ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

MOORE THEOLOGICAL COLLEGE

ON

STAGE 1 ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED PART 3A CONCEPT PLAN DEVELOPMENT

AT

CORNER OF KING STREET & CARILLON AVENUE, NEWTOWN, NSW

MAY 2009 **REF: E21871K-RPT**

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1 INTRODUCTION

Moore Theological College commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a Stage 1 environmental site assessment to assess the likelihood of contamination of the subsurface soils for the proposed Part 3A Concept Plan development at the corner of King Street and Carillon Avenue, Newtown, NSW.

The proposed Part 3A Concept Plan includes the following sites located in Newtown:

- No. 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23-25, 27-31, 33 & 35 King Street;
- No. 1A & 1-20 Little Queen Street; and
- No. 2-16, 18-28, 30, 32, 38, 40, 42, 44 & 48 Carillon Avenue.

The location of the Part 3A Concept Plan is shown on Figure 1 and the concept layout plan is shown on Figure 2. For the purpose of this investigation "the site" is the proposed Part 3A Concept Plan. The Stage 1 investigation was confined to the site boundaries as shown on Figure 3.

The Stage 1 investigation was undertaken generally in accordance with an EIS proposal (Ref: EP4179K) of 18 March 2009 and written acceptance from Allen Jack & Cottier Pty Ltd on behalf of the Moore Theological College of 14 April 2009.

This report describes the investigation procedures and presents the results of the Stage 1 environmental site assessment, together with comments, discussion and recommendations.

1.1 Proposed Development Details

The proposed development will be staged over a number of years and includes the following works:

- proposed new seven storey library and learning centre (at the corner of King Street & Carillon Av);
- new teaching and administration floor space;
- new student and teaching staff accommodation fronting Carillon Av;
- providing new walkways for pedestrians along Little Queen Street;
- new basement car park;
- refurbishment of terrace houses facing Little Queen Street;
- construction of utilities and services for the proposed development; and
- stormwater, drainage and bulk earthworks associated with the proposed development.

1.2 Previous Investigation Reports

J&K have previously undertaken geotechnical investigations for the proposed development. The results of the investigation are presented in the following reports:

- *Report to Moore Theological College on Geotechnical Investigation for Proposed Redevelopment Between King Street and Carillon Avenue, Newtown, NSW*, Ref: 21871VTrpt, dated 10 March 2008;
- *Supplementary Geotechnical Investigation, Moore Theological College, 2-16 Carillon Avenue, Newtown, NSW*, Ref: 21871VTlet, dated 27 August 2008; and
- *Report to Moore Theological College on Geotechnical Investigation for Proposed Library Building at Corner King Street and Carillon Avenue, Newtown, NSW*, Ref: 21871VT2rpt, dated 26 February 2009.

A brief summary of the subsurface conditions encountered during the J&K geotechnical investigations is presented in this report.

2 ASSESSMENT OBJECTIVES

2.1 Investigation Objectives

The primary objective of the Stage 1 investigation was to identify wide spread soil contamination conditions at the site generally in accordance with the following guidelines:

- *Guidelines for Consultants Reporting on Contaminated Sites NSW DECC (EPA) 1997;*
- *State Environmental Planning Policy No.55 – Remediation of Land (SEPP55);*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines);*
- *NSW DECC (EPA) Guidelines for Assessing Service Station Sites – 1994;* and
- *Contaminated Lands Management Act - 1997*.

A secondary investigation objective was to undertake a preliminary waste classification assessment for off-site disposal of excavated soil and rock associated with the proposed development works.

2.2 Scope of Work

The scope of work undertaken to achieve the objectives included:

1. Review of J&K geotechnical investigation reports previously undertaken for the proposed development at the site;
2. Review of historical aerial photographs;

3. Review of historical land title records;
4. Search of the NSW DECC (EPA) notices for the site under Section 58 of the Contaminated Land Management Act (1997);
5. Search of the NSW DECC (EPA) public register for licences, applications or notices for the site;
6. Search of WorkCover databases for underground storage tank (USTs) licenses;
7. Review of City of Sydney Council historical development applications (DA) and building approvals (BA) records for the site;
8. Review of regional geology and groundwater conditions, including the location of registered groundwater bores and major underground services in the vicinity of the site;
9. Design and implementation of a field sampling program;
10. Laboratory analysis of selected soil samples; and
11. Preparation of a report presenting the results of the Stage 1 assessment.

Field work for this investigation was undertaken on 22 April 2009.

3 SITE INFORMATION

3.1 Site Identification

The site identification details are summarised in the following table:

Site Owner:	Moore Theological College & University of Sydney
Site Address:	Part 3A Concept Plan includes the following sites located in Newtown: • No. 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23-25, 27-31, 33 & 35 King Street; • No. 1A & 1-20 Little Queen Street; and • No. 2-16, 18-28, 30, 32, 38, 40, 42, 44 & 48 Carillon Avenue.
Lot & Deposited Plan:	Lot 100 in DP106825; Lot 1 in DP171499; Lot 6 in DP664096; Lots A & B in DP314368; Lot 17 in DP830070; Lots 26, 27 & 28 in DP939363; Lots 18, 19, 20, 21 in DP1041490; Lots 22 – 29 in DP1117009; Lot 1 in DP456704; Lot 1 in DP66399; Lot 1 in DP66008; Lot 1 in DP547291; Lot 102 in DP866098; and Lots 1 - 12 in DP33414.
Local Government Authority:	City of Sydney
Current Zoning:	The site includes the following land use zones: • 2(b) Residential (Medium Density); • 3 Business; • 5 Special Uses (University); and • 10 Mixed Uses.
Area of Part 3A Concept Plan:	Approximately 15,000m^2
AHD:	Approximately 34m – 43m
Geographical Location:	N: 6248180 E: 332280 (approximately)
Site Locality Plan:	Refer to Figure 1
Site Layout Plan	Refer to Figure 2

The site falls within the following Heritage Conservation Areas identified under the South Sydney LEP:

- Sydney University Conservation Area – includes properties to the north of Carillon Avenue;
- King Street Conservation Area – includes properties with frontage to King Street; and

- Bligh and Camperdown Terrace Conservation Area – all other properties.

The site includes the following heritage items listed under the South Sydney LEP:

- No. 6, 8, 10, 12, 14, 16, 18 and 20 Little Queen Street, Newtown.

3.2 Site Description

The Part 3A Concept Plan is located in a predominantly commercial/retail area of Newtown located to the south of the University of Sydney and includes the following individual sites:

- No. 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23-25, 27-31, 33 & 35 King Street;
- No. 1A & 1-20 Little Queen Street; and
- No. 2-16, 18-28, 30, 32, 38, 40, 42, 44 & 48 Carillon Avenue.

The concept plan area is bounded by Carillon Avenue to the north, King Street to the south, east and north-east and by Newtown North Public School and commercial buildings to the west. The concept plan area is intersected by Little Queen Street which runs from north to south and Campbell Street which runs from east to west. University of Sydney is located to the north of the sites adjacent to Carillon Avenue and commercial/retail buildings are located to the east and south of the sites adjacent to King Street.

The concept plan area is located in an undulating regional topographic setting which generally falls to the north-west and west. The intersection of King Street and Carillon Avenue is located on top of a ridge line which generally falls towards the north-west, west and south-west. Relatively steep slopes are located further to the west of the concept plan area. Sites with frontage onto King Street generally sloped towards the north and north-west at approximately 5° to 15°. Sites with frontage onto Carillon Av generally sloped towards the north-west at approximately 10° to 15°.

An inspection of the sites undertaken for the Stage 1 investigation on 17 April 2008 encountered the following:

- No. 1 King Street: The site was occupied by a three storey building surrounded by concrete paved hardstand areas. A small car park and access driveway onto King Street was located on the south section. A landscaped garden with a small tree was located along the east boundary. Concrete paved ramps (retained by an approximately 1m high wall) and steps were located along the north boundary. EIS understand that the building was being used for administrative purposes by Moore College;

- No. 3, 5, 7, 9 & 11 King Street: The sites were occupied by two storey residential buildings with frontage onto King Street. The buildings occupied the majority of the site with small landscaped areas to the north. EIS understand that the buildings provided accommodation for college students;

- No. 13, 15, 17, 19 & 21 King Street: The sites were occupied by two to three storey buildings with frontage onto King Street. The ground level of the buildings was occupied by commercial/retail shops. No. 21 King Street was occupied by "Moore Books" which included a cafe. The area to the north of the buildings was occupied by landscaped gardens with trees and bushes. The area included two grassed lawns retained by walls of approximately 0.5m to 2m high. A paved driveway was located to the north of the landscaped garden which provided access onto Little Queen and Campbell Streets;

- No. 23-27 King Street: The site was occupied by an automotive workshop with frontage onto King Street. Communication with the workshop personnel indicated that a former grease trap was located on the south section of the workshop. EIS understand that the grease trap has since been filled in and paved with concrete. The area in the immediate vicinity of the grease trap generally sloped onto King Street. A concrete bunded tank located along the south-east boundary contained drums of oil and grease. Communication with the client has indicated that the site was formerly used as a galvanizing plant/facility (possibly zinc galvanizing) prior to use of the site as an automotive workshop;

- No. 27-31 King Street: The site was occupied by a two storey commercial building with frontage onto King Street;

- No. 33 & 35 King Street: The site was occupied by a single storey residential building with a small landscaped garden along the south site boundary;

- No. 1A, 1 to 20 Little Queen Street: The sites were occupied by two storey residential buildings with frontage onto Little Queen Street. At the time of the inspection, the buildings located on the corner of Little Queen and Campbell Streets were being demolished;

- No. 2-16 Carillon Avenue: The site was occupied by a two and three storey building with frontage onto Carillon Avenue. The buildings were being used by

Moore College. Concrete paved walkways and driveways were located along the north site boundary;

- No. 18-28 Carillon Avenue: The site was occupied by four buildings (ranging from 1 to 4 storeys) with a central paved area occupied by landscaped gardens and concrete paved car park and driveway onto Carillon Avenue. The buildings formed a part of the Church of England Deaconess Institution;

- No. 30 & 32 Carillon Avenue: The site was occupied by two single storey residential buildings to the north-east of the site. A single storey building was located along the south site boundary. The buildings were surrounded by gravel surfaced driveways. The residential buildings were being demolished during the inspection. Stockpiles of fill and demolition rubble were located in the driveway;

- No. 38, 40, 42 and 44 Carillon Avenue: The site was occupied by a two storey residential building with frontage onto Carillon Avenue. The building was divided into 4 residential units with landscaped areas along Carillon Av. Landscaped areas were located to the rear of the units. An asphaltic concrete paved car park was located to the south of the site with access to Campbell Street. A small undercover car park was located in this area;

- No. 48-64 Carillon Avenue: The site was occupied by a two storey child care centre with frontage onto Carillon Avenue. A landscaped area was located along the north site boundary. A play area was located to the south of the building. An asphaltic concrete driveway and car park was located to the east and south-east of the child care centre. EIS understand that the site is currently owned by University of Sydney.

