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Remediation Action Plan

Proposed Redevelopment, Hunter Sports High School
Pacific Highway, Gateshead

Prepared for
NSW Public Works

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Executive Summary

This Remediation Action Plan (RAP) has been prepared for the proposed redevelopment of Hunter Sports High School. The RAP details the aims, methods and procedures by which remediation and site validation of identified localised contamination is conducted to render the development area suitable for ongoing use as a high school.

The proposed development comprises a staged remediation and construction program including demolition of some existing structures, construction of new school buildings and outdoor areas. The proposed development has been provided by the client as 'milestone' drawings as presented in Appendix B.

As a result of preliminary site investigation and subsequent targeted subsurface investigation, areas of localised petroleum hydrocarbon, PAH and asbestos impacts have been identified within the proposed development area.

Due to the minor and localised nature of the contamination and the proposed construction program, an on-site management option for remediation has been recommended for long-term management of identified impacts. The remediation comprises capping of identified impacts beneath buildings, pavements or clean soil capping in order to minimise exposure of site users to the contamination.

Long-term management of the capping of identified localised contamination will be completed via preparation and implementation of a long-term site management plan which outlines the details of the contamination and the procedures for management of the contamination should breaching of the capping be required.

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Report on Remediation Action Plan
Proposed Redevelopment, Hunter Sports High School
Pacific Highway, Gateshead

1. Introduction

This remediation action plan has been prepared for the proposed redevelopment at Hunter Sports High School, Pacific Highway, Gateshead. The investigation was commissioned in an email dated 27 June 2016 by Jennifer Bates of NSW Public Works and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal NCL160440 dated 24 June 2016.

The RAP has been developed based on available standards and guidelines prepared by the relevant authorities, and the results of the following investigations carried out by DP:

- "Report on Preliminary Site Investigation (Contamination)", Report No 81598.01.R001 Rev 0, October 2014 (Ref 1);
- "Report on Targeted Investigation for Contamination", Report No 81961.00.R.001 Rev 1, May 2016 (Ref 2).

The investigations indicated that the site contains fill materials which contain contaminants that exceed relevant health-based guidelines. Localised asbestos containing materials (ACM) were also identified on the surface and within near surface filling and noted as potentially being present elsewhere on site. A summary of the investigation findings is presented in Section 3 and tables presenting the results of soil analysis are provided in Tables 5 to 8, Appendix A.

This RAP details the aims, methods and procedures by which the remediation and site validation will be achieved within the development area to enable construction of the high school development.

An excavation plan showing the indicative location of the proposed cut material has been provided by the client (EJE Ref 249335 007 Rev 1). The client has also provided separate information regarding approximate volumes for excavation.

2. Review of Site Information

2.1 Site Description

Hunter Sports High School is located at 2-4 Pacific Highway Gateshead, NSW and is identified as Lot 1540 DP 755233.

The school is bounded to the east by the Pacific Highway, to the north by Wiripaang Public School, to the west by Johnsons Creek and bushland and to the south by a playing field.

The site is shown on Drawing 1, Appendix B and in Figure 1 below.

Figure 1: Site location (shown in red)

For the purposes of this RAP, 'the site' refers to those areas of proposed development, including associated access, driveways and infrastructure as presented in the attached 'milestone' drawings as presented in Appendix B, plus any ancillary areas to be disturbed as part of construction works. The procedures as presented in this RAP are not expected to be required outside of the 'milestone areas' as presented in Appendix B.

2.2 Proposed Development

It is understood that the development of the site will include demolition of some existing site structures and construction of new structures in the north-eastern and eastern portion of the lot ('Block S', 'Block T' and 'Block U') with associated pathways, landscaping and site improvements. The proposed development is presented in the drawing by EJE Architecture in Appendix B.

The proposed development includes the following:

- Block S – Movement Complex;

- Block T – Three two-storey buildings and one three-storey building;
- Block U – One single-storey building.

Some excavations will be required through existing fill to facilitate installation of services, planting of trees in addition to general earthworks and footing excavations for structures.

This RAP relates to the remediation of contaminated soils via capping through the construction of buildings slabs and pavements. For the purposes of the assessment, the proposed development includes all areas proposed to be disturbed including all new buildings, demolition areas, driveway, landscaping and infrastructure, plus incidental near-surface activities such as landscaping, footpaths etc. Based on the information provided in the excavation plan in Appendix B, the majority of excavation activities for the proposed development occur within or in the immediate vicinity of proposed construction works.

2.3 Site History

The site history review undertaken as part of the Preliminary Site Investigation (PSI) (Ref 1) indicated that the site was 'Dedicated for Public School Purposes' from 1957 to 1995 and then owned by the 'Minister for Education, Training and Youth Affairs' from 1995 to present. Prior to 1957 the site was vacant bushland.

An aerial photo review identified buildings in the north-eastern portion of the site and sports fields / cleared areas located in the central and southern portions of the site (construction between 1957 and 1965).

In 1977 a Bini Shell structure was constructed in the central eastern portion of the site. The Bini Shell was demolished in January 2016.

The results of Reference 1 indicated a history of various modifications to the grounds of the school, with building extensions / new construction (i.e. new structures, pathways and road works), landscape / tree removal featuring prominently in the school's history.

Details of site history are provided in Reference 1.

2.4 Geology and Hydrogeology

Reference to the 1:100,000 Newcastle Coalfields Geology Sheet indicates that the majority of the site is underlain by Permian aged Adamstown subgroup of the Newcastle Coal Measures comprising conglomerate, sandstone, siltstone, coal and tuff. The south-western corner of the site is underlain by Quaternary aged alluvial deposits comprising gravel, silt, clay and sand.

Reference to the Acid Sulphate Soil Risk Map for Wallsend prepared by the Department of Land & Water Conservation indicates that there is no known occurrence of acid sulphate soils within the site.

Reference to the NSW Contours Hunter and Central Coast LiDAR indicates site levels range from approximately 32 m AHD in the north-eastern corner to approximately 15 m AHD in the south-western corner of the site.

An on-line groundwater bore search undertaken through the NSW Natural Resource Atlas website indicated some registered groundwater bores in proximity to the site (Ref 1). A summary of the records for the nearest two wells is provided below:

- GW 202806 – Located approximately 450 m north of the site. The bore was drilled to 15 m depth and encountered topsoil / fill to 1.0 m, underlain by clay to 1.3 m, underlain by interbedded coal, sandstone and carbonaceous siltstone to termination at 15 m depth. Water bearing zones were not recorded for the bore. The well is licensed as a monitoring bore and was installed in January 2013;
- GW 201552 – Located approximately 120 m south-east of the site. The bore was drilled to 9 m depth and encountered fill to 0.5 m, underlain by various clay layers to termination at 9 m. Water bearing zones were encountered from 6 m to 9 m with a standing water level of 6.1 m depth. The well is licensed as a monitoring bore and was installed in October 2011.

A previous geotechnical investigation conducted DP in October 2014 (Ref 9) observed groundwater whilst augering in the southern portion of the site (sports fields) at depths of 1.0 m to 9.0 m BGL (approximately 8.7 m to 17.2 m AHD).

Another previous geotechnical investigation conducted in the northern portion of the site by DP in October 2015 (Ref 10) observed groundwater at depths of 1.2 m and 2.9 m (approximately RL 26.1 m to 22.6 m AHD).

It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

The regional groundwater flow regime is believed to be towards the west to south west towards Johnsons Creek which is located near the western and southern site boundaries.

3. Results of Previous Investigations

The results of the PSI (Ref 1) generally indicated the following:

- The site history review and inspection conducted considered the potential for gross contamination at the site to be low;
- Presence of ACM in the form of fibro fragments were identified at the surface at several locations across the site;
- Presence of ACM in the form of fibro fragments and also building rubble in surface soils suggested that there was potential for contamination within fill materials at the subject site;
- Minor quantities of fuels and chemicals were observed in storage sheds in the site. It was considered that the potential for gross contamination from the storage of the fuels and chemicals is low;

- A potential source of Polychlorinated Biphenyl (PCB) contamination was identified associated with the former substation in the eastern portion of the site. It was also considered that the potential for gross contamination from the substation is low.

A subsurface investigation was recommended to further assess possible potential contamination within the site and to assess requirements for ongoing management and / or remediation of contamination prior to and during construction. Remediation of the surface ACM was recommended as part of ongoing site use and also prior to construction works at the site.

The results of the targeted investigation for contamination (Ref 2) generally indicated the following:

- The general absence of gross contamination within the site;
- Localised elevated lead concentrations in soil, exceeding health-based and ecological investigation levels at one location (Bore 214/0.5). The elevated lead concentrations were encountered in fill materials adjacent to the southern site boundary (i.e. outside the proposed development area);
- Localised petroleum hydrocarbon concentrations ($<C_{16}$-C_{34}) exceeding the adopted ecological screening level in gravel filling in one sample (Bore 204/0.1), located immediately beneath asphalt pavement (proposed Block T development area);
- Localised benzo(a)pyrene concentrations ($<C_{16}$-C_{34}) exceeding the adopted ecological investigation level in filling in one sample (Bore 203/0.5), located immediately beneath asphalt pavement (proposed Block T development area);
- The results of asbestos testing (identification tests in soils) indicated the absence of asbestos fines contamination at the locations tested. Fibro fragments analysed from the surface and near surface filling contained asbestos in all material samples tested;
- Waste classification analysis on soils (including leachability testing where required) indicated that the analysed soil samples were classified as 'General Solid Waste' based on chemical contaminants. The presence of asbestos, however, would influence waste classification.

