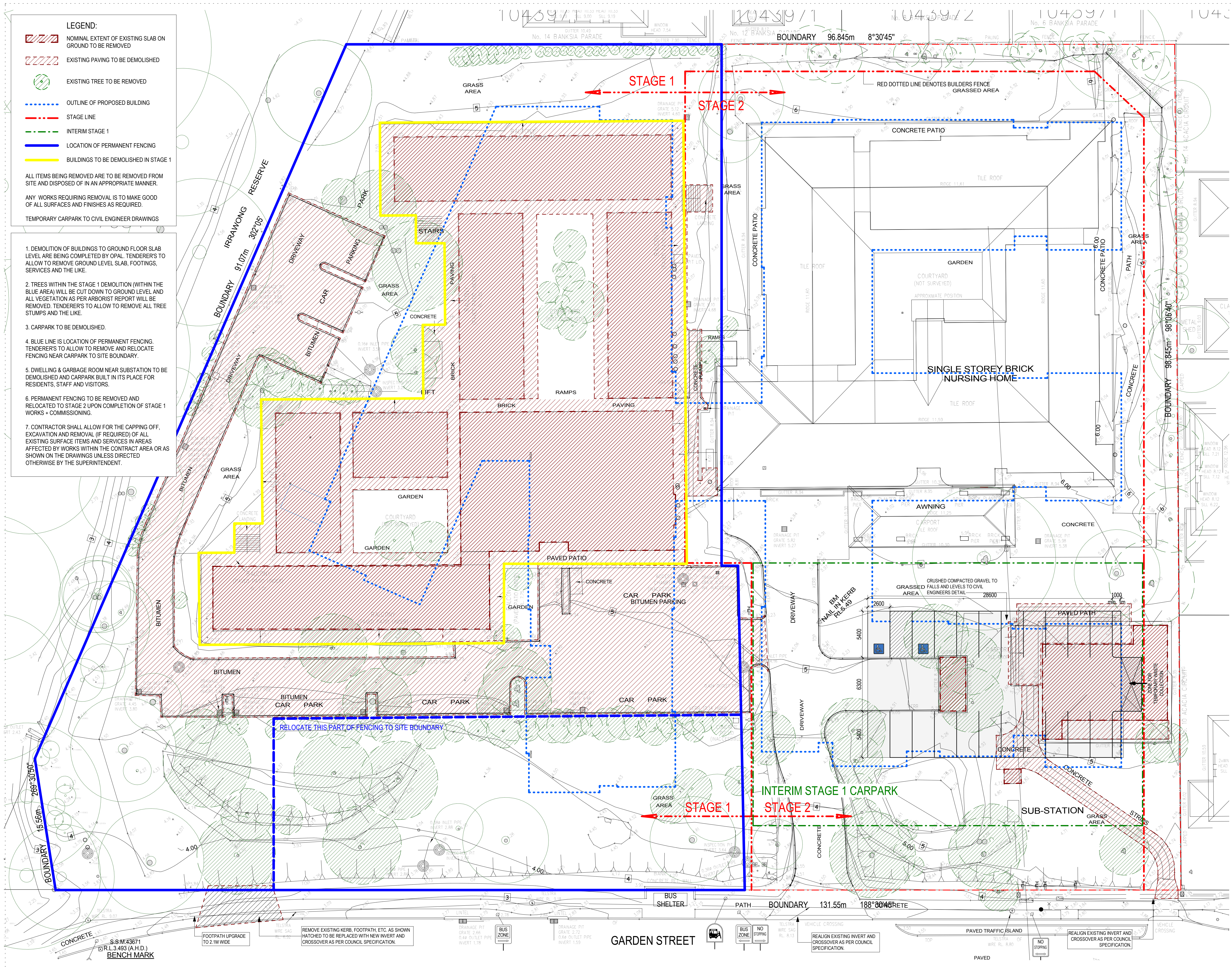
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Title
BULK EARTHWORKS - TEMPORARY CUT AND FILL OPTION



Amendments		
Issue	Description	Date
A	TENDER	15/02/19
B	REVISED TENDER	27/02/19

FOR TENDER

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Drawing Title

DEMOLITION PLAN - STAGE 1

Scale

1:200

Drawing Created (date)

11/30/17

Drawing Created (by)