The majority of the services were located in the paved walkways along King, Little Queen and Campbell Streets and Carillon Avenue.

3.3 Regional Geology

The 1:100,000 geological map of Sydney (Map 9130, 1:100,000 Department of Mineral Resources [now the Department of Primary Industries] – 1983) indicates the site to be underlain by Ashfield Shale of the Wianamatta Group. Ashfield Shale typically consists of black to dark grey shale and laminate.

3.4 Hydrogeology

Department of Water and Energy (DWE) records were researched for the investigation and indicated that 13 registered groundwater bores lie within 2km of the site. The groundwater bore records are presented in Appendix C. A brief summary of the details are provided below:

Ref No	Approx. distance from site(m)	Approx. direction from site	Depth(m)	Registered Purpose
GW103258	1000	West	7.0	Monitoring
GW105317	550	South-west	6.5	Monitoring
GW109729	600	South-west	6.0	Monitoring
GW109730	600	South-west	6.5	Monitoring
GW105938	600	South-east	NA	Domestic
GW102357	1160	South-east	6.0	Monitoring
GW102358	1180	South-east	6.0	Monitoring
GW102356	1200	South-east	6.0	Monitoring
GW102363	1200	South-east	3.0	Monitoring
GW102362	1200	South-east	3.0	Monitoring
GW102365	1220	South-east	6.0	Monitoring
GW102359	1220	South-east	6.0	Monitoring
GW102360	1240	South-east	6.0	Monitoring

The majority of the bores were registered for monitoring purposes with one registered for domestic use. The standing water level (SWL) in the bores was measured at depths ranging from approximately 0.83m to 3.66m. The majority of the bores encountered relatively shallow groundwater at approximately 1m.

Standing water level (SWL) was measured in the boreholes drilled for the J&K geotechnical investigation undertaken during March 2008. Groundwater seepage was encountered in borehole BH6 during drilling at a depth of approximately 4.2m. SWL was measured in boreholes BH1, BH5 and BH6 at depths of 4.8m, 5.6 and 1.2 respectively, 1.5 to 4 hours after the completion of drilling.

The stratigraphy of the site consists of residual clayey soils overlying relatively shallow bedrock. Based on these conditions groundwater is not considered to be a significant resource in the immediate area of the site. Groundwater seepage can be expected on top of the shale bedrock.

3.5 Jeffery and Katauskas Geotechnical Site Assessment Results

The geotechnical investigations previously undertaken by J&K included drilling 19 boreholes for the proposed development as shown on Figure 3. Additional investigation was undertaken at No. 2-16 Carillon Avenue and for the proposed library on No. 1 King Street.

The boreholes were drilled using a track mounted hydraulically operated drill rig equipped with spiral flight augers. Reference should be made to the J&K geotechnical reports for details of the subsurface conditions encountered in the boreholes. A brief summary of the subsurface conditions is provided below:

- Concrete pavement of approximately 0.14m to 0.3m in thickness was encountered in boreholes BH10, BH12, BH13, BH103, BH201 and BH202. BH3 encountered brick pavement of approximately 0.09m in thickness;
- Fill was encountered in all the boreholes drilled for the investigation and extended to depths of approximately 0.2m to 1.6m. The fill material typically consisted of sandy gravel, silty clay, silty sand and clayey silt. The clay fill was generally low to high plasticity with various colourings. The sand fill was generally fine to medium grained with various colourings. The fill contained inclusions of fine to medium grained sand, coal, brick, glass and concrete fragments, fine grained gravel, root fibres and igneous gravel,
- Natural silty clay was encountered beneath the fill in all the boreholes and extended to depths of approximately 1m to 4.4m. The silty clay was generally of medium to high plasticity with various colourings. The natural soil contained inclusions of ironstone gravel, iron indurated gravel, roots and shale bands;
- Shale bedrock was encountered beneath the natural soil in all the boreholes and extended to the termination depth of the boreholes. BH11 encountered siltstone on top of the shale bedrock. The shale was generally brown and grey with inclusions of iron indurated and clay bands. Reference should be made to the geotechnical report for details on weathering and rock strength; and
- Groundwater seepage was encountered in borehole BH6 during drilling at a depth of approximately 4.2m. SWL was measured in boreholes BH1, BH5 and BH6 at depths of 4.8m, 5.6 and 1.2 respectively, 1.5 to 4 hours after the completion of drilling.

4 SITE HISTORY ASSESSMENT

4.1 Aerial Photographs

Aerial photographs of the site taken in 1930, 1951, 1961, 1968, 1970, 1978, 1986, 1994, 1999 and 2004 were obtained from the Department of Lands and were reviewed as part of the assessment of the site history. The following information was obtained:

1930 - The photograph was of poor quality. The site was occupied by numerous small to medium sized buildings which appeared to have been used for commercial/residential purposes. A relatively small warehouse building was located on No. 23-27 King Street. A landscape area with some small trees occupied No. 1 King Street. Carillon Avenue, King, Little Queen and Campbell Streets appeared to have been paved. Campbell Street extended further east into the site. Large ovals and playing fields associated with the University of Sydney were located further to the north of the site. Relatively high density retail/residential development was located to the south, east and west of the site.

1951 - Small residential buildings surrounded by landscaped areas were located on the east section of the site. A small residential building surrounded by a relatively large vacant grassed area was located on No. 2-16 Carillon Av. Small residential buildings were located on No. 30, 32, 38, 40, 42, 44 and 48 Carillon Avenue. A small warehouse building was located on No. 21 King Street. A relatively large building surrounded by smaller buildings was located at No. 18-28 Carillon Avenue. The immediate surrounds appeared similar to the 1930 photograph.

1961 - The residential buildings located on No. 1 King Street and No. 2-16 Carillon Avenue had been demolished and replaced with relatively large buildings. The buildings appeared similar to the present facilities occupied by Moore College. A new building was also located along the south boundary of No. 18-28 Carillon Avenue. A vacant area surfaced with grass and exposed soil was located on the south section of No. 48 Carillon Avenue adjacent to Campbell Street. A new building was located on the north section of No. 48 Carillon Avenue. New buildings associated with Sydney University were located further to the north of the site.

1968 - The buildings located on the east section between Little Queen and King Streets appeared similar to the buildings currently existing on site. The large building located on No. 2-16 Carillon Avenue extended further to the east. Landscaped areas were located in the north section of No. 13-15, 17-19, 21, 23-27 King Street. A small warehouse was located on the south section of No. 48 Carillon Avenue. The remaining sections of the site were similar to the 1961 photograph. Relatively large warehouses were scattered further to the south and west of the site.

1970 - The site and immediate surrounds appeared similar to the 1968 photograph.

1978 - The buildings located on the east section of No. 18-28 Carillon Avenue had been demolished. The remaining sections of the site and immediate surrounds appeared similar to the 1970 photograph.

1986 - The residential buildings located on No. 38, 40, 42 and 44 Carillon Avenue had been replaced by a relatively large building surrounded by landscaped areas. Two driveways were located adjacent to the building. A new building was located on the east section of No. 18-28 Carillon Avenue. The remaining sections of the site and immediate surrounds appeared similar to the 1978 photograph.

1994 - The site appeared similar to the current layout. The immediate surrounds appeared similar to the 1986 photograph.

1999 - The site and immediate surrounds appeared similar to the 1994 photograph.

2004 - The site and immediate surrounds appeared similar to the 1999 photograph.

4.2 Land Title Search

A limited historical land title search in is progress on our behalf by Advance Legal Search. The results of the search will be forwarded when received.

4.3 Council Records

A search of the City of Sydney online archive for Development Application (DA) and Building Approval (BA) records was undertaken by EIS on 30 April 2009. The results of the search are summarised in the following table:

File Number	Date of Application	Application Details/Description of Works
No. 1 King Street		
312/77	Nov 1977-Oct 1978	Use of premises for the storage, display and retail of heavy duty clothing, footwear and camping equipment and as a residence.
414/66	Jun 1966 – Feb 1968	Proposed erection of an office building – The Masters Builders Association of NSW.
No. 3-5A King Street		
758/59	Oct 1959 – Jul 1964	Erection of new buildings – H. J. Ashworth for University of Sydney.
No. 7 King Street		
513/62	Jun 1962 – Jul 1962	Use of factory premises at rear for printing – William Scotts.
1113/63	Nov 1963 – Mar 1964	Use of premises for light woodworking – Westgate Building Service
409/67	May 1967 – Nov 1967	Use of rear section of the premises for commercial printing – FL Rex on behalf of Moore Theological College.
476/70	Aug 1970 – Sep 1970	Use premises for offices, shops and residence – Moore Theological College.
44 82 0540	Aug 1982 – Feb 1983	Use of premises as doctors surgery – Dr R Doyle
No. 17-19 King Street		
093/56	Aug 1955 – Jan 1958	Additions to adjoining hotel – Tooth & Co Ltd.
781/57	Sep 1957 – Jan 1958	Construct a covered beer garden, lounge & womens toilet block and enlarge mens lavatory – Tooth & Co Ltd.
No. 21 King Street		
6073	Nov 1956	White Horse Hotel, cutting holes in the kerb.
3806/57	Jul 1957 – Nov 1957	White Horse Hotel, cut hole in kerb for fitting removable hooks for lowering casks into the celler.
No. 23/25 King Street		
757/65	Sep 1965 – Nov 1965	Use factory premises for automotive brake steering service – Heggies Brake and Steering Service on behalf of Moore Theological College.
900/65	Nov 1965 – May 1966	Use premises for manufacturing light coil springs & wire frames – Aust Springs P/L & W. C. Cale.

File Number	Date of Application/ Approval	Application Details/Description of Works
No. 23/25 King Street		
1004/65	Dec 1965 – Oct 1970	Use of premises for automotive engineering – John Ratcliff Malcolm.
No. 2-16 Carillon Avenue		
548/58	Aug 1958 – Apr 1959	Erection of a students hostel – Professor H Ingham Ashworth.
758/59	Oct 1959 – Jul 1964	Erection of new buildings – H. J. Ashworth for University of Sydney.
No. 18/28 Carillon Avenue		
528/58	Aug 1958 – Oct 1961	Erection of additional storey and use for accommodation purposes - Church of England Deaconess Institute.
593/59	Aug 1959 – Oct 1961	Erection of new 3 storey building – Church of England Deaconess Institute.
2648/60	Nov 1960 – Dec 1965	Extensions to Deaconess House.
840/72	Jul 1972 – Oct 1973	Extension to Deaconess House – Trustees of the Church of England Deaconess Institution.
No. 48-64 Carillon Avenue		
1349/74	Dec 1974 – Feb 1976	New timber deck and alterations – Sydney Teachers College.
1201/76	Nov 1976 – May 1977	Installation of mechanical ventilation at the Student Health Centre – Sydney Teachers College.
1208/76	Nov 1976 – Jun 1977	Alterations – Sydney teachers College.
No. 5 Little Queen Street		
0098/57	Feb 1957 – Jan 1988	Application for continued use of premises for residential purposes – Mr Edward Stanley.
No. 2-12, 18 & 20 Little Queen Street		
45 80 1479	Sep 1980 – Jun 1981	Alterations - 8 new laundry/bathrooms at dwellings – New Life Design & Drafting.
No. 121-125 Campbell Street		
724/77	Oct 1977 – Jan 1978	Use site for car parking – Moore Theological College.