Water leach testing was conducted on one sample with elevated lead concentrations (Bore 214/0.5). The results of the water leach test are used to assess the potential for contaminants to leach from soils if retained on site. The results of the water leach testing were compared to ANZECC criteria (where available) and indicated a relatively high concentration in the leach test, exceeding the adopted ANZECC criteria by several orders of magnitude. It is considered that the high total concentration of lead and the subsequent high lead concentration in the water leach result in the sample from Bore 214/0.5 are indicative of particulate metal in the sample.

The previous investigations concluded that remediation is required to render the site suitable for high school landuse. As stated above, for the purposes of the RAP, 'the site' includes those areas of proposed development, including associated access, driveways and infrastructure as presented in the attached 'milestone' drawings as presented in Appendix B, plus any ancillary areas to be disturbed as part of construction works.

Following the targeted investigation (Ref 2), remediation (emu pick) of the identified surface asbestos contamination was carried out and validated by an appropriately qualified consultant. This remediation was an interim management measure, prior to the commencement of further works at the site.

4. Conceptual Site Model

A Conceptual Site Model (CSM) has been prepared for the site with reference to the National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amendment Measure 2013) Schedule B2 (Ref 3). The CSM identifies potential contaminant sources and contaminants of concern, contaminant release mechanisms, exposure pathways and potential receptors. The CSM is presented in Table 1 below.

The proposed remediation approach (Refer to Section 6) is to place contaminated soils beneath a suitable capping layer to prevent accessibility. The capping layer will comprise a concrete slab (i.e. proposed building floor slabs/concrete pavements. This remediation approach will inhibit the potential exposure pathways described below in Table 1.

Table 1: Conceptual Site Model

Known and Potential Primary Sources	Primary Release Mechanism	Secondary Release Mechanism	Potential Impacted Media	Contaminants of Concern	Exposure Pathway	Potential Receptors	
						Current	Future
Imported / dumped filling	Placement of filling on site	Long-term leaching / transport of contaminants via runoff, rain water infiltration / percolation	Soil, groundwater, surface water	TRH, BTEX, PAH, Metals, Pesticides, PCB, asbestos	Dermal contact, inhalation (dust / vapours), ingestion	Students, visitors / staff, maintenance workers, consultants, groundwater, surface water	Students, visitors / staff, maintenance workers, construction workers, consultants, groundwater, surface water
Demolition of Structures	Damage / incomplete removal of hazardous building materials prior to / during demolition	Spreading / burial of hazardous building materials during earthworks	Soil	Asbestos, lead, PCB, SMF	Dermal contact, inhalation (dust / vapours), ingestion		
Chemical / fuel storage / use	Spills / leaks from chemical use and storage	Long-term leaching of contaminants via runoff, rain water infiltration / percolation.	Soil, groundwater, surface water	TRH, heavy metals, BTEX, PAH, pesticides, herbicides	Dermal contact, inhalation (dust / vapours), ingestion		
Observed fibro fragments	Dumping, damage to existing structures	Weathering, mechanical damage (crushing, breaking etc. from impact)	Soil	Asbestos	Dermal contact, inhalation		
Former substation	Spills / leaks of oil from electrical installations	Long-term leaching / transport of contaminants via runoff, rain water infiltration / percolation	Soil, groundwater, surface water	PCB, hydrocarbons	Dermal contact, inhalation (dust / vapours), ingestion		

Notes to Table 1:

BTEX – Benzene, Toluene, Ethylbenzene and Xylenes
PAH – Polycyclic Aromatic Hydrocarbons
SMF – Synthetic Mineral Fibres
TRH – Total Recoverable Hydrocarbons

5. Assessment of Remediation Options

A number of remediation options were reviewed with reference to the principles and criteria defined in relevant documents, including, the following:

- NEPC, "National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013", 11 April 2013 (Ref 3);
- NSW EPA, Contaminated Site, "Guidelines for the NSW Site Auditor Scheme 2nd Edition", April 2006 (Ref 4).

NEPC 2013 guidelines state that the preferred hierarchy of options for site clean-up and/or management are as follows:

- On site treatment of the contamination so that it is destroyed or the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which 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; and
- Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material;

or,

- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

Based on the distribution and depth of contaminated soils, subsurface conditions and the type of contamination (i.e. Lead, TRH, PAH, ACM) and concentrations present, a number of remediation options were considered as follows:-

1. No Action.
2. Off-site disposal of contaminated soils to a licensed landfill.
3. On site treatment and re-use (volatile hydrocarbon impacted soils only).
4. On site management (i.e. containment) of the contaminated soils.
5. A combination of Options 2 to 4.

No Action

The "No Action" option involves no remediation response to the contamination identified or likely to be present on the subject site. This option was considered not appropriate as it does not provide any means to appropriately address, remediate, alleviate, and/or manage the long and short-term human health and environmental risk of the contamination already identified on site.

Off-site Disposal of Contamination Soils

In general off-site disposal of the contaminated soils could be considered if there are time and land area restrictions at the time of remediation. However, if sufficient time and space is available for effective remediation of impacted soils, on site treatment is likely to be favourable than off-site disposal to minimise landfill disposal costs.

If fill materials are required to be removed from site as part of construction works, a preliminary classification of 'General Solid Waste' for general filling, or 'General Solid Waste' with bonded asbestos materials (Special Waste) would apply, depending on the presence of asbestos impact. Further detailed investigation and testing for waste classification, however, would be recommended for confirmation.

On Site Management of Contaminated Soils

On site management of contaminated soil would generally comprise the following:

- Excavation of contaminated soils where required (i.e. to invert depth of proposed capping layer, invert depth for proposed services or footing excavations);
- Placement of excavated contaminated materials in proposed fill areas (i.e. where beneath invert depth for proposed capping layer);
- Capping of contaminated soils beneath building footprint;
- Notification of contamination management on the property title/planning certificate;
- Ongoing management of the contamination in accordance with a long-term environmental management plan for the site.

On site management of contaminated soils within the proposed development area is considered to be a feasible remediation option to protect human health and the environment, and minimise constraints on the future use of the site for the ongoing landuse.

It is envisaged that site remediation and associated site filling can be integrated to ensure that the contaminated soil is placed above groundwater (if any) in designated capped areas, thereby minimising infiltration and possible migration of contaminants, and to prevent exposure to contaminated materials during the future use of the site.

On site Treatment and Re-use of Contaminated Material

In general on site treatment is most applicable to volatile contaminants such as TRH $C_6 - C_9$ and BTEX, and requires sufficient time and space to allow impacted materials to be treated in thin (approximately 300 mm) layers and regularly turned to allow aeration with reference to the NSW EPA Technical Note on Land farming (Ref 11). Depending on the contaminant compounds and their concentrations, the time taken to remediate the soils to levels suitable for re-use may vary from weeks to several months. Whilst this option is suitable for short-medium chain length TRH impacted materials on site, it may not be suitable for the longer chain TRH contamination.

While treatment of asbestos and PAH impacted soils are possible, the distribution of the contamination is likely to be sporadic and difficult to assess given the potential history of impact (i.e. demolition of structures across site and importation of filling (source unknown) across the site). The costs associated with additional investigation and remediation for these contaminants is also considered to be significant compared to on site management.

Based on the above the adopted remediation approach for the development is as follows:

- On site management (capping) of PAH, TRH, Lead and possible asbestos impacted soils (contingency measure).

On site management contaminated soil would generally comprise the following:

- Excavation to invert depth of proposed capping layer;
- Placement of excavated contaminated materials in proposed fill areas (i.e. where beneath invert depth for proposed capping layer) where applicable;
- Placement of geofabric marker/separation layer;
- Disposal of excess contaminated soils to an appropriately licensed landfill where applicable;
- Capping of contaminated soils with concrete (i.e. building slabs, concrete pavements).

It is noted that construction of the proposed development will essentially provide the above capping (i.e. no specific additional capping required), refer to Section 9.7 for geotechnical considerations.

On site management of contaminated soils is considered to be a feasible remediation option to protect human health and the environment, and minimise constraints on the future use of the site.

The Waste Hierarchy adopted by the NSW EPA is, in order of preference, Avoidance, Resource Recovery and Disposal. A ‘Cap and Contain’ approach would be consistent with a resource recovery initiative.

Off-site disposal of contaminated soils would generally comprise the following:

- Excavation of contaminated soils to the full depth of impact;
- Direct disposal of contaminated soils to an appropriately licensed waste disposal facility;
- Validation of the stripped surface/remaining soils to confirm appropriate removal of contaminated soils;
- Re-instatement of site soils (where required) to achieve design levels with ‘clean’ soil (ENM/VENM).

It is noted that off-site disposal is only likely to be economically feasible for localised areas of contamination.

6. Remediation Goals and Acceptance Criteria

6.1 Remediation Goals

The main objective of the remediation programme will be to place contaminated soils beneath a suitable capping layer to prevent exposure and accessibility. The capping layer will comprise a concrete slab/pavement.

Any excess materials requiring off-site disposal should be classified with reference to NSW EPA waste classification guidelines (Ref 5), and disposed to a facility which is licensed to receive such materials.

To further reduce the potential impact on the environment and human health, the following additional measures are recommended in the construction of the capping layer within the development area:

- Placement of a geofabric layer on top of the contaminated fill materials to act as a warning/marker layer and to provide separation from overlying materials. Note: Plastic sheeting could be used as an alternative marker layer (i.e. beneath concrete slabs);
- Preparation of a long term Site Management Plan (SMP). The SMP will outline the precautionary management procedures to be adopted if the permanent capping layer is breached in future. The SMP will also promote awareness of the contamination management and the requirement of avoiding disturbance to the capping where possible.

This process of remediation will substantially reduce the potential for human contact with materials that are contaminated so that the development site as presented in the milestone drawings in Appendix B can be made suitable for the ongoing high school use.