KM

Plotted and checked by

BG

Verified

BG

Approved

BG

Project No

160760

Drawing No

A-1000

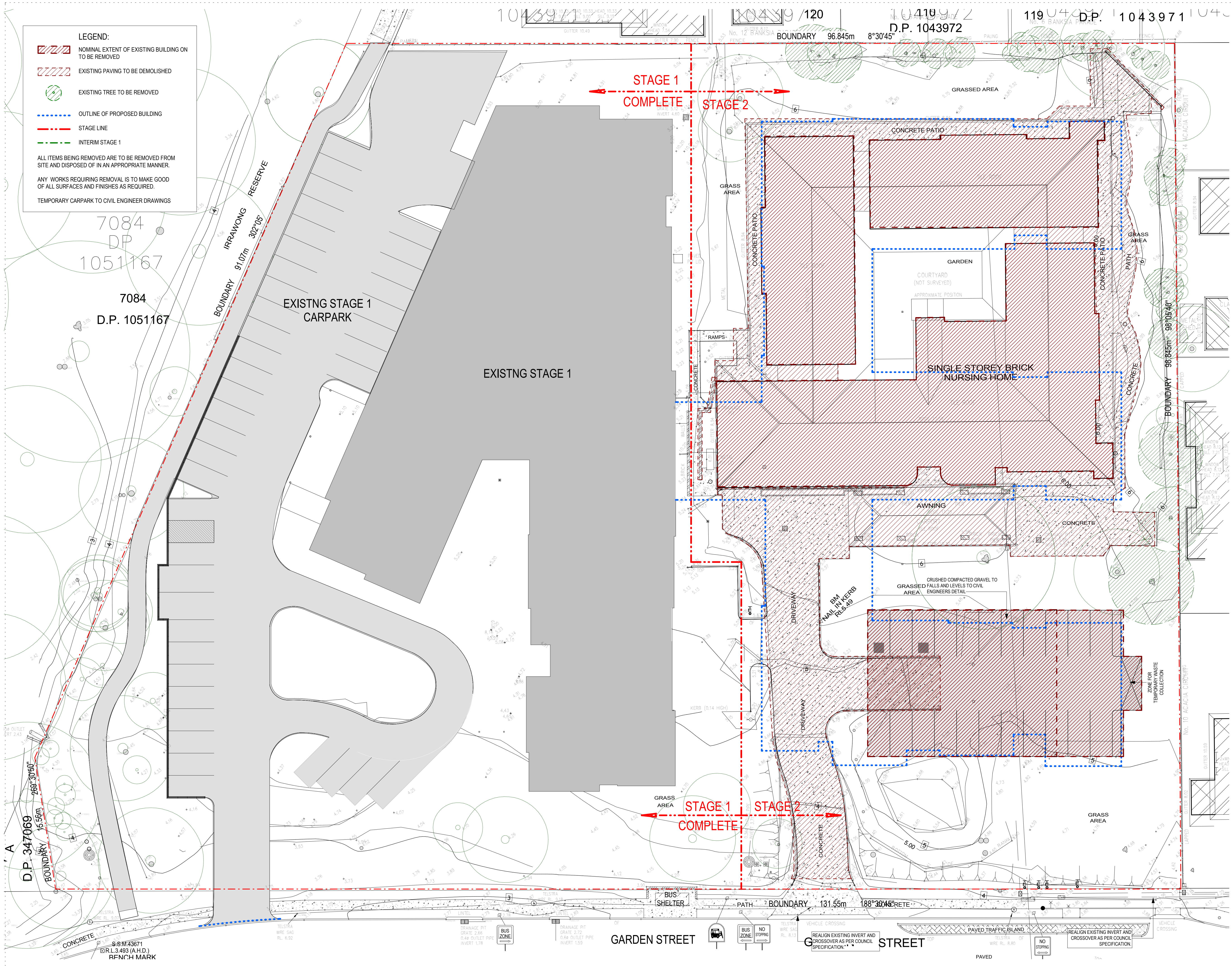
Issue

B

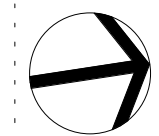
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27/02/2019 5:21:31 PM



Amendments		Date
Issue	Description	
A	TENDER	15/02/19
B	REVISED TENDER	27/02/19



FOR TENDER

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Project Title

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Drawing Title

DEMOLITION PLAN - STAGE 2

Scale	
Drawing Created (date)	01/08/19
Drawing Created (by)	KM
Plotted and checked by	BG
Verified	BG
Approved	BG

Project No	Drawing No	Issue
160760	A-1001	B

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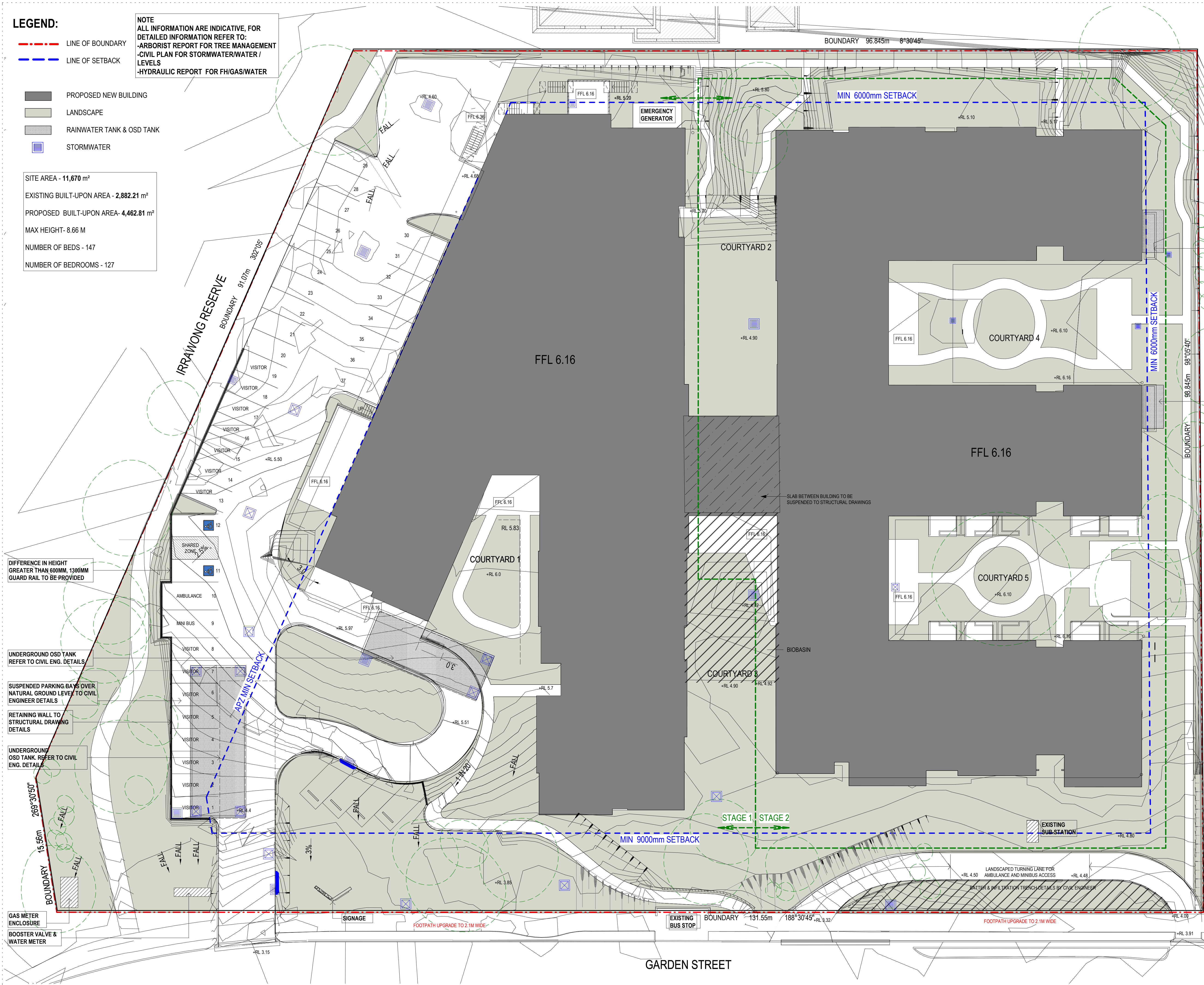
LEGEND:

- LINE OF BOUNDARY
--- LINE OF SETBACK

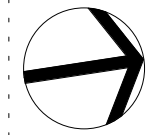
- PROPOSED NEW BUILDING
■ LANDSCAPE
■ RAINWATER TANK & OSD TANK
■ STORMWATER

SITE AREA - 11,670 m²
EXISTING BUILT-UPON AREA - 2,882.21 m²
PROPOSED BUILT-UPON AREA- 4,462.81 m²
MAX HEIGHT- 8.66 M
NUMBER OF BEDS - 147
NUMBER OF BEDROOMS - 127

NOTE
ALL INFORMATION ARE INDICATIVE, FOR
DETAILED INFORMATION REFER TO:
-ARBORIST REPORT FOR TREE MANAGEMENT
-CIVIL PLAN FOR STORMWATER/WATER /
LEVELS
-HYDRAULIC REPORT FOR FH/GAS/WATER



Issue	Description	Date
A	TENDER	15/02/19
B	REVISED TENDER	27/02/19



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Drawing Title

SITE PLAN

Scale	1:200
Drawing Created (date)	03/13/18
Drawing Created (by)	FC
Plotted and checked by	FC
Verified	DC
Approved	DP

Project No	Drawing No	Issue
160760	A-1100	B

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27/02/2019 5:21:55 PM

Appendix B Summary Tables



Health Screening Level Asbestos Concentration in Soil (% w/w)	
Category	HSL A ⁽¹⁾
Bonded ACM in soils	0.01
FA and AF in soils	0.001

Sample Information			Field Asbestos Quantification					Laboratory Analysis										
Sample ID	Date	Lab Report Number	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)*	Asbestos from ACM in soil (%w/w)	Sample Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	Asbestos from ACM in soil (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	Asbestos from FA in soil (%w/w)	Mass AF (g)	Mass Asbestos in AF (g)	Asbestos from AF in soil (%w/w)	Asbestos from FA & AF in soil (%w/w)
Opal Warriewood DSI Asbestos Quantification Table																		
DP (2017) PSI																		
DPBH4 1.9-2	6/06/2016					N/A												No Asbestos Detected
DPBH6 0.1-0.2	15/06/2016					N/A												Chrysotile Asbestos Detected, below laboratory LOR of 0.1g/kg
DPBH10 0.4-0.5	15/06/2016					N/A												No Asbestos Detected
DPBH10 1.9-2.0	15/06/2016					N/A												No Asbestos Detected
DPBH11A 1.9-2.0	15/06/2016					N/A												No Asbestos Detected
DPBH12 0.9-1.0	6/06/2016					N/A												No Asbestos Detected
DPBH12 1.9-2.0	6/06/2016					N/A		-	-	-	-	-	-	-	-	-	-	-
DPBH14 0.4-0.5	6/06/2016					N/A												Chrysotile Asbestos Detected, below laboratory LOR of 0.1g/kg
DPBH14 1.0-1.45	6/06/2016					N/A												No Asbestos Detected
JBS&G (2019) DSI																		
BH01 0-1.0	11/02/2019		10	16200	0	0.0	0.000	824	0	0	0	0	0	0	0	0	0	0
BH01 1.0-2.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH01 2.0-3.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH01 3.0-3.5	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH02 0-1.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH02 1.0-2.0	11/02/2019		10	16200	0	0.0	0.000	735	0	0	0	0	0	0	0	0	0	0
BH02 2.0-3.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH03 0-1.0	11/02/2019		10	16200	0	0.0	0.000	598	0	0	0	0	0	0	0	0	0	0
BH03 1.0-2.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH03 2.0-3.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH04 0-1.0	11/02/2019		10	16200	0	0.0	0.000	619	0	0	0	0	0	0	0	0	0	0
BH04 1.0-2.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH05 0-1.0	11/02/2019		10	16200	4	0.6	0.004	-	-	-	-	-	-	-	-	-	-	-
BH05 1.0-2.0	11/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH06 0.2-0.5	11/02/2019		10	16200	22	3.3	0.020	699	6.155	0	0.0704	0	0	0	0	0	0	0
BH07 0.2-1.0 (0.5-0.6)	11/02/2019		10	16200	10.0	1.5	0.009	578	0	0	0	0	0	0	0	0	0	0
BH08 0.2-1.0 (0.5-0.6)	12/02/2019		10	16200	0	0.0	0.000	658	0	0	0	0	0	0	0	0	0	0
BH08 1.0-1.5 (1.4-1.5)	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH09 0.1-1.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH09 1.5-1.6 (1.0-2.0)	12/02/2019		10	16200	0	0.0	0.000	582	0	0	0	0	0	0	0	0	0	0
BH09 3.0-4.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH09 2.0-3.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH10 0.1-1.0 (0.5-0.6)	12/02/2019		10	16200	8	1.2	0.007	584	0	0	0	0	0	0	0	0	0	0
BH10 1.0-1.8	12/02/2019		10	16200	0	0.0	0.000	644	0	0	0	0	0	0	0	0	0	0
BH11 0.2-1.0	12/02/2019		10	16200	6.0	0.9	0.006	800	0	0	0	0	0	0	0	0	0	0
BH11 1.0-2.0	12/02/2019		10	16200	10	1.5	0.009	-	-	-	-	-	-	-	-	-	-	-
BH12 0.2-0.5	12/02/2019		10	16200	0	0.0	0.000	617	0	0	0	0	0	0	0	0	0	0
BH13 0-1.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH13 1.0-2.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH13 1.5-1.6	12/02/2019		-	-	-	-	-	608	0	0	0	0	0	0	0	0	0	0
BH13 2.0-3.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH15 0.2-1.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH15 0.5-0.6	12/02/2019		-	-	-	-	-	632	0	0	0	0	0	0	0	0	0	0
BH15 1.0-2.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
BH15 1.5-1.6	12/02/2019		-	-	-	-	-	681	0	0	0	0	0	0	0	0	0	0
BH15 2.0-3.0	12/02/2019		10	16200	0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP01 0.0-1.0	12/02/2019		10	16200	94.0	14.1	0.087	892	0	0	0	0	0	0	0	0	0	0
TP01 1.0-2.0	12/02/2019		10	16200	0.0	0.0	0.000	712	0	0	0	0	0	0	0	0	0	0
TP01 2.0-3.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP02 0.0-1.0	12/02/2019		10	16200	0.0	0.0	0.000	712	0	0	0	0	0	0	0	0	0	0
TP02 1.0-2.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP02 2.0-3.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP02 3.0-4.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP03 0.0-1.0	12/02/2019		10	16200	114.0	17.1	0.106	-	-	-	-	-	-	-	-	-	-	-
TP03 1.0-2.0	12/02/2019		10	16200	170.0	25.5	0.157	726	0	0	0	0	0	0	0	0	0	0
TP03 2.0-3.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP04 0.0-1.0	12/02/2019		10	16200	214.0	32.1	0.198	915	0	0	0	0	0	0	0	0	0	0