4.4 WorkCover Database Records

A records search for licenses to store dangerous goods was undertaken on our behalf by WorkCover. A copy of the WorkCover letter is presented in Appendix C. The records did not indicate the existence of any licences, including those for underground storage tanks, in the concept plan area.

4.5 NSW DECC (EPA) Records

A search of the NSW DECC (EPA) on line database did not indicate the existence of any DECC (EPA) notices for the site under section 58 of the Contaminated Land Management Act (1997).

A search of the NSW DECC (EPA) on-line public register did not indicate the existence of any notices for the site.

4.6 Assessment of Historical Information Integrity

The site history assessment has generally been obtained from: government records including the council archive documents; historical aerial photographs and NSW WorkCover records. The veracity of the information from these sources is considered to be high, however, given the age of the development and the lack of information available on activities prior to 1950's, a certain degree of information loss is to be expected.

Non verifiable anecdotal information has not been relied upon during assessment of historical site use. Therefore, there is considered to be a high level of integrity associated with information obtained with respect to historical use of the site.

4.7 Summary of Historical Site Use

The search of historical information has indicated the following:

- A review of the historical aerial photographs indicated that the sites were occupied by numerous small to medium sized buildings which appeared to have been used for commercial/residential purposes since at least 1930. Moore College facilities located on No. 1 King Street and No. 2-16 Carillon Avenue were constructed during 1951 and 1961. The residential buildings located on No. 38, 40, 42 and 44 Carillon Avenue were replaced by a relatively large building during 1978 to 1986. The sites and immediate surrounds appeared similar to the present condition since at least 1994;
- The council records search indicated that the land use of the sites was residential, commercial and retail since at least 1958. The rear section of No. 7

King Street was used for commercial printing between 1962 and 1970. No. 23-25 King Street was used as an automotive workshop since at least 1965. No. 18-28 Carillon Avenue was used by the Church of England Deaconess Institute for accommodation purposes since at least 1958;

- There are no recorded notices listed on the NSW DECC (EPA) CLM and public registers for the site; and
- WorkCover have no records of underground storage tank licenses issued for the site.

5 POTENTIAL CONTAMINATION SOURCES

5.1 General Contamination Processes

Contamination of surface and subsurface soils generally arises from previous land use that can include petroleum hydrocarbon and warehouse storage, manufacturing processes and pesticide and fertiliser usage. Imported fill soils may contain contaminants derived from unknown sources. Migration of contaminants can occur in permeable subsurface soil or fill materials and via man-made and natural drainage systems. The extent of contamination migration is dependent on the hydro-geological environment and the chemical and physical characteristics of the contaminants. Contamination migration in clayey soils can be expected to be limited, whilst sandy soils are conducive to greater spatial migration.

Backfill to service trenches can form contamination migration pathways via poorly compacted or permeable backfill. Backfill may also be contaminated.

The general history of contamination of sites in the Sydney region indicates that analysis for heavy metals including lead, copper and zinc should be incorporated in the schedule of laboratory testing. In addition screening tests should be performed on selected samples for polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs), petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (BTEX) and asbestos. Contaminants including cyanide, phenolic compounds, barium, beryllium, cobalt, manganese, vanadium and boron are generally associated with specific site industrial uses and so have not been considered in this investigation.

5.2 Potential Site Specific Contamination

Based on the review of the historical site information and an inspection of the site and the immediate surrounds, potential contamination in the proposed development area may be associated with the following:

- Heavy metals associated with the use of No. 23-25 King Street as a galvanizing facility;
- Hydrocarbon contamination associated with the use of No. 23-25 King Street as an automotive workshop;
- Oil and grease associated with the former underground grease trap at No. 23-25 King Street;
- Solvents associated with the use of No. 7 King Street for commercial printing and woodworks;
- Contamination associated with the storage/use/spillage of chemicals/materials used for various commercial/retail purposes at the sites;
- Use of hazardous building material including asbestos and lead paint for the construction of buildings prior to 1990's; and
- Contamination associated with historically imported fill material used to create the existing site levels.

5.3 Site Specific Contaminants of Concern

The compounds identified as soil contaminants of concern at the subject site include:

- Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;
- Total petroleum hydrocarbons (TPH);
- Monocyclic aromatic hydrocarbon (BTEX) compounds: Benzene, Toluene, Ethyl Benzene and Xylenes;
- Polycyclic aromatic hydrocarbons (PAHs) including Benzo(a)pyrene;
- Organochlorine pesticides (OCPs): Aldrin, dieldrin, DDT, chlordane, etc;
- Organophosphorus pesticides (OPPs);
- Polychlorinated Biphenyls (PCBs);
- Oil and grease; and
- Asbestos.

5.4 Potential Receptors

The main potential contamination receptors are considered to include:

- Johnstons Creek located approximately 1.4km to the north-west of the site;
- Blackwattle Bay located approximately 1.8km to the north of the site;

- Site visitors, workers and adjacent property owners, who may come into contact with contaminated soil and/or be exposed to contaminated dust arising from construction activity; and
- Future site occupants.

5.5 Contaminant Laydown and Transport Mechanisms

At this site, mobile contaminants would be expected to move down to the rock surface and migrate laterally down-slope from the source. The movement of contaminants would be expected to be associated with groundwater flow and seepage at the top of the bedrock.

6 ASSESSMENT CRITERIA DEVELOPMENT

6.1 Regulatory Background

In 1997 the NSW Government introduced the *Contaminated Land Management Act, 1997* (CLM Act). This act, associated regulations, State Environmental Planning Policy (SEPP) No.55 – Remediation of Land (1998) and associated NSW DECC (EPA) guidelines, were designed to provide uniform state-wide control of the management, investigation and remediation of contaminated land.

Prior to granting consent for any proposed rezoning or development, SEPP55 requires the consent authority to:

- consider whether the land is contaminated;
- consider whether the site is suitable, or if contaminated, can be made suitable by remediation, for the proposed land use;
- be satisfied that remediation works will be undertaken prior to use of the site for the proposed use.

Should the assessment indicate that the site poses a risk to human health or the environment, remediation of the site is required prior to commencement of the proposed development works. SEPP55 requires that the relevant local council be notified of all remediation works, whether or not development consent is required. Where development consent is not required, 30 days written notice of the proposed works must be provided to council. Details of validation of remediation work must also be submitted to Council within one month of completion of remediation works.

The consent authority may request that a site audit be undertaken during, or following the completion of the site assessment process. Under the terms of the CLM Act the

NSW DECC (EPA) Site Auditor Scheme was developed to provide a system of independent review for assessment reports. An accredited Contaminated Site Auditor is engaged to review reports prepared by suitably qualified consultants to ensure that the investigation has been undertaken in accordance with the guidelines and confirm that the sites are suitable for their intended use.

Section 59(2) of the CLM Act states that specific notation relating to contaminated land issues must be included on S.149 planning certificates prepared by Council where the land to which the certificate relates is:

- within an investigation or remediation area.
- subject to an investigation or remediation order by the DECC (EPA).
- the subject of a voluntary investigation or remediation proposal.
- the subject of a site audit statement.

Submission of contaminated site investigation and validation reports to council as part of rezoning or development application submissions may also result in notation of actual or potential site contamination on future S.149 certificates prepared for the site.

Section 60 of the CLM Act sets out a positive duty on an owner, or person whose activities cause contamination, to notify the DECC if they are aware that the contamination presents a significant risk of harm.

Off-site disposal of fill, contaminated material and excess soil/rock excavated as part of the proposed development works is regulated by the provisions of the Protection of the Environment Operations Act (POEO Act 1997) and associated regulations and guidelines including the *Waste Classification Guidelines Part 1: Classifying Waste. DECC NSW 2008.* All materials should be classified in accordance with these guidelines prior to disposal.

Section 143 of the *Protection of the Environment Operations Act 1997* states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner.

6.2 Soil Contaminant Threshold Concentrations

The soil investigation levels adopted for this investigation are derived from the NSW DEC (now DECC) document *Guidelines for the NSW Site Auditor Scheme (2nd Edition) 2006* and the National Environmental Protection Council document *National Environmental Protection (Assessment of Site Contamination) Measure 1999*. The

contaminant thresholds listed below are levels at which further investigation and evaluation is required to assess whether the site is considered suitable for the proposed urban land use.

To accommodate the range of human and ecological exposure settings, a number of generic settings are used on which the Health based Investigation Levels (HILs) can be based. Four categories of HILs are adopted for urban site assessments. Contaminant levels for a standard residential site with gardens and accessible soil (Column A in Table A-1) are based on protection of a young child resident at the site. The remaining categories (Columns D to F) present alternative exposure settings where there is reduced access to soil or reduced exposure time. These categories include residential land use with limited soil access, recreational and public open space and commercial/industrial use. Where the proposed land use will include more than one land use category (eg. mixed residential/commercial development) the exposure setting of the most "sensitive" land use is adopted for the site.

Threshold concentrations for petroleum hydrocarbon contaminants including total petroleum hydrocarbons (TPH) and monocyclic aromatic hydrocarbon (BTEX) compounds have previously been established in the *NSW DECC (EPA) Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994) publication and this document is referenced in the 2006 Site Auditor Guidelines. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have also been introduced in the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPC Guidelines).

The Provisional Phyto-toxicity Investigation Levels (PPILs) are generic values based on phytotoxicity data for plant response to specific contaminants in a sandy loam matrix and are included in the contaminated site assessment where the proposed land use includes gardens and accessible soils.

The *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPC Guidelines) do not provide numeric guidelines for the assessment of asbestos in soil. NSW DECC (EPA) advice (2006) has indicated that consultants should use their 'professional judgement' regarding determination of appropriate investigation and remediation levels for asbestos in soils; however the NSW DECC (EPA) have not published numerical guidelines for the assessment of asbestos in subsurface soils.