It is noted that fill materials are likely to be present across the school playing fields. The potential for contamination within filling has been identified within the site. Procedures for management of potential impacts in filling outside the proposed development area are outside the scope of this RAP. It is recommended that these areas should, however, be included in ongoing long-term site management as a precautionary measure.

6.2 Remediation Acceptance Criteria

Achievement of the objective of capping and containment of the asbestos, PAH, and TRH contamination identified within the proposed development area will be demonstrated by the successful construction of the capping layer. In the case of contained soils the remediation acceptance criteria (RAC) will not, therefore, take the form of a set of concentrations for various contaminants. Rather, the RAC will be deemed to have been attained when the capping has been successfully installed.

In addition to the above, imported fill used to reinstate site excavations, raise site levels (if required) and for use in the pavement or landscape areas should be classified as Virgin Excavated Natural Material (VENM) or Excavated Natural material (ENM) (refer to Ref 6) and should be accompanied by a certificate from the supplier, otherwise detailed assessment (including analysis of representative samples) will be required prior to use on site.

Where remediation/validation of parts of the site are considered, the Remediation Acceptance Criteria (RAC) for soils remaining on site with respect to the proposed landuse and identified contaminants are provided in Table 2 below.

It is considered that the validation analysis should focus on the identified areas of concern and the associated contamination. In order to provide for contingency situations, however, RAC are also established for other contaminants (i.e. heavy metals, hydrocarbons etc.). This should, however, only be used as and when required (i.e. if signs of such contaminants are observed, suspected or found).

The adopted criteria are as follows:

- NEPM 2013 (Ref 3) - Health Investigation Levels (HIL) and Health Screening Levels (HSL) for standard residential landuse with access to soils (HIL A/HSL A);
- NEPM 2013 (Ref 3) - Management Limits for Residential, Parkland and Public Open Space Landuse – Coarse Soil Texture for TRH impact;
- NEPM 2013 (Ref 3) – Ecological Investigation Levels (EIL) and Ecological Screening Levels (ESL) for urban residential and public open space;
- CRC Care 2011 (Ref 4) – Petroleum based HSL for direct contact for standard residential landuse with access to soils (HSL A).

For the purposes of providing a single RAC for each analyte the lowest of the above criteria (i.e. most conservative) has been adopted as the RAC as shown in Table 2 below. It is noted that the use of recreational landuse is consistent with the zoning and proposed landuse at the site.

Table 2: Site RAC (mg/kg)

Contaminant	NEPM HIL C [b] / HSL C [c]	CRC Care Direct Contact - HSL C[a]	NEPM Management Limits – Residential / open space Landuse / Coarse Soil [d]	NEPM EIL / ESL [g] Urban Residential / open space	Adopted RAC (mg/kg)
Asbestos[e]	0.001% for FA and AF; 0.01% w/w for ACM; and no visible asbestos for surface soils	NC	NC	NC	Nil (imported fill and excavation validation) OR 0.01% w/w for ACM and no visible asbestos for surface soils for existing filling
Arsenic	300	NC	NC	100	100
Cadmium	90	NC	NC	NC	90
Chromium	300	NC	NC	410 (Cr III)	300 (Cr VI)
Copper	17000	NC	NC	110	110
Lead	600	NC	NC	1100	600
Mercury	80	NC	NC	NC	80
Nickel	1200	NC	NC	220	220
Zinc	30000	NC	NC	310	310
TRH (C_6-C_{10})-BTEX (F1)	NC	5100	700	180	180
TRH (>C_{10}-C_{16})-Naphthalene (F2)	NC	3800	1000	120	120
TRH (>C_{16}-C_{34})	NC	5300	2500	300	300
TRH (>C_{34}-C_{40})	NC	7400	10,000	2800	2800
Benzene	NC	120	NC	50	50
Toluene	NC	18000	NC	85	85
Ethylbenzene	NC	5300	NC	70	70

Table 2: Site RAC (mg/kg) (cont.)

Contaminant	NEPM HIL C [b] / HSL C [c]	CRC Care Direct Contact - HSL C[a]	NEPM Management Limits – Residential / open space Landuse / Coarse Soil [d]	NEPM EIL / ESL [g] Urban Residential / open space	Adopted RAC (mg/kg)
Xylene	NC	15000	NC	105	105
Total PAH	300	NC	NC	NC	300
Benzo(a)pyrene	NC	NC	NC	0.7	0.7
Benzo(a)pyrene TEQ	3	NC	NC	NC	3
Naphthalene	NC	1900	NC	170	1900
PCBs	1	NC	NC	NC	1

Notes for Table 2:

a CRC Care (2011) – Petroleum based HSL for direct contact – Table B4 (Ref 3)

b NEPC (2013) Health-based investigation levels (HIL) – Table 1A(1) Ref 3

c NEPC (2013) Health-based screening levels for vapour intrusion - standard residential landuse (Sand 0 to <1 m) – Table 1A(3) Ref 3

d NEPC (2013) Management Limits for TPH – Table 1 B(7) Ref 3

e WA DOH (2009) – Trigger levels for residential landuse with minimal access to soils (Ref 12)

f Adoption of a lower RAC should be considered when the material will be below the water table or potentially in contact with surface water due to the leachable characteristics of Naphthalene.

G EIL/ESL apply to the top 2 m of the soil profile. Some EILs are based on conservative soil parameters, which may be increased subject to the results of additional analysis of CEC (Section 9.2).

NC No Criteria

NL Non Limiting

It is noted that with the exception of localised, TRH, PAH and asbestos contamination identified within the development area (Refer to Section 3), the soil investigation results provided in Tables 5 to 8 (Ref 2) in Appendix A meet the adopted RAC.

NEPC (2013) provides the following definitions for forms of asbestos:

- Bonded **asbestos containing material (ACM)** comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin (e.g. asbestos fencing and vinyl tiles). This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
- **Fibrous asbestos (FA)** comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).

- **Asbestos fines (AF)** include free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. Bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substantial degree of damage which increases the potential for fibre release.

From a risk to human health perspective, FA and AF are considered to be equivalent to 'friable' asbestos.

NEPC (2013) stipulates that the threshold for asbestos soil contamination under a standard residential with access to soil land use scenario is:

- 0.001% asbestos for FA and AF;
- 0.01% w/w asbestos for ACM;
- No visible asbestos for surface soils.

6.3 Long Term Management

A long term SMP will be required for the site. The SMP should be prepared at the completion of remediation works. The SMP will promote awareness of the contamination management and the requirements to avoid disturbance (where possible), and provide an outline and maintenance requirements.

The SMP will recommend routine inspections of the capping layer to monitor for erosion, cracking, settlement or movements of the capping slab/pavements and landscape areas. Maintenance would be required if the site inspection indicates that the capping layer is not operating effectively (i.e. if significant cracking is present within concrete slabs or if the pavement areas are eroding or cracking.

The SMP will need to be noted on the Section 149 planning certificate to ensure future landholders (if any) or future developments on the site are aware of the management requirements for the development area.

7. Responsibilities

In order to achieve the goals of the remediation/earthworks programme, the following roles and responsibilities have been identified for the contractor and consultants:

Contractor

The contractor is responsible for on-site operations including:

- Handling of fill materials (contaminated or otherwise) including excavations, stockpiles, segregation, placement, compaction, disposal of excess fill materials;
- Safety of all personnel on site;
- Measures to minimise environmental effects;

- Preparation of a site specific construction environmental management plan (CEMP) and WHS plan. The CEMP will require review and comment by DP and the regulator (NSW Department of Planning and Environment - DPE) to confirm consistency with the objectives of the RAP prior to commencement of remediation;
- Ensure required licenses and approvals from regulatory authorities are obtained prior to remediation works commencing. It is noted that an appropriately licenced contractor will be required to conduct earthworks within the site due to the possible presence of ACM in filling. The contractor will need to hold the appropriate asbestos licence, and SafeWork NSW notification and approval is required prior to commencement of remediation works.

Occupational Hygienist (OH)

- Advice on management of asbestos contamination (if required);
- Set-up and maintenance, analysis and reporting of air monitoring for airborne asbestos fibres during construction works resulting in the disturbance of fill materials (i.e. any excavations, stockpiling, placement or transport of fill materials.

Environmental Consultant

A suitably qualified consultant should be used to carry out general site validation works comprising the following:

- Periodic inspections during remediation and validation works;
- Sampling and classification of on-site and imported fill materials (where required);
- Provision of a remediation and validation report;
- Provision of a long term SMP.

Client

- Overall project management;
- Engaging suitably qualified remediation contractor, and Environmental Consultant to conduct the remediation works;
- Ensure necessary approvals and notifications have been obtained prior to remedial works commencing;
- Liaison with the regulator (DPE), environmental consultant, remediation contractor during remediation process;
- Submission of validation reports to DPE.

Prior to the commencement of remedial works, a site meeting between the client, contractor and environmental consultant is recommended to confirm responsibilities and procedures in accordance with the agreed management plan.

8. Regulatory Approvals and Licences

State Environmental Planning Policy No. 55 - Remediation of Land (Ref 7 SEPP 55) aims to provide a state-wide planning approach to the remediation of contaminated land. Under clause 7(1) of SEPP 55 the approval authority is required to consider whether the land is contaminated, and:

a) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out; and

b) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

This RAP presents the proposed management and remediation options to address contamination on the site, being the development area as defined in the milestone drawings in Appendix B. Implementation of the RAP will render the site suitable for the proposed development.

In accordance with Clause 9 of SEPP 55 the definition of Category 1 remediation works which require development consent are as follows:

a) designated development, or

b) carried out or to be carried out on land declared to be a critical habitat, or

c) likely to have a significant effect on a critical habitat or a threatened species, population or ecological community, or

d) development for which another State environmental planning policy or a regional environmental plan requires development consent, or

e) carried out or to be carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:

   i) coastal protection,

   ii) conservation or heritage conservation,

   iii) habitat area, habitat protection area, habitat or wildlife corridor,

   iv) environment protection,

   v) escarpment, escarpment protection or escarpment preservation,

   vi) floodway,

   vii) littoral rainforest,

   viii) nature reserve,

   ix) scenic area or scenic protection,

   x) wetland, or

f) carried out or to be 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).