Table A: Asbestos Quantification/Identification Summary Table

Job number: 55792
Client: Opal Aged Care
Name: Opal Seaside Warriewood DSI/RAP



Health Screening Level Asbestos Concentration in Soil (% w/w)	
Category	HSL A ⁽¹⁾
Bonded ACM in soils	0.01
FA and AF in soils	0.001

Sample Information			Field Asbestos Quantification					Laboratory Analysis										
Sample ID	Date	Lab Report Number	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)*	Asbestos from ACM in soil (%w/w)	Sample Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	Asbestos from ACM in soil (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	Asbestos from FA in soil (%w/w)	Mass AF (g)	Mass Asbestos in AF (g)	Asbestos from AF in soil (%w/w)	Asbestos from FA & AF in soil (%w/w)
TP04 1.0-2.0	12/02/2019		10	16200	250.0	37.5	0.231	-	-	-	-	-	-	-	-	-	-	-
TP05 0.0-1.0	12/02/2019		10	16200	38.0	5.7	0.035	-	-	-	-	-	-	-	-	-	-	-
TP05 1.0-2.2	12/02/2019		10	16200	0.0	0.0	0.000	727	0	0	0	0	0	0	0	0	0	0
TP06 0.0-1.0	12/02/2019		10	16200	24.0	3.6	0.022	-	-	-	-	-	-	-	-	-	-	-
TP06 0.0-0.3	12/02/2019		-	-	-	-	-	701	0	0	0	0	0	0	0	0	0	0
TP06 1.0-1.9	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP07 0.0-1.0	12/02/2019		10	16200	0.0	0.0	0.000	786	0	0	0	0	0	0	0	0	0	0
TP07 1.0-2.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP07 2.0-3.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP07 3.0-4.0	12/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP08 0.0-1.0	12/02/2019		10	16200	140.0	21.0	0.130	-	-	-	-	-	-	-	-	-	-	-
TP08 1.0-2.5	12/02/2019		10	16200	1072	160.8	0.993	714	0	0	0	0	0	0	0	0	0	0
TP09 0.0-1.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP09 1.0-2.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP09 2.0-2.5	13/02/2019		10	16200	100.0	15.0	0.093	743	0	0	0	0	0	0	0	0	0	0
TP10 0.0-1.0	13/02/2019		10	16200	0.0	0.0	0.000	696	0	0	0	0	0	0	0	0	0	0
TP10 1.0-2.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP10 2.0-2.5	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP11 0.0-1.4	13/02/2019		10	16200	0.0	0.0	0.000	700	0	0	0	0	0	0	0	0	0	0
TP12 0.0-0.5	13/02/2019		10	16200	0.0	0.0	0.000	860	0	0	0	0	0	0	0	0	0	0
TP12 0.5-1.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP12 1.0-2.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP13 0.0-0.5	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP13 0.5-1.0	13/02/2019		10	16200	0.0	0.0	0.000	846	0	0	0	0	0	0	0	0	0	0
TP13 1.0-2.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP14 0.0-0.5	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP14 0.5-1.0	13/02/2019		10	16200	0.0	0.0	0.000	757	0	0	0	0	0	0	0	0	0	0
TP14 1.0-2.1	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP14 2.1-3.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP14 3.0-4.3	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP15 0-0.3	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP15 0.3-0.5	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP15 0.5-1.0	13/02/2019		10	16200	472	70.8	0.437	-	-	-	-	-	-	-	-	-	-	-
TP15 1.0-2.0	13/02/2019		10	16200	506.0	75.9	0.469	685	0	0	0	0	0	0	0	0	0	0
TP15 2.0-3.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP16 0.0-1.0	13/02/2019		10	16200	0.0	0.0	0.000	743	0	0	0	0	0	0	0	0	0	0
TP16 1.0-2.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP16 2.0-2.5	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP17 0.0-1.0	13/02/2019		10	16200	178.0	26.7	0.165	798	0	0	0	0	0	0	0	0	0	0
TP17 1.0-2.0	13/02/2019		10	16200	186	27.9	0.172	-	-	-	-	-	-	-	-	-	-	-
TP17 2.0-3.0	13/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP18 0.0-0.8	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP18 0.8-2.0	14/02/2019		10	16200	50	7.5	0.046	757	0	0	0	0.0433	0.0130	0.0017	0	0	0	0.0017
TP18 2.0-2.5	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP19 0.0-1.0	14/02/2019		10	16200	0.0	0.0	0.000	789	0	0	0	0	0	0	0	0	0	0
TP19 1.0-2.0	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP19 2.0-2.5	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP20 0.0-1.1	14/02/2019		10	16200	0.0	0.0	0.000	760	0	0	0	0	0	0	0.0137	0.0011	0.0001	0.0001
TP20 1.1-2.0	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP20 2.0-2.5	14/02/2019		10	16200	0.0	0.0	0.000	789	0	0	0	0	0	0	0	0	0	0
TP20 2.5-3.5	14/02/2019		10	16200	320.0	48.0	0.296	-	-	-	-	-	-	-	-	-	-	-
TP21 0.0-0.5	14/02/2019		10	16200	0.0	0.0	0.000	705	0	0	0	0	0	0	0	0	0	0
TP21 0.5-0.8	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP21 0.8-1.5	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP22 0.0-1	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
TP23 0-0.5	14/02/2019		10	16200	0.0	0.0	0.000	-	-	-	-	-	-	-	-	-	-	-
HA01 0-0.7	12/02/2019		10	16200	4.0	0.6	0.004	523	0	0	0	0	0	0	0	0	0	0
HA02 0.2-1	15/02/2019		10	16200	0.0	0.0	0.000	516	0	0	0	0	0	0	0	0	0	0

Note: **Bold** = positive detection / observation of ACM, AF/FA. (1) = HSL A criteria exceedance.
* assumes a concentration of 15% asbestos in fragments of identified ACM (NEPC 2013)

Table B : Summary of Soil Analytical Results
Project Number: 55792
Project Name: Opal Seaside Warriewood DSI