The WorkCover publication *Working with Asbestos Guide* (NSW WorkCover 2008) states that, where buried asbestos in encountered, "A competent occupational hygienist should assess the site to determine:

- If asbestos material is bonded or friable
- The extent of asbestos contamination
- Safe work procedures for the remediation of the site"

"Any asbestos cement products that have been subjected to weathering, or damaged by hail, fire or water blasting are considered to be friable asbestos and an asbestos removal contractor with a WorkCover license for friable asbestos removal is required for its removal". Under the *NSW Occupational Health and Safety (OHS) Regulations 2001* and WorkCover requirements all necessary disturbance works associated with asbestos containing materials must be conducted by a licensed AS-1 Asbestos Removal Contractor.

6.2.1 Site Assessment Criteria for Soil Contaminants

The 'Parks and recreational open spaces' (Column E of Table A-1) exposure setting has been adopted for this assessment and the appropriate soil criteria are listed in the following table:

Site Soil Assessment Criteria (mg/kg)			
Contaminant	**HIL Column E Exposure Setting**	**Guidelines for Assessing Service Station Sites (1994)**	**Phyto-toxicity Investigation Levels**
Inorganics			
Arsenic (total)	200		20
Cadmium	40		3
Chromium (III)	24%		400
Copper	2000		100
Lead	600		600
Mercury (inorganic)	30		1
Nickel	600		60
Zinc	14000		200
Organic Contaminants			
TPH (C_6-C_9)		65	
TPH (C_{10}-C_{36})		1000	
Benzene		1	
Toluene		1.4	
Ethylbenzene		3.1	
Total Xylenes		14	
Total PAHs	40		
Benzo(a)pyrene	2		
Aldrin + Dieldrin	20		
Chlordane	100		
DDT+ DDD + DDE	400		
Heptachlor	20		
PCBs (Total)	20		

For the purpose of off-site disposal, the classification of soil into 'General Solid Waste', "Restricted Solid Waste" and 'Hazardous Waste" categories is defined by chemical contaminant criteria outlined in *Waste Classification Guidelines Part 1: Classifying Waste. DECC NSW 2008.* These chemical contaminant criteria are summarised in Table A-2.

6.3 Evaluation of Soil Analysis Data and Contaminant Threshold Concentrations

Assessment of the soil analytical data using the soil contaminant threshold concentrations has been undertaken in accordance with the methodology outlined in the *National Environmental Protection (Assessment of Site Contamination) Measure (1999) Schedule 7(a) Soil Investigation Levels* and the statistical analysis methods outlined in the *NSW EPA Contaminated Sites Sampling Design Guidelines (1995)*.

The following criteria have been adopted for assessment of the analytical data:

- Concentrations of contaminants above the guideline levels are a trigger for further assessment. If the individual concentrations are below the guideline levels, the site can be considered suitable for the intended use; and
- Where contamination results exceed the site criteria developed above a method of remediating the site is to physically and selectively remove the contamination hotspots from the site. This process should be continued until statistical analysis of the data meets the above criteria. Validation of the remediated site is generally required to demonstrate that the site is suitable for the proposed land use.

7 ASSESSMENT PLAN AND METHODOLOGY

7.1 Sampling Density

The *NSW DECC (EPA) Sampling Design Guidelines (1995)* for contaminated site investigations state that samples should be obtained from a minimum of 25 evenly spaced sampling points in the concept plan area (approximately 1.5 hectares).

Soil samples were obtained from 8 sampling locations for the Phase 1 investigation. This density is approximately 32% of the minimum sampling density and is considered adequate for the Phase 1 investigation.

The boreholes were drilled on a judgemental sampling plan in accessible areas of the site as shown on Figure 3. A judgement sampling plan was adopted as access was limited due to the existing buildings.

Boreholes BH104, BH109 and BH110 were drilled outside the investigation area covered by this report. The subsurface conditions encountered in these boreholes are discussed in a separate report.

Groundwater sampling and analysis has not been undertaken for the Phase 1 assessment.

7.2 Data Quality Objectives

The data quality objectives (DQOs) for the Phase 1 assessment are outlined in the following table:

State the problem	The site is located in a predominantly commercial/retail area in Newtown. The Phase 1 assessment was designed to identify widespread soil contamination at the site. A site history assessment was undertaken for the investigation in order to identify historical landuse that may have resulted in soil and/or groundwater contamination at the site. Based on the review of the historical site information and an inspection of the site and the immediate surrounds, potential contamination in the proposed development area may be associated with the following: • Heavy metals associated with the use of No. 23-25 King Street as a galvanizing facility; • Hydrocarbon contamination associated with the use of No. 23-25 King Street as an automotive workshop; • Oil and grease associated with the former underground grease trap at No. 23-25 King Street; • Solvents associated with the use of No. 7 King Street for commercial printing and woodworks; • Contamination associated with the storage/use/spillage of chemicals/materials used for various commercial/retail purposes at the sites; • Use of hazardous building material including asbestos and lead paint for the construction of buildings prior to 1990's; and • Contamination associated with historically imported fill material used to create the existing site levels. The compounds identified as soil contaminants of concern at the subject site include: heavy metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (BTEX), asbestos, organochlorine (OC) and organophosphate (OP) pesticides and polychlorinated biphenyls (PCBs).
Identify the decision	The principal objective of the investigation was to assess widespread soil and groundwater contamination conditions at the site.
Identify inputs into the decision	The following data will be reviewed to resolve the decision statement: • Site history information. • Review of previous site investigation results (if available). • Physical site data that includes topography and other relevant information.

<table>
<tr><td></td><td>Analytical schedule for soils
<table>
<tr><th>Class</th><th colspan="2">Analytes</th></tr>
<tr><td>Metals and metalloids</td><td>Arsenic
Cadmium
Chromium
Copper</td><td>Mercury
Nickel
Lead
Zinc</td></tr>
<tr><td>Organics</td><td colspan="2">Total petroleum hydrocarbons;
BTEX (benzene, toluene, ethyl benzene, xylenes);
Polycyclic Aromatic Hydrocarbons (PAHs);
Pesticides: organochlorine and organophosphates;
Polychlorinated biphenyls (PCBs)</td></tr>
<tr><td>Asbestos</td><td colspan="2">Asbestos identification</td></tr>
</table>

The soil contamination assessment included:
• Soil laboratory analysis of 13 fill and natural soil samples from 8 boreholes for the contaminants of concern;
• Additional TCLP leachate analysis on selected samples based on the initial laboratory results in order to provide a preliminary waste classification assessment; and
• Field QA/QC procedure included the collection and analysis of approximately 15% of the field soil samples as intra-laboratory duplicates for heavy metals.</td></tr>
<tr><td>Study Boundaries</td><td>The study was confined to the Part 3A Concept Plan boundaries as shown on Figures 2 and 3.</td></tr>
<tr><td>Develop a Decision Rule</td><td>The results of the sample analysis were compared with the concentrations specified in the site assessment criteria (refer to Section 6). The QA/QC program implemented for the project were assessed by comparison with the criteria outlined below (refer to Section 7.3) to demonstrate that the information obtained from the sample analysis results are reliable.</td></tr>
<tr><td>Specify Limits on Decision Errors</td><td>Decision errors are false positive or false negative i.e. stating the site is clear when it is contaminated; or stating that the site is contaminated when it is not. The most significant of these is a false negative i.e. stating that the site is suitable for proposed use when, if fact, it is contaminated. This error could potentially impact on the health of the site users. This study will assume that elevated concentrations of contaminants are present in the soil and groundwater of the investigation area unless demonstrated otherwise.</td></tr>
<tr><td>Optimise the Design for Obtaining data</td><td>The overall data set was optimised by reviewing the data as the project proceeded. When necessary, adjustments were made to the sampling or analytical program.</td></tr>
</table>

7.3 Data Quality Indicators

The purpose of Data Quality Indicators (DQIs) is to develop criteria to assess the reliability of the laboratory data. The following table provides the DQIs and the methods adopted to achieve these.

DQIs	Method of Achievement
Documentation Completeness	• Review of site history and site inspection information • Preparation of sampling and analysis location plan • Preparation of chain of custody records • Laboratory sample receipt information • NATA registered laboratory results
Data Completeness	• Soil sampling in accessible areas of the site • Sampling program based on the objectives of the DECC (EPA) Sampling Design Guidelines. For the Phase 1 investigation, soil samples were obtained from 8 boreholes drilled in accessible areas of the site. This number of boreholes represents approximately 32% of the minimum guideline density which is 25 sampling locations • On-site visual and PID assessment of samples • Analysis for all potential contaminants of concern
Data Comparability	• The use of appropriate sampling techniques • The use of appropriate preservation, storage and transport methods • The use of NATA registered laboratories for all analyses
Data Representativeness	• Adequate coverage of sample locations across the site. For the Phase 1 assessment, sampling was undertaken in accessible areas of the site • Representative coverage of analysis for contaminants of concern
Data Precision and Accuracy	• Use of trained and qualified field staff • Appropriate industry standard sampling equipment and decontamination procedures • Field QA/QC including intra-laboratory duplicates • Acceptable RPDs for duplicate comparison • Check of laboratory quality control methods and results

The success of the DQIs is based on assessment of the data set as a whole and not on individual acceptance or exceedance within the data set. The validation, as part of the DQOs, involves the technical review of the data using defined Quality Assurance (QA) Assessment Criteria.

The criteria for the technical review of data for this project are summarised below:

- Collection and analysis of approximately 15% of the field soil samples as intra-laboratory duplicates for heavy metals.
- Relative percentage differences (RPDs) will be calculated for intra-laboratory duplicates. The RPD is calculated as the absolute value of the difference

between the initial and repeat result divided by the average value, expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

- For results that were greater than 10 times the Practical Quantitation Limit (PQL) RPDs less than 50% were considered acceptable.
- For results that were between 5 and 10 times PQL RPDs less than 75% were considered acceptable.
- For results that were less than 5 times the PQL RPDs less than 100% were considered acceptable.

- Review of laboratory QA/QC data (including surrogate recovery, repeat analysis, duplicates, matrix spikes and method blanks).

The success of the Data Quality Indicators will be based on an assessment of the data set as a whole and not on individual acceptance or exceedance within the data set.

8 INVESTIGATION PROCEDURE

8.1 Subsurface Investigation and Soil Sampling Methods

Subsurface investigations were undertaken using a four-wheel-drive (4wd) mounted hydraulically push tube rig. Soil samples were obtained from disposable polyethylene push tube samplers. Sampling personnel used disposable Nitrile gloves during sampling activities.

Soil and rock samples were obtained at various depths, based on observations made during the field investigation. All samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. During the investigation, soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS 4482.1-2005 and AS 4482.2-1999 as summarised in the following table:

Analyte	Preservation	Storage
Heavy metals	Unpreserved glass jar with Teflon lined lid	Store at <4o, analysis within 28 days (mercury and Cr[VI]) and 180 days (other metals).
VOCs (TPH/BTEX)		Store at <4o, nil headspace, extract within 14 days, analysis within forty days
PAHs, OC/PCBs		
Asbestos	Sealed plastic bag	None

Each sample was labelled with a unique job number, the sampling location, sampling depth and date. All samples were recorded on the borehole logs presented in Appendix A and on the chain of custody (COC) record presented in Appendix B.