Based on the above the site remediation works are considered to be Category 2 under SEPP55, i.e. remediation work that does not need development consent under SEPP 55, however, this would need to be confirmed by the consent authority (DPE).

It is noted that the proposed high school development, which is integral to the remediation of the site (i.e. building) will require development consent from DPE. Development consent will therefore be required to facilitate remediation of the site.

Based on review of Appendix VI of the Guidelines for the NSW Site Auditor Scheme (Ref 4), the following consent, notification or licence requirements are anticipated:

- Any conditions outlined in the Development Application(DA);
- WorkCover NSW asbestos removal work licence under the Work Health and Safety Regulation 2011 (WHS Regulation) and appropriate notification prior to commencement.

The DA consent for the proposed development should be structured so that each milestone area can be remediated and validated separately. Interim validation reporting should be considered at the completion of each milestone area, with a standard long-term site management plan adopted for each milestone. Notification of the validation, on-site management and long term SMP on the Section 149 planning certificate could be conducted at the completion of works for the site.

9. Remediation Methodology

9.1 Sequence of Remediation

The client has supplied ‘Milestone Key Diagrams’ (Appendix B) which identify the proposed construction sequence and staging for construction. The sequence for construction has two stages comprising ten milestones and is outlined in Table 3 below. Table 3 also summarises activities within each milestone and identifies activities which are known to require remediation action based on the excavation / disturbance of contaminated soils in the development area (i.e. Block T).

It is recommended that the presence and extent of identified impacts within the proposed development area (Block T) are further assessed following demolition of site structures which currently cover a significant portion of the development area (Proposed Development Plan and Milestone Key Diagrams, Appendix B).

Contingency procedures are required should additional potentially contaminated soils be identified during all site development and are outlined in Section 9.8 (unexpected finds).

Table 3: Proposed Development Summary - Stages and Milestones

Stage	Milestone	Activities
1	**1** Construction of Block S (Movement Complex)	o Fencing of around designated construction area – builders compound; o Placement of builders site shed / materials compound; o Decommission old services; o Demolish existing features i.e. landscaping / trees, car park including kerb / gutters etc; o Construction of new service road; o Installation of services (stormwater, power, communications) including cuts for new pits; o Construction of new building (single-storey), pavements, fencing, landscaping etc.
	2 Preparing for Block T Development	o Decant buildings within proposed Block T footprint (part Block A, B, Block L and a covered outdoor learning area) and move items to recently completed Block S.
	3 Preparing for Block T Construction	o Establish builders compound; o Decommission old services; o Demolish existing site features i.e. landscaping / trees, part Block A and B, Block L, pavements etc.
	4 Construction of Block T	o Construction of new buildings (three two-storey buildings and one three-storey building), pavements, landscaping etc. o Installation of new services (stormwater, power, communications); o Establish temporary extension of builders compound to the north east of Block T; o Demolition of some exisiting site features in the temporary builders compound i.e. landscaping / trees, pavements etc; o Installation of new services in the temporary builders compound.
	5 Preparing for Block U Development	o Decant buildings within proposed Block U footprint (part Block A and E and Block B, Block C and Block F) and move items to recently completed Block T.
	6 Preparing for Block U Construction	o Establish builders compound; o Decommission old services; o Demolish existing site features i.e. landscaping / trees, part Block A and E and Block B, Block C, Block F, pavements etc.
2	**7** Construction of Block U	o Construction of new building (single-storey building), pavements, landscaping etc. o Installation of new services (stormwater, power, communications).
	8 Preparing for Northern Development (Open Space and Tennis Court)	o Decant buildings Block D, E and J and move items to recently completed Block U.
	9 Preparing for northern development construction (Open Space and Tennis Court):	o Establish builders compound; o Decommission old services; o Demolish existing site features i.e. Block D, E, H and J, pavements etc.
	10 Construction of the New Tennis Court	o Establish builders compound; o Construct new tennis court.

Notes to Table 3:

Remediation action required

The following remediation methodology is recommended to achieve the remediation goals:

1. Client/Contractor obtains all necessary approvals and notifications to allow commencement of the works, including DPE approvals, and Work Cover NSW permit for asbestos related works (i.e. excavation, handling, placement and capping of soils containing possible ACM). The contractor should hold the relevant licenses/approvals as a precaution for any asbestos related works;
2. Inception meeting between the client, contractor, OH and environmental consultant to confirm responsibilities and procedures for remediation and construction;
3. Additional investigation of PAH / TRH impacted soils identified (Ref 2) within the proposed building footprint of development area Block T to delineate the extent and determine volume of material to be placed under the capping layer if suitable, see Section 9.2;

4. Co-ordinate excavations for service trenches (i.e. drainage / stormwater) in the north-eastern potion of development area Block T so that excess trench spoil (contaminated soils) can be utilised beneath capping if suitable. Contaminated trench spoil should not be re-used within service trenches;
5. Prior to capping, the site surface should be surveyed by a registered surveyor to confirm that appropriate levels have been achieved (i.e. to allow design finished levels for concrete slabs and pavements. Construction of building pad and pavements should only commence once appropriate levels have been achieved;
6. Following survey confirmation of site levels, place a geofabric marker/separation layer (Bidim A34 or similar) over the placed materials across the site. Plastic sheeting could be utilised immediately beneath concrete floor slabs or concrete pavements in lieu of the geofabric;
7. Excess soils excavated from within the site that cannot be accommodated beneath capping will require the following:
    - Temporary stockpiling;
    - Sampling and analysis to confirm waste classification in accordance with EPA guidelines (Ref 5) for off-site disposal to a licenced landfill;
    - Appropriate off-site disposal by a licenced contractor (refer to Section 10.2).
8. At the completion of capping, a validation inspection should be conducted by a suitably qualified environmental consultant to confirm that appropriate capping has been achieved in accordance with the RAP;
9. Upon the completion of capping, a suitably qualified environmental consultant should prepare a Remediation and Validation report that will be finalised following the completion of construction. A long term SMP would be required at the completion of construction for DPE review and approval, and in order for Lake Macquarie City Council to update the S149 certificate for the site. The SMP will be limited to the development area (i.e. building and associated pavements). A separate SMP may be prepared for the greater school grounds, including landscape areas to manage soils across the greater school site.

It is recommended that contaminated soils be placed beneath capping of one designated building footprint (e.g. Block T) to minimise notifications on the S149 certificate.

Due regard should be given to the geotechnical requirements for site development so that site works are compatible with remediation requirements. Staged construction should be conducted, including work outside school hours (where practical) in order to minimise potential exposure/risks to site users (refer to Section 13).

It is noted that the above procedure is not prescriptive and the contractor should confirm the construction process that will achieve the objectives of remediation in a practical and economical manner, with due regard to WHS. This procedure should be presented in the CEMP for the work.

Should remediation and validation of contamination outside the development area be required during works, consideration should be given to management of the identified additional contamination beneath pavements/buildings and/or filling within the milestone areas as part of the proposed works.

9.2 Additional Investigations

Previous investigations within the southern portion of the site and north-eastern portion of the site identified lead (south) and PAH / TRH (north-east, Block T development area) impact in filling. Additional investigation is recommended to delineate the extent of impacted soils and confirm the suitability for on-site management of contaminated soils and aid the assessment and likely volumes.

A supplementary investigation with reference to NEPM 2013 (Ref 3) would need to be conducted by a qualified environmental consultant to assess contaminant concentrations and leachability characteristics of filling within these areas and confirm the suitability of capping for remediation in this portion of the site.

The scope of work for the additional investigation should comprise the following:

- Drilling / Excavation of bores / pits across targeted areas of the site to approximately 0.5 m below the full depth of filling (up to ~1.0 m to 1.5 m). Consideration should be given to underground services;
- Collection of soil samples from each stratum or minimum 0.5 m depth for identification and laboratory testing purposes;
- Selected samples (representative fill materials or fill materials not previously encountered) to be submitted for laboratory analysis;
- Analysis of samples for total concentrations of potential contaminants (namely TRH, BTEX, PAH, OCP, OPP, PCB, Heavy Metals, Asbestos);
- Analysis of samples with elevated total contaminant concentration for water leachable concentrations (i.e. ASLP);
- Interpretation of the results and confirmation of the suitability of capping as the remediation approach.

9.3 Disposal of Contaminated Materials

Any excess contaminated materials within the development area which cannot be accommodated beneath capping must be disposed of to an appropriately licensed landfill.

Previous investigations indicated that fill materials are likely to be classified as ‘General Solid Waste’ assuming favourable TCLP testing and use of suitable immobilisation approvals.

Materials requiring off-site disposal must be classified in accordance with the *NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (November 2014 – Ref 5).* The criteria for disposal in accordance with Reference 5 are presented in Table 4 and Table 5 below. In addition, asbestos contaminated soil/fill from the development area that cannot be accommodated under capping will require disposal to a licensed landfill as ‘special waste’ in accordance with Reference 5.