	Metals & Metalloids								TPHs (NEPC 1999)					TRHs (NEPC 2013)						BTEX						
	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-C60 Fraction	>C10-C60 Fraction (Total)	>C10-C16 less Naphthalene (F2)	C6-C10 Fraction	C6-C10 less BTEX (F1)	Benzene	Ethylbenzene	Toluene	Xylene (o)	Xylene (m & p)	Xylene (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
EQL	2	0.4	1	1	1	0.1	1	1	20	20	50	50	50	50	100	100	50	50	20	20	0.1	0.1	0.1	0.1	0.2	0.3
NEPC 2013 EIL, EILs Aged Sediment	100		320	190	1100		170	400																		
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil															300	2800		120		180	50	70	85			105
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL A																										
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																										
NEPM 2013 Mgmt Limits - Residential, Parkland and Public Open Space, Coarse														1000	2500	10000			700							
NEPM 2013 Soil HIL A	100	20	100	6000	300	40	400	7400																160		
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																		110		45	0.5	55	160			40
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 1 to <2m																		240		70	0.5	NL	220			60
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 2 to <4m																		440		110	0.5	NL	310			95

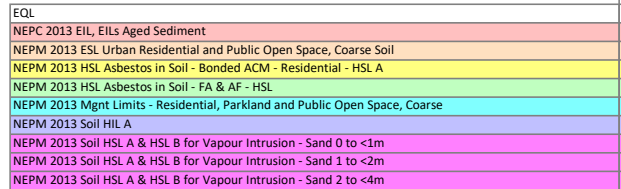
Field ID	Depth / Parent	Fill / Natural	Date	SampleCode	Report Number																										
DP (2017) PSI																															
DPBH4_1.9-2	1.9-2	Fill	6/06/2016	148124-1	DP (2017)	<4	4.1	11	110	38	<0.1	3	210	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH6_0.1-0.2	0.1-0.2	Fill	15/06/2016	148474-3	DP (2017)	6	<0.4	12	23	60	<0.1	5	73	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH10_0.4-0.5	0.4-0.5	Fill	15/06/2016	148474-6	DP (2017)	<4	<0.4	8	8	25	<0.1	4	34	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH10_1.9-2.0	1.9-2.0	Fill	15/06/2016	148474-7	DP (2017)	<4	<0.4	8	4	6	<0.1	2	6	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH11A_1.9-2.0	1.9-2.0	Fill	15/06/2016	148474-8	DP (2017)	4	<0.4	13	9	12	<0.1	5	17	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH12_0.9-1.0	0.9-1.0	Fill	6/06/2016	148124-3	DP (2017)	<4	<0.4	3	24	19	<0.1	1	22	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH12_1.9-2.0	1.9-2.0	Fill	6/06/2016	148124-4	DP (2017)	7	<0.4	11	9	11	<0.1	5	27	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH14_0.4-0.5	0.4-0.5	Fill	6/06/2016	148124-5	DP (2017)	<4	<0.4	13	17	19	<0.1	16	28	<25	<50	<100	<100	-	<50	<100	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
DPBH14_1.0-1.45	1.0-1.45	Fill	6/06/2016	148124-6	DP (2017)	6	0.4	29	740	55	<0.1	22	96	<25	<50	<100	130	-	<50	120	<100	-	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<3
JBS&G (2019) DSI																															
BH01 0-1M	0-1.0	Fill	11/02/2019	S19-Fe14849	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH02 0.1-0.2	0.1-0.2	Fill	11/02/2019	S19-Fe14850	640095	4.6	<0.4	9.6	15	170	<0.1	<5	170	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH02 1-2	1.0-2.0	Fill	11/02/2019	S19-Fe14851	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0-0.1	0-0.1	Fill	11/02/2019	S19-Fe14852	640095	4.3	<0.4	8.2	6.8	18	<0.1	<5	23	<20	<20	67	66	133	<50	120	<100	120	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
QC20181102	BH03 0-0.1	Fill	11/02/2019	S19-Fe14861	640095	4.3	<0.4	7.7	8.2	20	<0.1	<5	26	<20	<20	130	81	211	<50	190	<100	190	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
QA20181102	BH03 0-0.1	Fill	11/02/2019	211362-1	211362	7	<0.4	13	12	21	<0.1	4	47	<25	<50	<100	<100	-	<50	<100	<100	<50	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<1
BH03 0-1	0-1.0	Fill	11/02/2019	S19-Fe14854	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14868	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 2.5-2.6	2.5-2.6	Sandy Clay	11/02/2019	S19-Fe14853	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH04 0-1	0-1.0	Fill	11/02/2019	S19-Fe14855	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH05 0-1.0	0-1.0	Fill	11/02/2019	S19-Fe14856	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH05 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14857	640095	4.8	<0.4	7.1	6.2	100	<0.1	<5	40	<20	<20	<50	56	56	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH05 1.5-1.6	1.5-1.6	Fill	11/02/2019	S19-Fe14858	640095	11	<0.4	8	15	35	<0.1	<5	96	<20	<20	51	63	114	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH06 0.2-0.5	0.2-0.5	Fill	11/02/2019	S19-Fe14860	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH07 0.2-0.3	0.2-0.3	Fill	11/02/2019	S19-Fe14859	640095	4.2	<0.4	7.3	<5	22	<0.1	<5	21	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH07 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14896	640095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH08 0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16941	640386	3.7	<0.4	24	19	38	<0.1	15	46	<20	130	460	<50	590	270	340	<100	610	270	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH09 1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16942	640386	12	<0.4	21	7.4	14	<0.1	8.4	28	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH10_0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16943	640386	6.7	<0.4	31	56	30	<0.1	23	49	<20	<20	110	120	230	<50	190	<100	190	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH10_1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16944	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH10_1.9-2.0	1.9-2.0	Clayey Sand	12/02/2019	S19-Fe16945	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH11_0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16946	640386	6.7	0.9	19	28	100	<0.1	8.6	120	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH12_0.2-0.5	0.2-0.5	Fill	12/02/2019	S19-Fe16947	640386	3.9	<0.4	11	17	66	<0.1	<5	66	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH13_1.5-1.6	1.5-0.6	Fill	12/02/2019	S19-Fe16948	640386	7.4	<0.4	15	6.1	36	<0.1	<5	27	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH15_0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16951	640386	8.9	<0.4	15	6.2	25	<0.1	<5	54	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
BH15_1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16952	642747	12	<0.4	14	7.6	15	<0.1	<5	70	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
QC20190212	BH15_1.5-1.6	Fill	12/02/2019	S19-Fe16949	640386	6	<0.4	16	12	28	<0.1	<5	37	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
QA20190212	BH15_1.5-1.6	Fill	12/02/2019	211475-1	211475	4	<0.4	13	110	28	<0.1	3	27	<25	<50	<100	<100	-	<50	<100	<100	<50	<25	<25	<0.2	<1	<0.5	<1	<2	<1	
HA01_0.0-0.7	0-0.7	Fill	12/02/2019	S19-Fe16940	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA01_0.6-0.7	0.6-0.7	Fill	12/02/2019	S19-Fe16939	640386	2.9	0.6	25	23	810	<0.1	25	56	<20	<20	<50	<50	<50	<50	<100	<100	<100	<50	<20	<20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3
HA02 0.2-1AQ	0.2-1.0	Fill	15/02/2019	S19-Fe22270	641092	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA02 0.5-0.6	0.5-0.6	Fill	15/02/2019	S19-Fe22268	641092	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA03 0.1-0.2	0.1-0.2	Fill	15/02/2019	S19-Fe34162	642427	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP01 0-1	0-1.0	Fill	12/02/2019	S19-Fe16953	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP01 1-2 AQ	1.0-2.0	Fill	12/02/2019	S19-Fe16954	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP02 0-1 AQ	0-1.0	Fill	12/02/2019	S19-Fe16955	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP03 1-2 AQ	1.0-2.0	Fill	12/02/2019	S19-Fe16956	640386	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP04	Fragment	Fill	21/02/2019	S19-Fe27877	641755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Table B : Summary of Soil Analytical Results
Project Number: 55792
Project Name: Opal Seaside Warriewood DSI