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard chain of custody procedures. Detailed EIS field sampling protocols are included in Appendix D.

8.1.1 Photoionisation Detector (PID) Screening

A portable PID was used in this investigation to assist with selection of samples for laboratory hydrocarbon (TPH/BTEX) analysis. The PID is sensitive to volatile organic compounds. The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The portable PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source.

The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.

Photoionisation detector (PID) screening of detectable volatile organic compounds (VOC) was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled glass jar samples following equilibration of the headspace gases. The PID headspace data is included on the COC documents.

8.2 Laboratory Analysis - Soil Samples

Analysis of soil samples was undertaken by NATA registered laboratories using analytical methods detailed in the Schedule B(3) NEPC (1999) Guideline on Laboratory Analysis of Potentially Contaminated Soils. Laboratory analysis was undertaken by Envirolab Services Pty Ltd (NATA Accreditation No. 2901).

For this investigation selected soil samples were analysed for contaminants using the following laboratory techniques:

- Heavy metals – Nitric acid digestion. Analysis by ICP.
- Low level mercury – cold vapour AAS.
- OC and OP pesticides and PCBs – Extracted with acetone/hexane. Analysis by GC/ECD.
- PAHs – Soil extracted with dichloromethane/acetone. Analysis by GC/MS.

- TPH (volatile) – Soil extracted with methanol. Analysis by P&T GC/PID.
- TPH – Soil extracted with dichloromethane/acetone. Analysis by GC/FID.
- BTEX – Soil extracted with methanol. Analysis by P&T PID. Confirmed with column flame ionisation detection.
- Asbestos – Polarizing light microscopy.

Toxicity characteristic leaching procedure (TCLP) leachates were prepared by rotating soil samples in a mild acid solution for 18 hours (NSW EPA WD-3 Method). Leachates were analysed using the analytical procedures outlined above.

9 RESULTS OF INVESTIGATION

9.1 Subsurface Conditions

Eight boreholes were drilled for this investigation. Site details and borehole locations are shown on Figure 3. For details of the subsurface soil profile reference should be made to the borehole logs in Appendix A. A summary of the subsurface conditions encountered by the boreholes is presented below:

Pavement

Concrete pavement of approximately 0.11m to 0.15m in thickness was encountered in boreholes BH101, BH105 and BH111.

Fill

Fill was encountered in all the boreholes drilled for the investigation and extended to depths of approximately 0.2m to 1.8m. The fill material typically consisted of silty sand, silty clay, silty sandy gravel, sandy clay silt and silty sandy clay. The sand fill was generally fine to coarse grained with various colourings. The clay fill was generally low to high plasticity with various colourings.

The fill material contained inclusions of ash, sandstone, shale, igneous and ironstone gravel, root fibres, slag, concrete, terracotta and brick fragments, clay nodules and metal fragments.

A concrete slab of approximately 0.12m in thickness was encountered in BH111 at a depth of approximately 0.5m.

Natural Soils

Silty clay natural soil was encountered beneath the fill in all the boreholes drilled for the investigation and extended to the termination depths of approximately 1m to 3m. The silty clay was generally of high plasticity with various colourings.

The natural soils contained inclusions of ironstone gravel, iron-indurated and shale bands.

Bedrock

Bedrock was not encountered in the boreholes drilled for the investigation to the maximum termination depths of approximately 1m to 3m.

Groundwater

Groundwater seepage was not encountered in the boreholes during drilling. The boreholes were dry during drilling and a short time after completion of drilling. Longterm monitoring of groundwater conditions was not undertaken for this investigation.

9.2 Laboratory Results - Soil

The laboratory analysis results for soil samples are summarised in Tables B and C inclusive and analysis reports are presented in Appendix B. The site soil assessment criteria for this investigation are specified in the "Site Assessment Criteria for Soil Contaminants" section earlier in this report. The results of the analyses are summarised below. Envirolab report 28383 includes results for the soil samples obtained from BH104, BH109 and BH110. These boreholes were located outside the investigation area covered by this report. The results for the soil samples obtained from BH104, BH109 and BH110 are discussed in a separate report.

Heavy Metals

Ten fill and three natural soil samples were analysed for heavy metals. Fill samples BH103 (0.5m to 0.7m) and BH108 (0.2m to 0.4m) encountered elevated concentrations of lead of 730mg/kg and 1000mg/kg respectively above the health investigation level (HIL) of 600mg/kg. The results of the remaining analyses were below the HIL.

The majority of the fill and one of the natural soil samples encountered elevated copper, lead, mercury, nickel and zinc concentrations above the Provisional

Phyto-toxicity Investigation Levels (PPILs). The elevated PPIL concentrations are summarised in the following table:

Summary of Elevated Heavy Metal PPIL Results (mg/kg)

Heavy metal	Copper	Lead	Mercury	Nickel	Zinc
PPILs	100	600	1	60	200
BH102 (0.2 - 0.4)	-	-	-	-	260
BH103 (0.5 – 0.7)	130	730	1.5	-	820
BH107 (0.2 – 0.4)	-	-	-	-	220
BH108 (0.2 – 0.4)	-	1000	-	-	470
BH111 (1.5 – 2.0)	140	-	-	81	-
BH111 (2.05 – 2.25)	-	-	-	210	-

Natural soil sample BH111 (2.05m to 2.25m) encountered a nickel concentration of 210mg/kg which is below the HIL of 600mg/kg. This concentration is not consistent with the results obtained for natural soil from other sections of the site.

Fill samples BH102 (0.2m to 0.4m), BH103 (0.5m to 0.7m), BH106 (0.4m to 0.8m), BH107 (0.2m to 0.4m), BH108 (0.2m to 0.4m) and BH111 (1.5m to 2.0m) encountered lead concentrations above the CT1 and below the SCC1 criteria outlined in the *Waste Classification Guidelines Part 1: Classifying Waste DECC NSW 2008*. Fill samples BH111 (0.11m to 0.22m), BH111 (1.5m to 2.0m) and underlying natural soil sample BH111 (2.05m to 2.25m) encountered nickel concentrations above the CT1 and below the SCC1 criteria.

Petroleum Hydrocarbons (TPH) and Monocyclic Aromatic Hydrocarbons (BTEX)

PID soil sample headspace readings ranged from 0ppm to 2.7ppm equivalent isobutylene. These results indicate a lack of PID detectable volatile organic contaminants.

Eleven fill and one natural soil samples were analysed for petroleum hydrocarbons and BTEX compounds. The results of the analyses were below the site assessment criteria.

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines Part 1: Classifying Waste DECC NSW 2008.

Polycyclic Aromatic Hydrocarbons (PAHs)

Ten fill and one natural soil samples were analysed for a range of PAHs including Benzo(a)pyrene. Fill sample BH102 (0.2m to 0.4m) encountered an elevated total PAHs concentration of 132mg/kg above the site assessment criteria of 40mg/kg.

Fill samples BH102 (0.2m to 0.4m), BH103 (0.5m to 0.7m) and BH108 (0.2m to 0.4m) encountered elevated B(a)P concentration of 13mg/kg, 3.3mg/kg and 2.9mg/kg respectively above the site assessment criteria of 2mg/kg.

The results of the remaining analyses were less than the site assessment criteria.

Fill samples BH103 (0.5m to 0.7m), BH107 (0.2m to 0.4m) and BH108 (0.2m to 0.4m) encountered concentrations of B(a)P above the CT1 and below the SCC1 criteria outlined in the *Waste Classification Guidelines Part 1: Classifying Waste DECC NSW 2008*. Sample BH102 (0.2m to 0.4m) encountered a B(a)P concentration above the CT2 and below the SCC2 criteria. The total PAHs results of all the samples were below the SCC1 criteria of 200mg/kg.

Polychlorinated Biphenyls (PCBs)

Eight fill samples were analysed for a range of PCBs. The results of the analyses were below laboratory practical quantitation limit and less than the site assessment criteria.

The results of all analyses were less than the SCC1 criteria outlined in the *Waste Classification Guidelines Part 1: Classifying Waste DECC NSW 2008*.

Organochlorine (OC) and Organophosphorus (OP) Pesticides

Eight fill samples were analysed for a range of OC and OP pesticides. The results of the analyses were below the laboratory practical quantitation limit and less than the site assessment criteria.

The results of all analyses were less than the SCC1 criteria outlined in the *Waste Classification Guidelines Part 1: Classifying Waste DECC NSW 2008*.

Asbestos

Eight fill samples were screened for the presence of asbestos fibres. The results of the analyses indicated that asbestos fibres were not encountered within the samples and no respirable fibres were detected.

Toxicity Characteristics Leaching Procedure (TCLP)

TCLP leachates (acid) were prepared for five fill and one natural soil samples based on the initial laboratory heavy metal and Benzo(a)pyrene results. The extracts were analysed for lead, nickel and PAHs as required. The results of the majority of the analyses were less than the TCLP1 criteria listed in Table A-2.

Natural soil sample BH111 (2.05m to 2.25m) encountered a TCLP nickel concentration of 4.6mg/kg which is above the TCLP1 and below the TCLP2 criteria listed in Table A-2.

9.3 Assessment of Analytical QA/QC

The objective of the assessment of the laboratory QA/QC is to ensure that the sample data is reliable. All laboratory reports for project E21871K have been checked and issued as final by Envirolab Services Pty Ltd, NATA Accreditation No. 2901, Report numbers: 28383 and 28383-A.