Table 4: – Landfill Disposal Criteria – Total Concentrations

CONTAMINANT THRESHOLD VALUES FOR CLASSIFYING WASTE BY CHEMICAL ASSESSMENT WITHOUT DOING THE LEACHING TEST (1)		
Contaminant	**Maximum Values of Total Concentration for Classification without TCLP**	
	General Solid Waste CT1 (mg/kg)	**Restricted Solid Waste CT2 (mg/kg)**
Benzene	10	40
Toluene	288	1152
Ethyl Benzene	600	2400
Xylenes (total)	1000	4000
C_6-C_9 petroleum hydrocarbons	650	2600
C_{10}-C_{36} petroleum hydrocarbons	10000	40000
Lead	100	400
Arsenic	100	400
Cadmium	20	80
Chromium (total)	100	400
Mercury	4	16
Nickel	40	160
Polycyclic Aromatic Hydrocarbons (total)	200	800
Benzo(a)pyrene	0.8	3.2

Notes to Table 4:
Adopted from Table 1 – Ref 5

Table 5: Landfill Disposal Criteria – Leachable and Total Concentrations

LEACHABLE CONCENTRATION (TCLP) AND TOTAL CONCENTRATION (SCC) FOR CLASSIFYING WASTE BY CHEMICAL ASSESSMENT (1)				
Contaminant	Maximum Values for Leachable Concentration and Total Concentration when used together			
	General Solid Waste		Restricted Solid Waste	
	Leachable Concentration TCLP1 (mg/L)	Total Concentration SCC1 (mg/kg)	Leachable Concentration TCLP2 (mg/L)	Total Concentration SCC2 (mg/kg)
Benzene	0.5	18	2	72
Toluene	14.4	518	57.6	2073
Ethyl Benzene	30	1080	120	4320
Xylenes (total)	50	1800	200	7200
C_6-C_9 petroleum hydrocarbons(2)	N/A(2)	650	N/A(2)	2600
C_{10}-C_{36} petroleum hydrocarbons(2)	N/A(2)	10000	N/A(2)	40000
Lead	5	1500	20	6000
Arsenic	5	500	20	2000
Cadmium	1	100	4	400
Chromium (total)	5	1900	20	7600
Mercury	0.2	50	0.8	200
Nickel	2	1050	8	4200
Polycyclic Aromatic Hydrocarbons (total)	N/A	200	N/A	800
Benzo(a)pyrene	0.04	10	0.16	23

Notes to Table 5:

(1) Adopted from Table 2 – Ref 5

(2) Petroleum hydrocarbons are assessed only by total concentration (SCC1 or SCC2)

N/A – Not applicable

Classification of materials for off-site disposal will include inspection, sampling and analysis at generally not less than one per 25 m^3. The frequency of testing required for classification should be confirmed by a suitably qualified environmental consultant, and will depend on the volume and consistency of the material.

Appropriate tracking of the excess soils should be conducted by the licenced contractor (refer to Section 10.4).

9.4 Stockpiling of Contaminated Materials

Where required, contaminated material shall be temporarily stockpiled at a suitable location(s) within the site.

All stockpiles of contaminated material shall be appropriately fenced and demarcated to clearly delineate their boundaries. Stockpiles shall be lightly conditioned by water sprinkler and covered by geotextile or similar cover to prevent dust blow. Geotextile silt fences or hay bales should be erected around each stockpile to prevent losses by surface erosion where required or sediment run-off. The location and quantity of stockpiled contaminated soils should be recorded by the contactor.

If temporary stockpiling is required outside 'the site' area or within the site following capping, stockpiles should be placed over plastic to minimise cross-contamination with underlying soils. The footprint of such stockpiles should also be validated via inspection and testing following removal as discussed in Section 10.

9.5 Loading and Transport of Contaminated Materials

The following procedure is recommended for the loading and transport of contaminated materials from the site (if required):

- Transport of contaminated material off the site should be via a clearly demarcated haul route;
- Removal of waste materials from the site should only be carried out by an experienced contractor holding appropriate licences, consents and approvals;
- Details of all contaminated materials removed from the site should be documented by the contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate). Such information should be provided to the environmental consultant responsible for site validation for reporting purposes;
- Measures should be implemented to minimise the potential for contaminated material to be spilled onto public roadways or tracked off-site on vehicle wheels.

9.6 Imported Fill

Imported fill used to reinstate site excavations within the development footprint should be classified as Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) and should be accompanied by a certificate from the supplier, otherwise detailed assessment (including analysis of representative samples) will be required prior to use on site. Soil proposed for importation should be confirmed to be VENM / ENM prior to delivery to the site.

9.7 Geotechnical Considerations

The site stripping, excavation and the placement and compaction of fill materials should be carried out with due consideration of geotechnical requirements for development. Deleterious inclusions such as organics, timber, metal, concrete (>200 mm) should be segregated from filling that may be used as engineered fill (i.e. for support of buildings or pavements).

Fill materials that will support structural loads, pavement or form structural backfill, should be placed and compacted to a suitable geotechnical specification that takes account of the intended purpose of the fill.

The geotechnical specification for earthworks should be prepared as part of the final design.

9.8 Contingency Plan

If contaminated soil quantities are such that they cannot be accommodated beneath the buildings, the excess materials will require stockpiling, classification, treatment (if required) and off-site disposal to a licensed landfill (to be considered if no other option).

If gross soil contamination is identified on site during remediation works, the materials should be appropriately investigated by a suitably qualified environmental consultant and either managed on site (if appropriate) or disposed off-site to a licenced landfill following classification.

The CEMP should provide further details regarding contingency procedures, including incident management and unexpected finds protocol.

9.9 Unexpected Finds

9.9.1 Potentially Contaminated Soils

The results of previous assessments at the site indicate the presence of PAH, TRH, lead and possible asbestos contamination within filling at the site. Due to the historical use of the site, history of demolition and the presence of uncontrolled filling at the site, there is potential for additional contamination within site soils. Contingency procedures are required should additional potentially contaminated soils be identified during site development.

The following general procedures are suggested for the assessment and management of potentially impacted filling/soils during remediation/earthworks. Based on the results of previous assessment, soils/filling may be potentially impacted by PAH, TRH, heavy metals (Lead) and asbestos:

- Excavation, handling loading and transport of contaminated materials should be undertaken by a licensed contractor in accordance with the appropriate regulatory approvals and legislative requirements;
- The progress of site excavations during construction should be inspected by the contractor during earthworks, and periodically by the contaminated lands consultant (i.e. DP). Potential soil contamination may include stained soils, odorous soils, soils containing fibro fragments, soils containing building rubble (i.e. bricks, tiles, concrete, timber etc.) and slag/ash products;

- If potentially contaminated soils are encountered (i.e. visual or olfactory indication of contamination), excavation of filling should cease, and the extent of the affected filling should be assessed by DP;
- The affected soils may need to be segregated based on visual/olfactory observations, and stockpiled for further assessment, alternatively, the soils may be suitable to remain on site beneath the cap;
- If the assessment of impacted materials indicates that the materials are not suitable to remain on site, the materials should be classified for disposal to an appropriately licensed landfill with reference to the NSW EPA waste classification guidelines (Ref 5);
- The affected area should be stripped and validated by DP;
- Excavation in the affected area cannot recommence until the validation testing indicates the absence of gross impact and no visual or olfactory indicators of contamination);
- Licensed contractor to load classified materials directly into appropriate trucks for transport and disposal to a licensed facility (Note: waste classification is required prior to off-site disposal).

9.9.2 Migration along Preferential Pathways

In the event that contamination is found to be migrating along preferential pathways (e.g. observed staining/odours within service trenches and conduits), the following contingency procedure will be adopted:

- Remedial excavations will be continued in the direction of migration to the practical extent possible (without causing damage to infrastructure) as directed by the structural engineer (it is anticipated that the extent to which impacted materials can be chased-out along service conduits would be limited due to structural elements and services) and site boundaries;
- If impacted materials are present at the practical limits of the remedial excavation, validation samples will be collected and analysed per the requirements of Section 10.1 to determine the degree of residual contamination present;
- If concentrations of residual contaminants at the practical extent of the remedial excavation exceed the landuse criteria then the following additional contingencies may be adopted:
    - Site specific risk assessment will be undertaken to determine the actual level of risk to human health;
    - Groundwater monitoring wells/soil bores will be considered (if feasible) hydraulically down gradient of the observed impacted material/preferential pathway to attempt to define extent and degree of preferential migration; and
    - Based on the results of the above, additional management controls and/or groundwater remediation measures may be required.

10. Validation Plan

10.1 Sample Collection, Handling and Analysis

10.1.1 Sample Collection and Handling

Sampling is anticipated to comprise validation of imported materials (where required) to be used during construction, validation of stockpile removal, or for assessment and waste classification of excess excavated soils for off-site disposal to a licenced landfill. Sampling data shall be recorded to comply with routine Chain of Custody requirements.

The general sampling, handling, transport and tracking procedures comprises:

- The use of stainless steel sampling equipment;
- The use of disposable gloves for each sampling event;
- Washing of all sampling equipment in contact with the sample, in a 3% solution of phosphate free detergent (Decon 90) then rinsing with distilled water prior to each sample being collected;
- Transfer of the sample immediately into new glass jars;
- Collection of 10% replicate samples for QA/QC purposes;
- Labelling of the sample containers with individual and unique identification including Project Number and Sample Number;
- Placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and
- Use of chain of custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

Any materials which are imported to the site (e.g. to backfill excavations) should be classified as Virgin Excavated Natural Materials (VENM) or Excavated Natural Material (ENM) and an appropriate report must be made available to the environmental consultant responsible for site validation prior to the importation of the material.

In the absence of confirming the source and suitability of imported fill for use on site, the VENM or ENM material should be assessed with reference to the Excavated Natural Material Order 2014 (Ref 6).

10.1.2 Sample Holding Times

Maximum sample holding times are as follows:

- Metals – six months;
- TRH/BTEX – 14 days;
- PAH – 14 days, and 40 days following extraction.

All samples must be collected in appropriate cooled and sealed containers.