						Polycyclic Aromatic Hydrocarbons																				Organochlorine Pesticides																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
						Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benz(b)pyrene	Benz(b)pyrene TEQ (lower bound)*	Benz(a)pyrene TEQ (medium bound)*	Benz(a)pyrene TEQ (upper bound)*	Benz(b)fluoranthene	Benz(b,j,k)fluoranthene	Benz(g,h,i)perylene	Benz(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Carcinogenic PAHs as B(a)P TEQ	Fluoranthene	Fluorene	Naphthalene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	PAHs (Total)	Pyrene	Total Positive PAHs	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	gamma-Chlordane	Endrin aldehyde	Endrin ketone	Heptachlor	Heptachlor Epoxide	Lindane	Methoxychlor	HCB	Toxaphene																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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/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	mg/kg

Project Name: Opal Seaside Warriewood DSI

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						EPA VIC - IWRG621	Phenols	OPPs	Polychlorinated Biphenyls										Chlorinated Benzenes		Asbestos													Asbestos - Trace Analysis													Other				
						Organochlorine Pesticides EPAVic	Other Organochlorine Pesticides EPAVic	Total Phenolics (as Phenol)	Total OPPs	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	PCBs (Total)	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	Asbestos Reported Result	Asbestos Sample Dimensions	Total Asbestos g/kg*	ACM - Comment	AF - Comment	FA - Comment	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment	Cation Exchange Capacity	EC 1:5 soil:water	pH 1:5 soil:water	% Clay	% Moisture 103oC								
						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	g	%w/w	%w/w	g	g	g	g	g	g	Comment	Comment	Comment	g/kg	Comment	Comment	Comment	Comment	Comment	Comment	meq/100g	µS/cm	ph Units	%	%									
EQL						0.1	0.1	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05																																	
NEPC 2013 EIL, EILs Aged Sediment																																																			
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil																																																			
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 Mgmt Limits - Residential, Parkland and Public Open Space, Coarse																																																			
NEPM 2013 Soil HIL A																	1	10																																	
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																																																			
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 1 to <2m																																																			
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 2 to <4m																																																			

Field ID	Depth / Parent	Fill / Natural	Date	SampleCode	Report Number
DP (2017) PSI					
DPBH4_1.9-2	1.9-2	Fill	6/06/2016	148124-1	DP (2017)
DPBH6_0.1-0.2	0.1-0.2	Fill	15/06/2016	148474-3	DP (2017)
DPBH10_0.4-0.5	0.4-0.5	Fill	15/06/2016	148474-6	DP (2017)
DPBH10_1.9-2.0	1.9-2.0	Fill	15/06/2016	148474-7	DP (2017)
DPBH11A_1.9-2.0	1.9-2.0	Fill	15/06/2016	148474-8	DP (2017)
DPBH12_0.9-1.0	0.9-1.0	Fill	6/06/2016	148124-3	DP (2017)
DPBH12_1.9-2.0	1.9-2.0	Fill	6/06/2016	148124-4	DP (2017)
DPBH14_0.4-0.5	0.4-0.5	Fill	6/06/2016	148124-5	DP (2017)
DPBH14_1.0-1.45	1.0-1.45	Fill	6/06/2016	148124-6	DP (2017)
JBS&G (2019) DSI					
BH01 0-1M	0-1.0	Fill	11/02/2019	S19-Fe14849	640095
BH02 0.1-0.2	0.1-0.2	Fill	11/02/2019	S19-Fe14850	640095
BH02 1-2	1.0-2.0	Fill	11/02/2019	S19-Fe14851	640095
BH03 0-0.1	0-0.1	Fill	11/02/2019	S19-Fe14852	640095
QC20181102	BH03 0-0.1	Fill	11/02/2019	S19-Fe14861	640095
QA20181102	BH03 0-0.1	Fill	11/02/2019	211362-1	211362
BH03 0-1	0-1.0	Fill	11/02/2019	S19-Fe14854	640095
BH03 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14868	640095
BH03 2.5-2.6	2.5-2.6	Sandy Clay	11/02/2019	S19-Fe14853	640095
BH04 0-1	0-1.0	Fill	11/02/2019	S19-Fe14855	640095
BH05 0-1.0	0-1.0	Fill	11/02/2019	S19-Fe14856	640095
BH05 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14857	640095
BH05 1.5-1.6	1.5-1.6	Fill	11/02/2019	S19-Fe14858	640095
BH06 0.2-0.5	0.2-0.5	Fill	11/02/2019	S19-Fe14860	640095
BH07 0.2-0.3	0.2-0.3	Fill	11/02/2019	S19-Fe14859	640095
BH07 0.5-0.6	0.5-0.6	Fill	11/02/2019	S19-Fe14896	640095
BH08 0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16941	640386
BH09 1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16942	640386
BH10 0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16943	640386
BH10 1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16944	640386
BH10 1.9-2.0	1.9-2.0	Clayey Sand	12/02/2019	S19-Fe16945	640386
BH11 0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16946	640386
BH12 0.2-0.5	0.2-0.5	Fill	12/02/2019	S19-Fe16947	640386
BH13 1.5-1.6	1.5-0.6	Fill	12/02/2019	S19-Fe16948	640386
BH15 0.5-0.6	0.5-0.6	Fill	12/02/2019	S19-Fe16951	640386
BH15 1.5-1.6	1.5-1.6	Fill	12/02/2019	S19-Fe16952	642747
QC20190212	BH15 1.5-1.6	Fill	12/02/2019	S19-Fe16949	640386
QA20190212	BH15 1.5-1.6	Fill	12/02/2019	211475-1	211475
HA01 0.0-0.7	0-0.7	Fill	12/02/2019	S19-Fe16940	640386
HA01 0.6-0.7	0.6-0.7	Fill	12/02/2019	S19-Fe16939	640386
HA02 0.2-1AQ	0.2-1.0	Fill	15/02/2019	S19-Fe22270	641092
HA02 0.5-0.6	0.5-0.6	Fill	15/02/2019	S19-Fe22268	641092
HA03 0.1-0.2	0.1-0.2	Fill	15/02/2019	S19-Fe34162	642427
TP01 0-1	0-1.0	Fill	12/02/2019	S19-Fe16953	640386
TP01 1-2 AQ	1.0-2.0	Fill	12/02/2019	S19-Fe16954	640386
TP02 0-1 AQ	0-1.0	Fill	12/02/2019	S19-Fe16955	640386
TP03 1-2 AQ	1.0-2.0	Fill	12/02/2019	S19-Fe16956	640386
TP04	Fragment	Fill	21/02/2019	S19-Fe27877	641755
TP04 0.2-0.3	0.2-0.3	Fill	12/02/2019	S19-Fe16957	640386
TP04 0-1 AQ	0-1.0	Fill	12/02/2019	S19-Fe16958	640386
TP05 1-2 AQ	1.0-2.0	Fill	12/02/2019	S19-Fe16959	640386
TP06 0.0-0.3	0-0.3	Fill	12/02/2019	S19-Fe17024	640386
TP06 1-1.9 AQ	1.0-1.9	Fill	12/02/2019	S19-Fe17026	640386
TP07 0-1 AQ	0-1.0	Fill	12/02/2019	S19-Fe16961	640386
TP07 3.4-3.5	3.4-3.5	Fill	12/02/2019	S19-Fe16962	640386
TP08	Fragment	Fill	21/02/2019	S19-Fe27878	641755