Chain of custody documentation and/or sample receipt advice notices were signed and dated by Envirolab Services stating that all samples were received cool, in good order and in suitable containers. Compliance of holding times was met for all analyses undertaken by Envirolab Services. EIS and laboratory QA/QC procedures for the site screening are summarised in the following table:

Contaminant	QA/QC Procedure						
	Total no. of Samples	Intra-lab Duplicate	Repeat Analysis	Matrix Spike	LCS	Lab Blank	Surrogate Spike
Heavy metals	13	2	✔	✔	✔	✔	-
TPH	12	-	✔	✔	✔	✔	12
BTEX	12	-	✔	✔	✔	✔	12
PAH	11	-	✔	✔	✔	✔	11
OCP	8	-	✔	✔	✔	✔	8
PCB	8	-	✔	✔	✔	✔	8
OPP	8	-	✔	✔	✔	✔	8
TCLP PAH	4	-	-	-	-	-	4
TCLP Metals	6	-	-	-	-	-	6

Field QA/QC samples are specified below:

Intra-laboratory soil duplicates - DUP1 was duplicate of BH111 (0.5m to 0.7m)
DUP2 was duplicate of BH105 (0.8m to 1.0m)

The RPD results for the field QA/QC duplicate samples are summarised in Table D. The following comments are an overall summary of the quality of the analytical component of the project:

1. Sample integrity and container requirements were documented as satisfactory.
2. All sample extraction analyses were performed within the required holding times.
3. Matrix spike, laboratory control sample (LCS) and surrogate recovery values indicated that the laboratory accuracy was very good.
4. Laboratory duplicate RPD results indicated that the sample precision was acceptable.
5. All methods were found to be free of analyte concentrations above the PQLs.
6. The intra -laboratory RPD values indicated that field precision was acceptable. The RPD values calculated for sample BH111 (0.5m to 0.7m) and DUP1 included some values outside of the acceptance criteria ie. copper (126%), nickel (118%) and zinc (70%). These values are considered to be the result of sample heterogeneity. The individual results were all significantly less than the relative acceptance criteria and are therefore not considered to have had a significant adverse effect on the data set as a whole.

The QA/QC data reported by Envirolab Services laboratory for the documented soil samples were assessed to be of sufficient quality to be considered acceptable for the environmental assessment of EIS project E21871K.

The QA/QC data including the RPD results are considered to meet the Data Quality Objectives developed for this project.

10 CONCLUSIONS AND RECOMMENDATIONS

The Stage 1 environmental site assessment undertaken for the proposed Part 3A Concept Plan development at the corner of King Street and Carillon Avenue, Newtown, was designed to assess the likelihood of contamination of subsurface soils.

The proposed development will be staged over a number of years and includes the following works:

- proposed new seven storey library and learning centre (at the corner of King Street & Carillon Av);
- new teaching and administration floor space;
- new student and teaching staff accommodation fronting Carillon Av;
- providing new walkways for pedestrians along Little Queen Street;
- new basement car park;

- refurbishment of terrace houses facing Little Queen Street;
- construction of utilities and services for the proposed development; and
- stormwater, drainage and bulk earthworks associated with the proposed development.

The scope of works for the Stage 1 assessment included undertaking a site history assessment and soil sampling from 8 boreholes drilled in accessible areas of the site as shown on Figure 3.

Based on the review of the historical site information and an inspection of the site and the immediate surrounds, potential contamination in the proposed development area may be associated with the following:

- Heavy metals associated with the use of No. 23-25 King Street as a galvanizing facility;
- Hydrocarbon contamination associated with the use of No. 23-25 King Street as an automotive workshop;
- Oil and grease associated with the former underground grease trap at No. 23-25 King Street;
- Solvents associated with the use of No. 7 King Street for commercial printing and woodworks;
- Contamination associated with the storage/use/spillage of chemicals/materials used for various commercial/retail purposes at the sites;
- Use of hazardous building material including asbestos and lead paint for the construction of buildings prior to 1990's; and
- Contamination associated with historically imported fill material used to create the existing site levels.

10.1 Summary of Soil Analysis Results

Fill and natural soil samples obtained from the boreholes drilled for the investigation were analysed for the following site specific contaminants of concern: heavy metals, PAHs including B(a)P, TPH, BTEX, OCP, OPP, PCBs and asbestos.

Elevated concentrations of contaminants were encountered in fill soil samples during this investigation as shown on Figure 3. A summary of the elevated results are presented in the table below:

Summary of Contamination Data in Fill Soil (mg/kg)						
Contaminant	**PPIL***	**HIL+**	**No. of Samples Analysed**	**No. of Results above the PPIL**	**No. of Results above the HIL**	**Maximum Value**
Copper	100	2000	13	2	-	140
Lead	600	600	13	2	2	1000
Mercury	1	30	13	1	-	1.5
Nickel	60	600	13	2	-	210
Zinc	200	14000	13	4	-	820
Total PAHs	NSL	40	11	-	1	132
B(a)P	NSL	2	11	-	3	13

Guideline Levels:

* Provisional Phyto-toxicity Investigation Level - *National Environment Protection (Assessment of Site Contamination) Measure 1999*

\+ 'Park, recreational open spaces' Column E of Table A-1 of the Health-Based investigation Level - *National Environment Protection (Assessment of Site Contamination) Measure 1999*

Explanation:

B(a)P Benzo(a)pyrene
PAH Total Polycyclic Aromatic Hydrocarbons

The Stage 1 investigation encountered elevated concentrations of lead, total PAHs and B(a)P in some of the fill samples above the site assessment criteria adopted for this investigation. The limited screening undertaken for the Stage 1 investigation has not identified the vertical and horizontal extent of the contaminants encountered at the site.

The investigation has shown that the fill material encountered at the site contains inclusions of ash and slag. Significant amounts of waste ash and gravely slag were available in the late nineteenth and early twentieth century as a result of the use of coal for industrial and domestic heating purposes. Widespread use of ash waste (either as ash or mixed with other soil and waste materials) as fill material was common in the inner suburbs of Sydney at this time. The lead and PAHs contamination can be associated with the ash and slag encountered in the fill.

A natural soil sample obtained from BH111 (2.05m to 2.25m) encountered a nickel concentration of 210mg/kg. The concentration was below the site assessment criteria of 600mg/kg but is considered elevated when compared to nickel concentrations generally encountered in natural soils. Borehole BH111 was located in No. 23-25 King Street which was formerly used as a galvanizing plant prior to use as an automotive workshop. The use of nickel and zinc in the galvanizing process could have impacted the soil in this area. Additional investigation should be undertaken to confirm the extent of nickel concentrations in the natural soil.

Selected fill samples encountered elevated concentrations of copper, lead, mercury, nickel and zinc above the PPIL assessment criteria specified in the *Guidelines for the NSW Site Auditor Scheme (2nd edition) 2006.* The PPIL assessment criteria are principally concerned with phytotoxicity (i.e. adverse effects on plant growth in established and proposed areas of landscaping) and are described in the *NEPC Guidelines* as "*somewhat arbitrary*", as the effect of these compounds on plant growth will depend on the soil and plant type. These elevations should be taken into consideration for this site as EIS understand that the proposed development includes landscaped areas and therefore elevated contaminant levels in these areas may influence plant growth.

10.2 Preliminary Waste Classification Assessment

TCLP leachates (acid) were prepared for five fill and one natural soil samples based on the initial laboratory heavy metal and Benzo(a)pyrene results. The extracts were analysed for lead, nickel and PAHs as required.

The results of the fill samples were less than the TCLP1 criteria. Natural soil sample BH111 (2.05m to 2.25m) encountered a TCLP nickel concentration of 4.6mg/kg which is above the TCLP1 and below the TCLP2 criteria listed in Table A-2.

Fill sample BH102 (0.2m to 0.4m) encountered a B(a)P concentration of 13mg/kg which is above the SCC1 and below the SCC2 criteria. Based on the B(a)P concentration, this material is classified as Restricted Solid Waste (non-putrescible)' according to the criteria outlined in *NSW DECC (EPA) Waste Classification Guidelines, Part 1: Classifying Waste, 2008.*

However, the fill material in borehole BH102 encountered inclusions of ash. Significant amount of waste ash was available in the late nineteenth and early twentieth century as a result of the use of coal for industrial and domestic heating purposes. Widespread use of ash waste (either as ash or mixed with other soil and waste materials) as fill material was common in the inner suburbs of Sydney at this time. The *"General Approvals of Immobilisation"* published in the NSW Government gazette on 16 July 1999 includes an immobilisation approval for ash contaminated materials (approval number 1999/05). The *"General Approvals of Immobilisation"* states that ash contaminated materials *"..can be classified according to their leachable concentration (TCLP) values alone."*, however, disposal restrictions indicate that the ash contaminated material can only be disposed of to a landfill with a leachate monitoring system. Treatment of this waste stream is not considered to be an economical option

Based on the TCLP results and the *"General Approvals of Immobilisation",* the fill soils are classified as 'General Solid Waste (non-putrescible)'. Further sampling and analysis is recommended to confirm this preliminary waste classification. The fill material is not suitable for reuse on another site.

The natural soil in the vicinity of BH111 is classified as 'Restricted Solid Waste (non-putrescible)' in accordance with the above criteria. Additional analysis including TCLP testing is recommended to confirm this classification and delineate the extent of the 'Restricted Solid Waste'. Tests should typically be undertaken on the basis of one sample per 500m^3 of soil to be disposed.

Any soil excavated for the proposed development should be disposed of to a suitable NSW DECC (EPA) licensed landfill. Fill and contaminated soil disposal costs are significant and may affect project viability. These costs should be assessed at an early stage of the project development to avoid significant future unexpected additional costs.

10.3 Asbestos Contamination Screening

The investigation undertaken by EIS included the analysis of 8 surficial soil samples for the presence of asbestos fibres using NATA accredited microscopic screening techniques. Asbestos, neither apparent to the naked eye nor apparent using microscopic techniques were not detected within the samples. The scope of work undertaken was designed to assess widespread surficial contamination and has not included an exhaustive assessment of the site for the presence of small scale asbestos contamination. EIS adopts no responsibility for small scale or buried asbestos features at the site which may be encountered during future earth or construction works at the site.

Hazardous building material including asbestos and lead paint was widely used in building construction prior to 1990's. Many of the buildings on site were constructed prior to 1990's and may contain hazardous building material. A suitable qualified hygienist should be engaged to undertake a hazardous building material inspection and to provide a clearance report.

10.4 Recommendations

Based on the scope of work undertaken for the Stage 1 assessment EIS consider that the site can be made suitable for the proposed development provided that the following is undertaken:

- A detailed Stage 2 investigation to meet the NSW DECC (EPA) Sampling Design Guidelines is undertaken. The Stage 2 investigation should include additional soil sampling in the vicinity of the boreholes BH102, BH103 and BH108 in order to identify the vertical and horizontal extent of contaminants encountered during the Stage 1 works;
- Groundwater investigation in the vicinity of the boreholes BH102, BH103 and BH108 to assess the impact of soil contamination on groundwater conditions at the site;
- Additional soil and groundwater investigation in the vicinity of BH111 in order to identify the extent of nickel contamination on the natural soils at the site;
- Additional TCLP leachate analysis in order to provide a thorough waste classification for the disposal of fill and natural soil associated with the development;
- Preparation of a remedial action plan (RAP) outlining the procedures to remediate the contaminants encountered at the site in order to render the site suitable for the proposed development; and
- Preparation of a validation assessment report demonstrating the outcomes of the remediation works.

EIS understand that the demolition and proposed construction will be undertaken in a staged manner. The additional works recommended above should be undertaken after the demolition of the existing buildings in order to obtain access beneath the buildings. The additional works can be staged in order to minimise delays to the proposed development work.