10.1.3 Validation Sample Analysis

If sampling is required for validation purposes, the samples will be analysed for the following parameters as a minimum:

- Waste classification of potentially impacted soils for off-site disposal purposes or validation of stockpile removal:
  - Total Recoverable Hydrocarbons (TRH);
  - Benzene, Toluene, Ethylbenzene and Xylene (BTEX);
  - Polycyclic Aromatic Hydrocarbons (PAHs);
  - Polychlorinated Biphenyls (PCB);
  - Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
  - Asbestos.
- Imported fill materials (ENM Suite):
  - TRH;
  - BTEX;
  - PAH;
  - Heavy Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
  - pH;
  - Electrical Conductivity;
  - Foreign material content (as per Ref 6).

The suite of analytes for the assessment of imported fill materials should be confirmed by the environmental consultant responsible for site validation, and should consider the source of materials, and contaminants which may be present (i.e. potential contaminants of concern).

If additional contamination is identified during construction, validation testing should be modified to suit the potential contaminants of concern.

10.2 Quality Assurance Plan

Field QA

Quality Assurance (QA) and Quality Control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy and prevent cross contamination.

The environmental consultant responsible for site validation should assess sampling accuracy and precision through the analysis of at least 5% field duplicate/replicate (blind) samples, 5% triplicate (split) samples, as well as the collection of field rinsate samples of sampling equipment at a rate of one per day of sampling operations.

Appropriate sampling procedures will be undertaken to minimise the potential for cross contamination, and will include the following:

- Standard operating procedures are followed;
- Site safety plans are developed prior to commencement of works;
- Replicate field samples are collected and analysed;
- Equipment rinsate samples are analysed as part of the QA/QC programme;
- Samples are stored under secure, temperature controlled conditions;
- Chain of custody documentation is employed for the handling, transport and delivery of samples to the selected laboratory.

Laboratory QA and QC

The NATA accredited laboratory will undertake in-house QA/QC procedures involving the routine testing of:

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis.

10.3 Achievement of Data Quality Indicators

Based on the analysis of quality control samples i.e. blind and split duplicates, equipment rinsates and in-house laboratory QA/QC procedures, the following data quality indicators will be required to be achieved:-

- Completion of field and laboratory chain of custody documentation;
- Use of experienced field staff;
- Collection of appropriate validation samples and analysis of appropriate analytes;
- Conformance with specified holding times;
- Accuracy of spiked samples within the laboratory's acceptable range (typically 70% to 130% for inorganic contaminants and greater for some organic contaminants);
- Field and laboratory duplicates samples will have a precision average of +/- 50% RPD (Relative Percent Difference);
- Field blind and split duplicates will be collected at a frequency of at least 5% of all samples, and rinsate samples of field equipment will be collected at one per day of sampling;
- Rinsate samples will show that the sampling equipment is free of introduced contaminants, i.e. the analytes show that the rinsate is within the normal range for deionised water.

Based on a fulfilment of the data quality indicators an assessment of the overall data quality will be presented in the final validation report.

10.4 Validation, Inspection and Reporting

A validation report should be prepared by a suitably qualified environmental consultant with respect to NSW EPA (2011) Contaminated Sites, "Guidelines for Consultants Reporting on Contaminated Sites" (Ref 8) and NEPM (2013) (Ref 3). An important part of site validation will be the inspection to confirm that appropriate capping has been achieved in accordance with the RAP. The report shall be submitted to DPE at the completion of the remediation works program. The validation report shall confirm that the development area has been remediated to a suitable standard for the proposed high school development.

Upon the completion of remediation and validation works and construction, a SMP would need to be completed for long-term management of capped materials within the development area (i.e. building slab, pavements etc.) (i.e. measures to reduce the likelihood of future disturbance, and procedures for handling/disposal in the event that identify contaminated materials are disturbed).

The SMP will promote awareness of the contamination management and the requirement of avoiding disturbance to the capping within the development area. The SMP will require review and approval by DPE. DPE should also ensure that the appropriate notification is placed on the Section 149 certificate for the development area.

It is understood that a separate SMP may be prepared for the greater school site including landscape areas (i.e. outside the current development area) which does not form part of this RAP.

Unless a statutory audit is required as part of the approval process, or DPE request that the investigation, RAP and validation works are conducted under audit conditions, there is no requirement for engagement of a NSW EPA Accredited Auditor for the project.

11. Environmental Management Plan (During Construction)

11.1 Introduction

The contractor should undertake the work with due regard to the minimisation of environmental effects and to meet all statutory and regulatory requirements.

The contractor shall prepare a project specific Construction Environmental Management Plan (CEMP) to supplement measures presented in the RAP and that also complies with, but not limited to, the requirements of the following legislation:

- Protection of the Environment Operations Act;
- Contaminated Land Management Act;
- Dangerous Goods Act;
- Construction Safety Act;
- Work Health and Safety Act (WorkCover); and
- Council Development Approval Conditions.

The contractor shall also be responsible that the site works comply with the following conditions:

- Wastes generated at the site are disposed in an appropriate manner;
- Fugitive dust leaving the confines of the site is minimised. As a precaution, air monitoring will be conducted at the boundaries of the site to monitor the presence of airborne asbestos fibres;
- No water containing any suspended matter or contaminants leaves the site in a manner which could pollute the environment;
- Vehicles shall be cleaned and secured so that no mud, soil or water are deposited on any public roadways or adjacent areas;
- Noise and vibration levels at the site boundaries comply with the legislative requirements.

Asbestos materials have been associated with various human respiratory diseases. The risk of contracting these diseases from contact with asbestos depends entirely on the fibres becoming airborne. It is important during disturbance of potential asbestos impacted soils that the potential for generating airborne asbestos fibres should be minimised. Moreover, levels of airborne asbestos fibres immediately outside the works area should be maintained to within the acceptable background level (i.e. <0.01 fibre/mL). As asbestos material identified on the site was generally in the form of fragments or bundles of fibre cement sheet, there is a low risk of asbestos fibres becoming airborne. Appropriate air monitoring should be conducted by the OH during remediation. Management measures regarding air monitoring should be included in the contractors CEMP (i.e. additional management measures, stop work etc.).

In order to achieve a minimisation of environmental effects, the following measures are recommended, and should be adopted by the appointed contractor.

The contractor's CEMP is to include:

- Contingency plans to respond to site incidents;
- Hours of operation;
- Site management plan for the operation phase of remedial works;
- A remedial schedule and hours of operation (which will be subject to development consent conditions);
- Details of relevant contacts;
- Any requirements outlined by the DPE for the management of contaminated or potentially contaminated land;
- Procedure(s) for dealing with deleterious materials that may affect containment of materials and/or use as fill (as per section 10.6), including waste management/recycling where relevant;
- Incident management/emergency response procedures;
- Any community consultation requirements.

11.2 Traffic Management

All vehicular traffic shall use only routes approved by Council, to and from the selected landfill where off-site disposal is undertaken. All loads shall be tarpaulin covered and lightly wetted to minimise the potential for materials or dust are dropped or deposited outside or within the site. The proposed landfill should be consulted for any additional requirements.

Each vehicle that has trafficked potentially impacted site soils within the site shall be inspected for cleanliness before being logged out as clean (wheels and chassis), or hosed down into a wheel wash or wash down bay (located at the site exit) until designated as clean when exiting the site.

Wheel wash silt residues should be collected periodically and either returned to the excavation area or included in the remediation stockpile. Such material will be treated as contaminated unless analysis proves otherwise.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent or approvals to dispose the waste materials according to the classification outlined in Reference 5.

Waste tracking should be conducted by the licensed contractor in accordance with regulatory requirements. Details of all materials removed from the site shall be documented by a contractor with copies of weighbridge slips, trip tickets and consignment disposal confirmation (where appropriate) provided to the environmental consultant responsible for site validation. A site log shall be maintained by the contractor to track disposed loads against on-site origin and location of the materials.

Truck dispatch shall be logged and recorded by the contractor for each load leaving the site. A record of the truck dispatch should be provided to the environmental consultant responsible for site validation by the contractor.

Similarly tracking and documentation of all on site movements of material should be maintained by the contractor.

11.3 Excavations

Records of all excavations and stockpile locations should be maintained. A site diary should also be maintained by the contractor to record daily progress, abnormal occurrences, incidents, and truck movements.

Excavations proposed within the proposed building footprint of ‘Block T’ and ‘Block U’ are shown in the client supplied excavation plan in Appendix B. Based on information supplied by the client, the cut excavation within ‘Block T’ (southern shaded area as shown on the attached excavation plan) will be approximately 600 m^2 in area, approximately 2.2 m depth below ground level and will generate approximately 1,300 m^3 of material. The cut excavation within ‘Block U’ T’ (northern shaded area as shown on the attached excavation plan) will be approximately 135 m^2 in area, approximately 2.2 m depth below ground level and will generate approximately 300 m^3 of spoil.

Contaminated material should be stockpiled at suitable locations within the site. All temporary stockpiles of contaminated material shall be secured and demarcated to clearly delineate their boundaries. Stockpile locations would require validation following stockpile removal.

All excavations shall be made with due regard to the stability of adjacent footings and structures. It will be the contractor's responsibility to provide adequate battering, shoring and/or underpinning to protect adjacent structures (if required).

No person shall be permitted to enter an unsupported excavation where it is more than 1.5 m deep or where it is considered to be unstable, irrespective of depth.

Records of all imported filling and placement should also be maintained by the contractor.

11.4 Stormwater Management and Control

Appropriate measures shall be taken to minimise the potential for potentially contaminated water or sediments to leave the site. Such measures could include:

- Construction of diversion bunds to divert stormwater from contaminated areas and contaminated soil stockpiles;
- Provision of sediment traps including geotextiles or hay bales. This would be required for contaminated soil stockpiles to prevent losses by surface erosion; and
- Construction of sediment control basins (if required).