Project Name: Opal Seaside Warriewood DSI

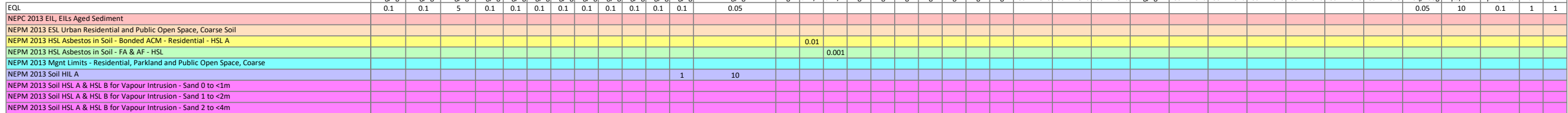
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Table C : Summary Table of ASLP Leachate Results

Project Number: 55792

Project Name: Opal Seaside Warriewood DSI



	Metals & Metalloids									
	Arsenic (Total)	Cadmium	Chromium (Total)	Copper	Lead	Mercury (Inorganic)	Nickel	Zinc	pH (ASLP - off)	pH (Leachate fluid)
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ph Units	ph Units
EQL	0.01	0.005	0.01	0.01	0.01	0.001	0.01	0.01	0.1	0.1
ANZAST 2018 Fresh Water 95%		0.002*	0.0084*	0.0126*	0.09078*	0.0006	0.099*	0.072*		

Field ID	Date	SampleCode	Report Number										
HA01_0.6-0.7	12/02/2019	M19-Fe38829	642983	-	-	-	-	0.05	-	-	-	6.7	5.9

NOTE: * hardness factor adjustment as per Table 3.4.4 of ANZAST (2018)

Table D : Summary of Groundwater Analytical Results
Project Number: 55792
Project Name: Opal Seaside Warriewood DSI



									TPHs (NEPC 1999)				TRHs (NEPC 2013)						BTEX							
	Arsenic (Total) (Filtered)	Cadmium (Filtered)	Chromium (Total) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Inorganic) (Filtered)	Nickel (Filtered)	Zinc (Filtered)	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)	Benzene	Ethylbenzene	Toluene	Xylene (o)	Xylene (m & p)	Xylene (Total)
EQL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	0.001	0.0001	0.001	0.001	0.001	0.00005	0.001	0.001	0.01	0.05	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05	0.01	0.01	0.001	0.001	0.001	0.001	0.002	0.003
ANZAST 2018 Fresh Water 95%		0.002*	0.0084*	0.0126*	0.09078*	0.0006	0.099*	0.072*												0.95				0.35		
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 2 to <4m																		1		1	0.8	NL	NL			NL
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 4 to <8m																		1		1	0.8	NL	NL			NL

Field ID	Date	SampleCode	Report Number																										
DP (2017) PSI				<0.001	<0.0001	<0.001	<0.001	<0.001	<0.00005	<0.001	0.004	<0.01	<0.05	<0.1	<0.1	-	<0.05	<0.1	<0.1	-	<0.05	<0.01	<0.01	<0.001	<0.001	<0.001	<0.002	<0.003	
DPBH11A	28/06/2016	149249-1	DP (2017)	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.00005	<0.001	0.006	<0.01	<0.05	<0.1	<0.1	-	<0.05	<0.1	<0.1	-	<0.05	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003
JBS&G (2019) DSI																													
BH01/MW01	15/02/2019	S19-Fe20312	640840	0.001	0.0003	0.001	0.028	0.004	<0.0001	0.007	0.07	<0.02	<0.05	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.05	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003
DPBH11A	15/02/2019	S19-Fe20313	640840	<0.001	<0.0002	<0.001	0.018	<0.001	<0.0001	0.005	0.053	<0.02	<0.05	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.05	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003
QA-W 150219	15/02/2019	S19-Fe20315	640840	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.005	<0.02	<0.05	<0.1	<0.1	<0.1	<0.05	<0.1	.	<0.1	<0.05	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003
QC-W150219	15/02/2019	211645-1	211645	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.00005	<0.001	<0.001	<0.01	<0.05	<0.1	<0.1	-	<0.05	<0.1	<0.1	-	<0.05	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.002	-
DPBH12	15/02/2019	S19-Fe20314	640840	<0.001	<0.0002	<0.001	0.003	<0.001	<0.0001	0.003	0.022	<0.02	<0.05	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.05	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003