An appropriate occupational health and safety plan may be required for the contaminants encountered at this site. This can be undertaken prior to commencement of any excavation works.

11 LIMITATIONS

The boreholes drilled for the investigation have enabled an assessment to be made of the existence of significant, large quantities of contaminated soils. EIS adopts no responsibility whatsoever for any problems such as underground storage tanks, buried items or contaminated material that may be encountered between sampling locations

at the site. The proposed construction activities at the site should be planned on this basis, and any unexpected problem areas that are encountered between boreholes should be immediately inspected by experienced environmental personnel. This should ensure that such problems are dealt with in an appropriate manner, with minimal disruption to the project timetable and budget.

The conclusions developed in this report are based on site conditions which existed at the time of the site assessment and the scope of work outlined previously in this report. They are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, and visual observations of the site and vicinity, together with the interpretation of available historical information and documents reviewed as described in this report.

The investigation and preparation of the assessment report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined previously in this report.

Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated.

EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination.

Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes.

Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work.

EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site.

EIS have not and will not make any determination regarding finances associated with the site.

Changes in the proposed or current site use may result in remediation or further investigation being required at the site.

During construction at the site, soil, fill and any unsuspected materials that are encountered should be monitored by qualified environmental and geotechnical engineers to confirm assumptions made on the basis of the limited investigation data, and possible changes in site level and other conditions since the investigation. Soil materials considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of EIS. EIS has used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report.

Should you require any further information regarding the above, please do not hesitate to contact us.

Yours faithfully
For and on behalf of
ENVIRONMENTAL INVESTIGATION SERVICES

Vittal Boggaram
Senior Environmental Scientist

Adrian Kingswell
Senior Associate

ENVIRONMENTAL INVESTIGATION SERVICES

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by Environmental Investigation Services (EIS) to assist with the assessment and interpretation of this assessment report.

An Environmental Assessment Report is Based on a Unique Set of Project Specific Factors
This assessment report has been prepared in response to specific project requirements as stated in the EIS proposed document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- the proposed land use is altered;
- the defined subject site is increased or subdivided;
- the proposed development details including size, configuration, location, orientation of the structures are modified;
- the proposed development levels are altered, eg addition of basement levels; or
- ownership of the site changes.

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

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

This Assessment is Based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the

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impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

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

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

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

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

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

ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
ADWG	Australian Drinking Water Guidelines
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)pyrene
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
DECC	Department of Environment and Climate Change (formerly DEC and EPA)
DNR	NSW Department of Natural Resources (now split between DWE and DECC)
DWE	NSW Department of Water and Energy
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EPA NSW	Environment Protection Authority, New South Wales (now part of DECC)
GC-ECD	Gas Chromatograph-Electron Capture Detector
GC-FID	Gas Chromatograph-Flame Ionisation Detector
GC-MS	Gas Chromatograph-Mass Spectrometer
HIL	Health Based Investigation Level
HM	Heavy Metals
ICP-AES	Inductively Couple Plasma – Atomic Emission Spectra
NATA	National Association of Testing Authorities, Australia
NEPC.	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
OCPs	Organochlorine Pesticides
OHS (OH&S)	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
P&T	Purge & Trap
RAP	Remedial Action Plan
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SEPP	State Environmental Planning Policy
sPOCAS	suspension Peroxide Oxidation Combined Acidity and Sulfate
SPT	Standard Penetration Test
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WP	Work Plan

REFERENCE DOCUMENTS

- ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (and updates).
- NSW DEC (2007) (now DECC) Guidelines for the Assessment and Management of Groundwater Contamination.
- Australian Government, National Occupational Health and Safety Commission (2005) Code of Practice for the Safe Removal of Asbestos.
- Australian Government, National Occupational Health and Safety Commission (2005) Code of Practice for the Management and Control of Asbestos in Workplaces.
- DUAP/NSW EPA (1998) (now NSW Department of Planning / NSW Department of Environment and Climate Change (DECC) incorporating the EPA) Managing Land Contamination: Planning Guidelines SEPP 55 - Remediation of Land.
- Dutch Ministry of Housing, Spatial Planning and the Environment (2000) Circular on target values for soil remediation.
- NEPM. (1999) National Environmental Protection (Assessment of Site Contamination) Measure (NEPC. Guidelines).
- NSW EPA (1994) (now NSW DECC) Contaminated Sites: Guidelines for Assessing Service Station Sites.
- NSW EPA (1995) (now NSW DECC) Contaminated Sites: Sampling Design Guidelines.
- NSW EPA (1996) (now NSW DECC) Guidelines for Solid Waste Landfills.
- NSW EPA (1997) (now NSW DECC) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.
- NSW DEC (2006) (now DECC) Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition).
- NSW EPA (1999) (now NSW DECC) Contaminated Sites: Guidelines on Significant Risk of Harm and the Duty to Report.
- NSW DECC (2008) Waste Classification Guidelines Part 1: Classifying Waste and Part 2: Immobilisation of Waste.
- NSW Legislation (1948) Rivers and Foreshores Improvement Act.
- NSW Legislation (1975) Dangerous Goods Act.
- NSW Legislation (1994) Environmental Planning and Assessment Act (EP&AA) and associated Regulations.
- NSW Legislation (1997) Contaminated Land Management Act.
- NSW Legislation (1997) Protection of the Environment Operations Act No156 which includes Schedule 2 of the Clean Waters Regulations 1972 made under the Clean Waters Act (1970).
- NSW Legislation (2000) Occupational Health and Safety Act.
- NSW Regulation (2001) Occupation Health and Safety Regulation.
- NSW WorkCover (2008) Working With Asbestos Guide.
- US EPA (2004) Region 9 Preliminary Remediation Goals.

TABLE A-1
ENVIRONMENTAL AND HEALTH-BASED SOIL INVESTIGATION LEVELS (mg/kg)

Substances	Health Investigation Levels (HILs)[1]				Provisional Phyto-toxicity Investigation Levels (PPILs)[1]	NSW EPA Guidelines for Assessing Service Station Sites[2]	Back-ground Ranges[1]
	A	D	E	F			
	'Standard' residential with garden/ accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intake; no poultry); includes children's day-care centres, kindergartens, preschools and primary schools	Residential with minimal opportunities for soil access: includes dwellings with fully and permanently paved yard space such as high-rise apartments and flats	Parks, recreational open space and playing fields: includes secondary schools	Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites			
METALS/METALLOIDS							
Arsenic (total)	100	400	200	500	20		1-50
Barium					300		100-3000
Beryllium	20	80	40	100			
Cadmium	20	80	40	100	3		1
Chromium(III)	12%	48%	24%	60%	400		
Chromium(VI)	100	400	200	500	1		
Chromium (total)							5-1000
Cobalt	100	400	200	500			1-40
Copper	1000	4000	2000	5000	100		2-100
Lead	300	1200	600	1500	600		2-200
Manganese	1500	6000	3000	7500	500		850
Methyl mercury	10	40	20	50			
Mercury (inorganic)	15	60	30	75	1		0.03
Nickel	600	2400	600	3000	60		5-500
Vanadium					50		20-500
Zinc	7000	28000	14000	35000	200		10-300
ORGANICS							
Aldrin + Dieldrin	10	40	20	50			
Chlordane	50	200	100	250			
DDT + DDD + DDE	200	800	400	1000			
Heptachlor	10	40	20	50			
Polycyclic aromatic hydrocarbons (PAHs)	20	80	40	100			
Benzo(a)pyrene	1	4	2	5			
Phenol	8500	34000	17000	42500			
PCBs (total)	10	40	20	50			
Petroleum Hydrocarbon Components (constituents):							
>C16 - C35 Aromatics	90	360	180	450			
>C16 - C35 Aliphatics	5600	22400	11200	28000			
>C35 Aliphatics	56000	224000	112000	280000			
C6-C9						65	
C10-C40						1000	
Benzene						1	
Toluene						1.4	
Ethyl Benzene						3.1	
Total Xylenes						14	
OTHER							
Boron	3000	12000	6000	15000			
Cyanides (complexed)	500	2000	1000	2500			
Cyanides (free)	250	1000	500	1250			
Phosphorus					2000		
Sulfur					600		
Sulfate					2000		

Reference should be made to the following guidelines for further details (as referenced in the above table):

1 National Environment Protection (Assessment of Site Contamination) Measure - 1999, National Environment Protection Council. Human exposure settings based on land use have been established for HILs and details are outlined in Taylor and Langley 1998.

2 NSW DECC (formerly EPA) Guidelines for Assessing Service station Sites - 1994.

TABLE A - 2
CHEMICAL CONTAMINANT CRITERIA FOR WASTE CLASSIFICATION
Waste Classification Guidelines. Part 1: Classifying Waste DECC NSW April 2008

GENERAL SOLID WASTE	RESTRICTED SOLID WASTE	HAZARDOUS WASTE
IF SCC ≤ CT1, TCLP NOT NEEDED TO CLASSIFY AS GENERAL SOLID WASTE	IF SCC ≤ CT2, TCLP NOT NEEDED TO CLASSIFY AS RESTRICTED SOLID WASTE	IF SCC > SCC2 TREAT AS HAZARDOUS WASTE
IF TCLP ≤ TCLP1 AND SCC ≤ SCC1 TREAT AS GENERAL SOLID WASTE	IF TCLP ≤ TCLP2 AND SCC ≤ SCC2 TREAT AS RESTRICTED SOLID WASTE	IF > TCLP2 TREAT AS HAZARDOUS WASTE

	GENERAL SOLID WASTE			RESTRICTED SOLID WASTE		
CONTAMINANT	CT1 (mg/kg)	TCLP1 (mg/L)	SCC1 (mg/kg)	CT2 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	100	5	500	400	20	2,000
Beryllium	20	1.0	100	80	4	400
Cadmium	20	1.0	100	80	4	400
Chromium VI	100	5	1,900	400	20	7,600
Cyanide (total)	320	16	5,900	1280	64	23,600
Cyanide (Amenable)	70	3.5	300	280	14	1,200
Fluoride	3,000	150	10,000	12,000	600	40,000
Lead	100	5	1,500	400	20	6,000
Mercury	4	0.2	50	16	0.8	200
Molybdenum	100	5	1,000	400	20	4,000
Nickel	40	2	1,050	160	8	4,200
Selenium	20	1	50	80	4	200
Silver	100	5.0	180	400	20	720
Benzene	10	0.5	18	40	2	72
Toluene	288	14.4	518	1,152	57.6	2,073
Ethylbenzene	600	30	1,080	2,400	120	4,320
Total xylenes	1,000	50	1,800	4,000	200	7,200
Total petroleum hydrocarbons (C6-C9)	-	-	650	-	-	2,600
Total petroleum hydrocarbons (C10-C36) (C10-C14, C15-C28, C29-C36)	-	-	10,000	-	-	40,000
Benzo(a)pyrene	0.8	0.04	10	3.2	0.16	23
Polycyclic aromatic hydrocarbons (Total)	-	-	200	-	-	800
Polychlorinated biphenyls	-	-	<50	-	-	<50
Phenol (nonhalogenated)	288	14.4	518	1,152	57.6	2,073
Scheduled chemicals	-	-	<50	-	-	<50