Discharge of any waters should meet the consent conditions from the appropriate authority. This should be verified by sampling and analyses undertaken by the contractor. For example, if excavations fill with water during validation works (i.e. due to rainfall), the water will require analysis to determine appropriate options for discharge (i.e. disposal to stormwater, sewer or collection by a licensed contractor). Should construction of a sediment pond be required during construction, the pond should be assessed for contamination and validated following decommissioning.

11.5 Control of Dust and Odour

Control of dust and odour during the course of the remediation works shall be maintained by the contractor and may include, but not necessarily be limited to, the following:

- The use of a water cart, as and when appropriate, to eliminate wind-blown dust;
- Use of sprays/sprinklers to prevent dust blow from stockpiles;
- Covering of stockpiles with plastic sheeting or geotextile membranes;
- Restriction of stockpile heights to 2 m above surrounding site level;
- Ceasing works during periods of inclement weather such as high winds or heavy rain;
- Regular checking of the fugitive dust and odour issues. Undertake immediate remediation measures to rectify any cases of excessive dust or odour;
- Provision of temporary capping over site soils such as the contractor staging area.

11.6 Noise Control

Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site should not breach statutory noise levels. Working hours will be restricted to those specified by Council.

12. Work Health and Safety

All site work must be undertaken in a controlled and safe manner with due regard to potential hazards, training and safe work practices. The practices outlined should generally comply with the WHS policies specified by the relevant Authorities.

The contractor shall prepare project specific WHS plans to supplement measures presented in the RAP. The following presents an outline of some basic requirements.

All personnel on site should be required to wear the following protection as a minimum:

- Steel-capped boots;
- Safety glasses or safety goggles with side shields meeting AS1337-1992 requirements (as necessary);
- Hard hat meeting AS1801-1981 requirements;
- Hearing protection meeting AS1270-1988 requirements when working around machinery or plant equipment if noise levels exceed exposure standards.

In the event that personnel are required to work in areas of potential contact with asbestos containing materials, the following protection will be required in accordance with the Worksafe Australia: Asbestos – Code of Practice and Guidelines Notes:

- Disposable coveralls to prevent contact with asbestos materials if large volumes of asbestos material are present;
- Breathing apparatus fitted with a Class P2 filter;
- Steel-capped boots;
- Nitrile work gloves meeting AS 2161-1978 requirements or heavy duty gauntlet gloves;
- Safety glasses or safety goggles with side shields meeting AS 1337-1992 requirements (as necessary);
- Hard hat meeting AS 1801-1997 requirements;
- Hearing protection meeting AS 1270-2002 requirements when working around machinery or plant equipment if noise levels exceed exposure standards.

Excavation, handling, stockpiling, transport etc. of materials containing asbestos should be undertaken by a licenced contractor in accordance with the Worksafe Australia: Asbestos – Code of Practice and Guidelines Notes, and the relevant statutory requirements such as Section 29 of the Protection of the Environment Operations (Waste) Regulation 1996. Based on the results of the previous investigations, the presence of asbestos materials is likely to be minor, and comprise bonded asbestos containing material (i.e. fibro fragments).

Due to works being undertaken within the grounds of an operating high school, the following measures should also be considered to minimise potential WHS risks to site users:

- Stage construction activities in order to minimise the area of contaminated soils exposed at any one time;
- Provide temporary covers over exposed contaminated soils where capping cannot be completed in a timely fashion to minimise exposure risks;
- Conduct higher risk work (i.e. stripping and exposure of contaminated soils) outside school hours (where practical).

13. References

1. Douglas Partners Pty Ltd, "Report on Preliminary Site Investigation (Contamination), Hunter Sports High School, Pacific Highway Gateshead, prepared for NSW Department of Public Works Government Architects Office, Project 81598, October 2014".
2. Douglas Partners Pty Ltd, "Report on Targeted Investigation for Contamination, Proposed Major Capital Works Upgrade, Hunter Sports High School, Pacific Highway, Gateshead', prepared for NSW Department of Public Works, Project 81961, May 2016".
3. National Environment Protection Council (2013), 'National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013', 11 April 2013.
4. NSW EPA, Contaminated Site, "Guidelines for the NSW Site Auditor Scheme 2nd Edition", April 2006.
5. NSW EPA, "Waste Classification Guidelines, Part 1: Classifying Waste", November 2014.
6. NSW EPA, "Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 – The Excavated Natural Material Order 2014", November 2014.
7. NSW EPA, "Managing Land Contamination, Planning Guidelines, SEPP55 – Remediation of Land", 1988.
8. NSW EPA Contaminated Sites (2011), "Guidelines for Consultants Reporting on Contaminated Sites", August 2011.
9. Douglas Partners Pty Ltd, "Report on Geotechnical Investigation, Hunter Sports High School, Pacific Highway Gateshead, prepared for NSW Department of Public Works Government Architects Office, Project 81598, October 2014".
10. Douglas Partners Pty Ltd, "Report on Geotechnical Investigation, Proposed Development, Hunter Sports High School, Pacific Highway Gateshead, prepared for NSW Public Works – Department of Finance, Services and Innovation, Project 81598.01, October 2015".
11. NSW EPA, "Best Practice Note: Landfarming", April 2014.
12. Western Australia Department of Health (2009), 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia', May 2009.

14. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at Pacific Highway, Gateshead in accordance with DP's proposal dated 24 June 2016 and acceptance received from Jennifer Bates dated 27 June 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of NSW Public Works for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About this Report
Table 5 to Table 7 – Summary of Contamination Results – Soil (DP May 2016)
Table 8 – Results of Asbestos Analysis on Soil / Fibro Sheeting Materials (DP May 2016)

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Table 5: Results of Soil Analysis - Metals

Bore	Depth (m)	PID (ppm)	As [3]	Cd	Cr [7]	Cu	Pb [4]	Pb TCLP	Pb ASLP	Hg [5,6]	Ni	Zn	Mn	Fe
202A	0.5	<1	10	<0.4	7	4	12	NT	NT	<0.1	1	12	110	41000
203	0.5	<1	6	<0.4	27	3	12	NT	NT	<0.1	1	9	1700	12000
204	0.1	<1	<4	<0.4	29	3	4	NT	NT	<0.1	1	14	2500	3800
BD1	-	<1	<4	<0.4	23	8	5	NT	NT	<0.1	2	24	1400	6700
205	0.01	<1	11	<0.4	11	21	53	NT	NT	<0.1	2	240	590	5700
206	0.01	<1	11	<0.4	17	15	18	NT	NT	<0.1	6	44	170	34000
BD2	-	<1	14	<0.4	14	16	13	NT	NT	<0.1	15	48	410	17000
207	0.01	<1	<4	<0.4	3	2	29	NT	NT	<0.1	<1	23	43	2700
208	0.01	<1	11	0.5	11	4	21	NT	NT	<0.1	1	210	24	46000
209	0.01	<1	14	<0.4	16	1	15	NT	NT	<0.1	1	10	11	61000
210	0.01	<1	9	0.5	14	13	32	NT	NT	<0.1	2	77	52	64000
211	1	<1	6	<0.4	8	13	25	NT	NT	<0.1	3	130	300	8400
212	0.5	<1	7	<0.4	6	12	39	NT	NT	<0.1	3	98	61	14000
213	0.3	<1	9	<0.4	5	4	19	NT	NT	<0.1	2	19	52	9300
214	0.5	<1	37	0.4	16	*370*	*1300*	0.46	7.8	<0.1	4	*8900*	2900	34000
215	0.5	<1	7	<0.4	13	1	12	NT	NT	<0.1	<1	19	16	17000
Laboratory PQL			4	0.4	1	1	1	NT	NT	0.1	1	1	1	1
NEPM HIL C [1] (Ref 3)			300	90	300	17000	600			80	1200	30000	19000	NC
Ecological Investigation Levels [8] (EILs) - Urban residential/Public open space			100	NC	410	110	1100	NC	NC	NC	220	310	NC	NC
NSW EPA - General Solid Waste Guidelines - CT1 (Ref 5)			100	20	100	NC	100/1500 [9]	5	NC	4	40	NC	NC	NC
NSW EPA - Restricted Solid Waste Guidelines - CT2 (Ref 5)			400	80	400	NC	400/6000 [9]	20	NC	16	160	NC	NC	NC
ANZECC 2000 - Trigger Values - Slightly to Moderately Disturbed Systems - Fresh (Ref 6)			NA	NA	NA	NA	NA	NA	0.0034	NA	NA	NA	NA	NA

Notes to Table 5:
All soil total concentration results in mg/kg on a dry weight basis
TCLP and ASLP results in mg/L
CT - Concentration Threshold
NA - Not Applicable
NC - No Criteria
NT - Not Tested
PID - Photoionisation Detector
PQL - Practical Quantitation Limits
SCC - Specific Contaminant Concentration
1 - Health Based Criteria for Recreational Land Use, including secondary schools
2- HIL generally applies to the top 3m of soil
3- HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)
4- HIL is based on blood lead models (adult lead model where 50% bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7)
5- Assessment of methyl mercury should only be considered if there is evidence of its potential source.
6- HIL does not address elemental mercury
7 - Chromium (VI) (Conservative)
8- EILs refer to contamination present in soil for at least two years
9- Total concentration for waste classification when used in conjunction with TCLP results
exceeds NEPM Health-Based Criteria for Recreational Landuse, including secondary schools
ANZECC 2000 Trigger values for slightly to moderately disturbed systems - fresh waters
Bold results exceed NSW EPA Waste Classification Guidelines for General Solid Waste following leachability testing
Italic results exceed NEPM Ecological Investigation Criteria for Urban Residential/Public Open Space
BD1 is a replicate sample of 204/0.1
BD2 is a replicate sample of 206/0.01