NOTE: * hardness factor adjustment as per Table 3.4.4 of ANZAST (2018)

Table D : Summary of Groundwater Analytical Results
Project Number: 55792
Project Name: Opal Seaside Warriewood DSI



	Polycyclic Aromatic Hydrocarbons															Organochlorine Pesticides																																	
	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (WHO)	Benzo(b,j)fluoranthene	Benzo(b,k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	PAHs (Total)	Pyrene	Total Positive PAHs	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	gamma-Chlordane	Endrin aldehyde	Endrin ketone	Heptachlor	Heptachlor Epoxide	Undane	Methoxychlor	HCB	Toxaphene				
EQL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L			
	0.001	0.001	0.001	0.001	0.001		0.001		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
ANZAST 2018 Fresh Water 95%																0.016																																	
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 2 to <4m																NL																																	
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 4 to <8m																NL																																	

Field ID	Date	SampleCode	Report Number																																													
DP (2017) PSI																																																
DPBH11A	28/06/2016	149249-1	DP (2017)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	-	<0.0002	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	-	<0.0001	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	-	<0.0002	<0.0002	-			
DPBH12	28/06/2016	149249-2	DP (2017)	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	-	<0.0002	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	-	<0.0001	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	-	<0.0002	<0.0002	-		
JBS&G (2019) DSI																																																
BH01/MW01	15/02/2019	S19-Fe20312	640840	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
DPBH11A	15/02/2019	S19-Fe20313	640840	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
QA-W 150219	15/02/2019	S19-Fe20315	640840	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
QC-W150219	15/02/2019	211645-1	211645	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	-	<0.002	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0 ^µ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DPBH12	15/02/2019	S19-Fe20314	640840	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTE: * hardness factor adjustment as per Table 3.4.4 of ANZAST (2018)

Table D : Summary of Groundwater Analytical Results
Project Number: 55792
Project Name: Opal Seaside Warriewood DSI

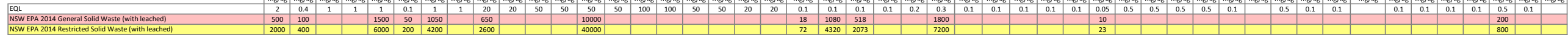


	OPPs	Polychlorinated Biphenyls								Major Cations				Major Anions				Other		
	Total OPPs	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	PCBs (Total)	Calcium (Filtered)	Magnesium (Filtered)	Potassium (Filtered)	Sodium (Filtered)	Sulphate (as SO4)	Carbonate Alkalinity (as CO3)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Ionic Balance
EQL	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MG/L	mg/L	mg/L	mg/L	mg/L	%
	0.0002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001					1		5	10			
ANZAST 2018 Fresh Water 95%					0.0006		0.00003													
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 2 to <4m																				
NEPM 2013 Groundwater HSL A & HSL B for Vapour Intrusion - Sand 4 to <8m																				

Field ID	Date	SampleCode	Report Number																						
DP (2017) PSI																									
DPBH11A	28/06/2016	149249-1	DP (2017)	<0.0002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	170	21	-	-	-	-	510	-	-	-	-
DPBH12	28/06/2016	149249-2	DP (2017)	<0.0002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	140	25	-	-	-	-	460	-	-	-	-
JBS&G (2019) DSI																									
BH01/MW01	15/02/2019	S19-Fe20312	640840	-	-	-	-	-	-	-	-	-	-	-	20	18	5.2	47	180	-	<20	<10	-	-	-
DPBH11A	15/02/2019	S19-Fe20313	640840	-	-	-	-	-	-	-	-	-	-	-	140	18	11	60	<5	-	460	<10	-	-	-
QA-W 150219	15/02/2019	S19-Fe20315	640840	-	-	-	-	-	-	-	-	-	-	-	150	19	12	56	<5	-	470	<10	-	-	-
QC-W150219	15/02/2019	211645-1	211645	-	-	-	-	-	-	-	-	-	-	-	150	18	11	59	<1	<5	490	-	490	<5	1
DPBH12	15/02/2019	S19-Fe20314	640840	-	-	-	-	-	-	-	-	-	-	-	140	19	11	27	<5	-	460	<10	-	-	-

NOTE: * hardness factor adjustment as per Table 3.4.4 of ANZAST (2018)

Project Name: Opal Seaside Warriewood DSI

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Project Name: Opal Seaside Warriewood DSI

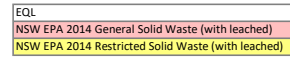
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Table F : Summary of TCLP Leachate Results for Waste Classification

Project Number: 55792

Project Name: Opal Seaside Warriewood DSI



	Metals & Metalloids								BTEXN	Polycyclic Aromatic Hydrocarbons																Ionic Balance			
	Arsenic (Total)	Cadmium	Chromium (Total)	Copper	Lead	Mercury (Inorganic)	Nickel	Zinc	Naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b,j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	PAHs (Total)	Pyrene	pH (TCLP - HCl addition)	pH (TCLP - initial)	pH (TCLP - off)	pH (Leachate fluid)
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ph Units	ph Units	ph Units	ph Units
EQL	0.01	0.005	0.01	0.01	0.01	0.001	0.01	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.1	0.1	0.1	0.1
NSW EPA 2014 General Solid Waste (leached)	5	1			5	0.2	2							0.04															

Field ID	Date	SampleCode	Report Number	<0.01	<0.005	<0.01	<0.01	0.01	<0.001	<0.01	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.9	6.5	5	5.1
BH07 0.2-0.3	11/02/2019	S19-Fe15222	640095	<0.01	<0.005	<0.01	<0.01	0.01	<0.001	<0.01	0.06	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.2	7.5	6.4	5.1	
BH10_0.5-0.6	12/02/2019	S19-Fe16967	640386	<0.01	<0.005	<0.01	<0.01	<0.01	<0.001	<0.01		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	2.2	7.5	6.4	5.1	
HA01_0.6-0.7	12/02/2019	M19-Fe38322	642983	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	6	5.1	5		

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