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TABLE B
SUMMARY OF LABORATORY TEST DATA
SOIL CHARACTERISATION ASSESSMENT
All data in mg/kg unless stated otherwise

ANALYTE			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES				OP PESTICIDES	PCBs	PETROLEUM HYDROCARBONS								PID VALUES	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Aldrin and Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor			Petroleum Hydrocarbons				Benzene	Toluene	Ethyl Benzene	Total Xylenes		
																			C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10} - C_{36}					
PQL - Envirolab Services			4	0.5	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.5	0.5	1	3	
Site Assessment Criteria ^			200 *	40 *	24% *	2000 *	600 *	30 *	600 *	14000 *	40 *	2 *	20 *	100 *	400 *	20 *	0.1 ^^	20 *	65 #	NSL	NSL	NSL	1000 #	1 #	1.4 #	3.1 #	14 #	
Provisional Phyto-toxicity Investigation Levels			20 **	3 **	400 **	100 **	600 **	1 **	60 **	200 **	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	
Location	Depth in metres	DESCRIPTION																										
BH101	0.1-0.2	Fill - Silty sand	LPQL	LPQL	9	3	24	LPQL	1	10	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH102	0.2-0.4	Fill - Silty clay	6	0.6	17	46	240	0.2	20	***260***	**132**	**13**	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	370	360	730	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH103	0.5-0.7	Fill - Silty clay	10	2.5	16	***130***	***730***	***1.5***	30	***820***	30.4	**3.3**	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	120	LPQL	120	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH103	1.2-1.4	Natural - Clay	7	LPQL	14	8	22	LPQL	LPQL	3	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH105	0.15-0.3	Fill - Silty sand	LPQL	LPQL	20	14	26	LPQL	19	41	5.4	0.5	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH105	0.8-1.0	Natural - Clay	LPQL	LPQL	3	9	11	LPQL	LPQL	LPQL	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0	na
BH106	0.4-0.8	Fill - Sand gravel	LPQL	LPQL	6	29	170	0.3	3	140	3.8	0.4	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH107	0.2-0.4	Fill - Silty sand	6	LPQL	18	23	260	0.2	7	***220***	14.5	1.4	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH108	0.2-0.4	Fill - Clayey silt	5	0.7	25	53	***1000***	0.6	19	***470***	32.7	**2.9**	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	170	360	530	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH111	0.11-0.22	Fill - Silty sand	LPQL	3	2	1	2	LPQL	49	6	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH111	0.5-0.7	Fill - Silty sand	LPQL	1	6	5	13	LPQL	23	23	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not Detected
BH111	1.5-2.0	Fill - Silty sand	LPQL	1.2	7	***140***	180	LPQL	***81***	52	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	1.8	na
BH111	2.05-2.25	Natural - Clay	LPQL	LPQL	3	36	14	LPQL	***210***	3	na	na	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	2.7	na
Total no. of samples			13	13	13	13	13	13	13	13	11	11	8	8	8	8	8	8	12	12	12	12	12	12	12	12	13	8
Maximum Value			10	3	25	140	1000	1.5	210	820	132	13	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	370	360	730	LPQL	LPQL	LPQL	LPQL	2.7	NC

EXPLANATION:

^ Site Assessment Criteria: Guideline concentrations adopted for the investigation as outlined below:
* National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines) Health Investigation Levels (HIL) - Column E, Parks, recreational open space
** Provisional Phyto-toxicity Investigation Levels (PPILs)
# NSW DECC (EPA) Guidelines for Assessing Service Station Sites - 1994
^^ In the absence of Australian guidelines, the laboratory PQL has been adopted as the site assessment criteria

Concentration above the Site Assessment Criteria **VALUE**
Concentration above PPILs ***VALUE***

ABBREVIATIONS:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)Pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
na: Not Analysed
NC: Not Calculated
OP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls
NSL: No Set Limit

TABLE C
SUMMARY OF LABORATORY TEST DATA
TOXICITY CHARACTERISTICS LEACHING PROCEDURE (TCLP)
All data in mg/L unless stated otherwise

ANALYTE	Lead	Nickel	B(a)P
PQL - Envirolab	0.03	0.02	0.001
TCLP1 - General Solid Waste *	5	2	0.04
TCLP2 - Restricted Solid Waste *	20	8	0.16
TCLP3 - Hazardous Waste *	>20	>8	>0.16
SAMPLE (Depth in metres)			
BH102 (0.2 - 0.4)	0.08	na	LPQL
BH103 (0.5 - 0.7)	0.16	na	LPQL
BH106 (0.4 - 0.8)	0.14	na	na
BH107 (0.2 - 0.4)	0.07	na	LPQL
BH108 (0.2 - 0.4)	0.36	na	LPQL
BH111 (1.5 - 2.0)	0.08	0.19	na
BH111 (2.05 - 2.25)	na	**4.6**	na
Total no. of samples	6	2	4
Maximum Value	0.36	4.6	LPQL

EXPLANATION:
* NSW DECC (EPA) Waste Classification Guidelines - Part 1: Classifying Waste - April 2008

Concentration above the General Solid Waste guideline level — VALUE
Concentration above the Restricted Solid Waste guideline level — VALUE

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
B(a)P: Benzo(a)Pyrene
na: Not Analysed

TABLE D
SOIL INTRA-LABORATORY DUPLICATE RESULTS
QA/QC - RELATIVE PERCENTAGE DIFFERENCES

SAMPLE	ANALYSIS	INITIAL (mg/kg)	REPEAT (mg/kg)	MEAN (mg/kg)	RPD %
Intra-laboratory Soil sample ID = BH111 (0.5-0.7) Dup ID = Dup 1 Envirolab Report: 28383	Arsenic	LPQL	LPQL	NC	NC
	Cadmium	1	1.4	1.2	33
	Chromium	6	7	6.5	15
	Copper	5	22	13.5	***126***
	Lead	13	16	14.5	21
	Mercury	LPQL	0.1	0.1	NC
	Nickel	23	89	56	***118***
	Zinc	23	48	35.5	***70***
Intra-laboratory Soil sample ID = BH105 (0.8-1.0) Dup ID = Dup 2 Envirolab Report: 28382	Arsenic	LPQL	LPQL	NC	NC
	Cadmium	LPQL	LPQL	NC	NC
	Chromium	3	3	3	0
	Copper	9	9	9	0
	Lead	11	10	10.5	10
	Mercury	LPQL	LPQL	NC	NC
	Nickel	LPQL	LPQL	NC	NC
	Zinc	LPQL	LPQL	NC	NC

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
NC: Not Calculated

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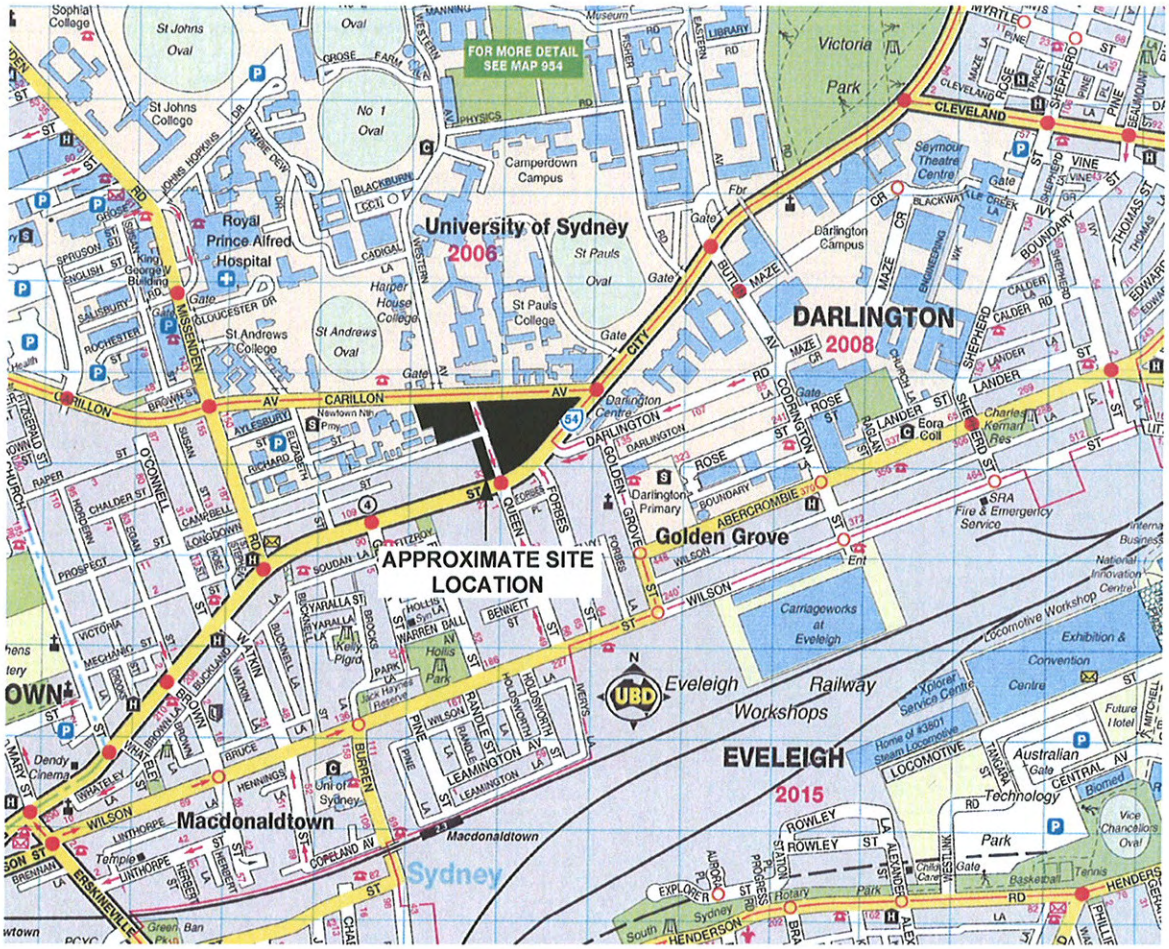
May, 2009



Ref: UBD Street Directory 2008 (44th Ed), Copyright Universal Publisher Pty Ltd.

NOTE: Reference should be made to the text for a full understanding of this plan

SITE LOCATION PLAN

Cnr King Street & Carillon Avenue, Newtown, NSW

EIS

ENVIRONMENTAL INVESTIGATION SERVICES

Job No: E21871K
Figure: 1