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Table 6: Results of Soil Analysis – TRH, BTEX

Bore	Depth (m)	PID (ppm)	TRH				TRH (NEPM)						BTEX				PAH
			C_6 - C_9	C_{10} - C_{14}	C_{15} - C_{28}	C_{29} - C_{36}	F1 (C_6-C_{10}-BTEX)	F2 (>C_{10}-C_{16} - Naphthalene)	C_6-C_{10}	>C_{10}-C_{16}	F3 (>C_{16}-C_{34})	F4 (>C_{34}-C_{40})	Benzene	Toluene	Ethyl Benzene	Xylenes	Naphthalene
202A	0.5	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
203	0.5	<1	<25	<50	<100	140	<25	<50	<25	<50	110	130	<0.2	<0.5	<1	<3	<1
204	0.1	<1	<25	<50	100	730	<25	<50	<25	<50	540	1000	<0.2	<0.5	<1	<3	<1
BD1	-	<1	<25	<50	190	680	<25	<50	<25	<50	600	1100	<0.2	<0.5	<1	<3	<1
205	0.01	<1	<25	<50	<100	210	<25	<50	<25	<50	220	110	<0.2	<0.5	<1	<3	<1
206	0.01	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
BD2	-	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
207	0.01	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
208	0.01	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
209	0.01	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
210	0.01	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
211	1	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
212	0.5	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
213	0.3	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
214	0.5	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
215	0.5	<1	<25	<50	<100	<100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1
Laboratory PQL			25	50	100	100	25	50	25	50	100	100	0.2	0.5	1	3	1
NEPM HSL C [1, 6] (Ref 3) SAND			NC	NC			NL/NL/NL/NL [1]	NL/NL/NL/NL [1]	NC	NC	NC	NC	NL/NL/NL/NL [1]	NL/NL/NL/NL [1]	L/NL/NL/NL	/NL/NL/NL	NL/NL/NL/NL [1]
NEPM HSL C [2, 6] (Ref 3) SILT			NC	NC			NL/NL/NL/NL [2]	NL/NL/NL/NL [2]	NC	NC	NC	NC	NL/NL/NL/NL [2]	NL/NL/NL/NL [2]	L/NL/NL/NL	/NL/NL/NL	NL/NL/NL/NL [2]
NEPM HSL C [3, 6] (Ref 3) CLAY			NC	NC			NL/NL/NL/NL [3]	NL/NL/NL/NL [3]	NC	NC	NC	NC	NL/NL/NL/NL [3]	NL/NL/NL/NL [3]	L/NL/NL/NL	/NL/NL/NL	NL/NL/NL/NL [3]
NEPM ESL Residential A,B,C [4, 7] (Ref 3) - Coarse Soils			NC	NC			180 *	NC	NC	120 *	300	2800	50	85	70	105	NC
NEPM ESL Residential A,B,C [4, 7] (Ref 3) - Fine Soils			NC	NC			180 *	NC	NC	120 *	1300	5600	65	105	125	45	NC
Management limits for TPH fractions in coarse soils - Residential A, B, C [5]			NC	NC			NC	NC	700	1000	2500	10000	NC	NC	NC	NC	NC
Management limits for TPH fractions in fine soils - Residential A, B, C [5]			NC	NC			NC	NC	800	1000	3500	10000	NC	NC	NC	NC	NC
NSW DECCW - General Solid Waste Guidelines - CT1 (Ref 5)			650 SCC1	10000 total SCC1			NC	NC	NC	NC	NC	NC	10	288	600	1000	NC
NSW DECCW - Restricted Solid Waste Guidelines - CT2 (Ref 5)			2600 SCC2	40000 total SCC2			NC	NC	NC	NC	NC	NC	40	1152	2400	4000	NC

Notes to Table 6:
All results in mg/kg on a dry weight basis
CT - Concentration Threshold
NA - Not Applicable
NC - No Criteria
NT - Not Tested
PID - Photoionisation Detector
PQL - Practical Quantitation Limits
SCC - Specific Contaminant Concentration
1- Soil HSLs for vapour intrusion (mg/kg) for SAND samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m
2- Soil HSLs for vapour intrusion (mg/kg) for SILT samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m
3- Soil HSLs for vapour intrusion (mg/kg) for CLAY samples recovered from 0 m to <1 m / 1 m to <2 m / 2 m to <4 m / >=4 m
4- ESLs are of low reliability except where indicated by * which indicates that the ESLs are of moderate reliability
5- Management limits are applied after consideration of relevant ESLs and HSLs
6- Multiplication factor may be applied (for depths >2m) subject to favourable biodegradation conditions - refer to 2.4.10
7- ESLs apply from the surface to 2 m depth below finished surface/ground level
8- Environmental Investigation Limit (EIL) - this value relates to fresh contamination.
exceeds NEPM HSL Health-Based Criteria for Recreational Landuse, including secondary schools
exceeds NEPM management limits for TPH fractions in fine soils - Residential A, B, C
Underlined results exceed the NEPM ESL guideline values for Recreational Landuse - coarse soils
Bold results exceed NSW DECCW Waste Classification Guidelines for General Solid Waste without leachability testing
BD1 is a replicate sample of 204/0.1
BD2 is a replicate sample of 206/0.01

Table 7: Results of Soil Analysis – PAH, PCB, OCP, OPP

Bore	Depth (m)	PID (ppm)	Total PAH	Benzo(a) Pyrene	Benzo(a) Pyrene TCLP	Benzo(a) Pyrene TEQ	PCB [3]	Total OPP	Chlorpyrifos	Total OCP	Aldrin + Dieldrin	Chlordane	DDT+DDE +DDD	Endosulphan	Endrin	Heptachlor	HCB	Methoxychlor
202A	0.5	<1	2.9	0.3	NT	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
203	0.5	<1	7.7	*0.81*	<0.001	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
204	0.1	<1	3.6	0.1	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BD1	-	<1	4.8	0.3	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
205	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
206	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	4.3	3.5	0.3	<0.1	<0.1	<0.1	0.5	<0.1	<0.1
BD2	-	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	4	3.3	0.3	<0.1	<0.1	<0.1	0.4	<0.1	<0.1
207	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
208	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
209	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
210	0.01	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
211	1	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
212	0.5	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
213	0.3	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
214	0.5	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
215	0.5	<1	NIL (+)VE	<0.05	NT	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Laboratory PQL			0.05	0.05	0.001	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NEPM HIL C [1] (Ref 3)			300	NC	NC	3	1	NC	250	NC	10	70	400	340	20	10	10	400
Ecological Investigation Levels [8] (EILs) - Urban residential/Public open space			NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	180 (DDT)	NC	NC	NC	NC	NC
NEPM ESL Residential A,B,C [7](Ref 3) - Coarse Soils			NC	0.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NEPM ESL Residential A,B,C [7](Ref 3) - Fine Soils			NC	0.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
NSW DECCW - General Solid Waste Guidelines - CT1 (Ref 5)			200 SCC1	0.8/10 [5]	0.04	NC	50 SCC1	NC	4	NC	NC	NC	NC	60	NC	NC	NC	NC
NSW DECCW - Restricted Solid Waste Guidelines - CT2 (Ref 5)			800 SCC2	3.2/23 [5]	0.16	NC	50 SCC2	NC	16	NC	NC	NC	NC	240	NC	NC	NC	NC

Notes to Table 7:
All total soil concentration results in mg/kg on a dry weight basis
TCLP results in mg/L
CT - Concentration Threshold
NA - Not Applicable
NC - No Criteria
NT - Not Tested
PID - Photoionisation Detector
PQL - Practical Quantitation Limits
SCC - Specific Contaminant Concentration
TEQ - Toxicity Equivalent Quotient
Total PAH - Sum of positive and PQL values
1 - Health Based Criteria for Commercial Land Use
2- ESLs apply from the surface to 2 m depth below finished surface/ground level
3- PCB HILs relates to non-dioxin-like PCB only
4- Endosulphan is total of Endosulphan I, Endosulphan II and Endosulphan Sulphate
5- Total concentration for waste classification when used in conjunction with TCLP results
exceeds NSW EPA Health-Based Criteria for Recreational Landuse including secondary schools
Bold results exceed NSW DECCW Waste Classification Guidelines for General Solid Waste without leachability testing
Italic results exceed NEPM Ecological Screening Level for Urban Residential/Public Open Space
BD1 is a replicate sample of 204/0.1
BD2 is a replicate sample of 206/0.01

Table 8: Results of Asbestos Identification on Soil/Fibro Sheeting

Location	Depth	Sample Type	Asbestos Identification	Trace Analysis
206	0.01	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
207	0.01	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
207	0.1	Material (fibro)	Chrysotile asbestos detected	-
211	1.0	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
212	0.5	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
213	0.3	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
214	0.5	Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
A1-soil[1]		Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
A1-fibro		Material (fibro)	Chrysotile asbestos detected. Amosite asbestos detected	-
A2-soil[1]		Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
A2-fibro		Material (fibro)	Chrysotile asbestos detected	-
A3-soil[1]		Soil	No asbestos detected at reporting limit of 0.1g/kg. Organic fibres detected	No asbestos detected
A3-fibro		Material (fibro)	Chrysotile asbestos detected	-
A4-fibro		Material (fibro)	Chrysotile asbestos detected	-
A5-fibro		Material (fibro)	Chrysotile asbestos detected. Amosite asbestos detected. Crocidolite asbestos detected	-

Notes to Table 8:

1 – Soil collected from immediately beneath fibro fragment

Appendix B

Drawing 1 – Test Location Plan (DP May 2016)
Overall and Part Site Plans (Drawing No. A005)
Milestone Key Diagrams (1 to 10)
Hunter Sports High – Excavation Plan (EJE Ref 249335 007 Rev 1)