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Phase 1 Environmental Site Assessment

75 Old Pittwater Road, Brookvale

for Clareville Pty Ltd
November 2011

J1566.2R-rev0

C. M. Jewell & Associates Pty Ltd

Phase 1 Environmental Site Assessment – 75 Old Pittwater Road, Brookvale
November 2011

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Measures

µg/L	micrograms per litre
km	kilometre
L	litre
m	metre
m^2	square metre
µS/cm	microsiemens per centimetre
mS/cm	millisiemens per centimetre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mm	millimetre

General

AHD	Australian Height Datum
AMG	Australian Map Grid
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	above-ground storage tank
CLM Act	Contaminated Land Management Act
CMJA	C. M. Jewell & Associates Pty Ltd
COPC	contaminants of potential concern
DA	development application
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DLWC	Department of Land and Water Conservation
DNAPL	dense non-aqueous-phase liquid
DNR	Department of Natural Resources
DP	deposited plan
DQO	data quality objectives
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
GDE	groundwater dependent ecosystems
HDPE	high-density polyethylene
MNA	monitored natural attenuation
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
PID	photoionisation detector
PQL	practical quantitation limit
ppmv	parts per million volume
PSH	phase-separated hydrocarbons
QA	quality assurance
QC	quality control
RAP	remediation action plan
RL	relative level
RPD	relative percentage difference
SWL	standing water level
TCLP	Toxicity Characteristics Leaching Procedure
THI	target hazard index
TOC	top of casing
TWA	time weighted average
UCL	upper confidence limit
UST	underground storage tank

Analytes – Organic

BaP	benzo(a)pyrene
BTEX	benzene, toluene, ethylbenzene, xylene
OCP	organochlorine pesticides
OPP	organophosphorus pesticides
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
SVOC	semivolatile organic compounds
TPH	total petroleum hydrocarbons
VHC	volatile halogenated compounds
VOC	volatile organic compounds

Analytes – Inorganic

As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Fe	Iron
Hg	Mercury
Mn	Manganese
Ni	Nickel
Pb	Lead
Zn	zinc

1.0 INTRODUCTION

1.1 Background

The Phase 1 Environmental Site Assessment (ESA) that this report describes, relates to land located at 75 Old Pittwater Road, Brookvale, New South Wales (the site). Specifically, the site is identified as Lot 2 in DP600059 and Lot A in DP166808.

The site location and setting is illustrated on the attached Figure 1.

C. M. Jewell & Associates Pty Ltd (CMJA) understands that the site is owned by Harrison Investments Pty Ltd (Harrison), which is owned by Clareville Pty Limited (Clareville). Other associated companies owned by Clareville include Harrison Manufacturing Co Pty Ltd (HMC) and A.S. Harrison Trading Company (ASH).

The site was purchased by Harrison in 1959 and operates as a chemical manufacturing facility; in particular, for the manufacturing of grease and mineral oil-based lubricants. The site covers an area of approximately 2.6 hectares (as provided by Harrison).

Historically:

- Prior to European settlement, the site was located on the extremity of a wetland now identified as Manly Lagoon.
- From 1840 to 1930, the site was used for farming.
- From 1930 to 1959, the site was used as a market garden.

Harrison is the holder of Environmental Protection Licence No.139 (the licence) issued under the *Protection of the Environment Operations Act* (1997), authorising the carrying out of scheduled activities on site. On 7 May 2004, the NSW Environmental Protection Authority[1] (EPA) issued a licence variation notice to Harrison, placing a Pollution Reduction Program (PRP) on the licence. The PRP required Harrison to *assess the performance of onsite treatment devices that prevents pollution of waters by the development of appropriate monitoring programs.*

Accordingly, Harrison commissioned Environmental Investigation Services (EIS) to coordinate the installation of groundwater monitoring wells and conduct groundwater monitoring on site.

During June 2003 and March 2005, twenty groundwater monitoring wells were installed at the site, at locations identified on Figure 4. (*Note:* The location of BH110 is unknown). EIS conducted five groundwater monitoring events between May 2005 and September 2008, submitting samples for laboratory analysis of:

- total petroleum hydrocarbons (TPH);
- benzene, toluene, ethyl-benzene, xylenes (collectively known as BTEX);
- polycyclic aromatic hydrocarbons (PAH); and
- phenols.

CMJA notes that TPH was the only contaminant of concern to exceed the relevent groundwater assessment criteria. Specifically, TPH fraction C_6-C_9 exceeded the *Airports (Environment Protection)*

[1] Because the relevant government department has changed its name several times in recent years, CMJA consider that it is simpler to now refer to it as the Environment Protection Authority (EPA) – being the statutory body responsible for regulation pursuant to the Contaminated Land Management Act 1997.

Regulations (1997) acceptable limit for freshwater, with concentrations ranging from 150 to 590 µg/L. All other contaminant concentrations were generally below the limit of reporting (LOR).

Details of EIS's groundwater monitoring events are provided in Section 3.5.

It is understood that the PRP has since been complied with, and the EPA requires no further groundwater monitoring to be conducted as part of that notice of variation to the licence.

From initial conversations with Harrison and their advisors MergeCo Pty Ltd (MergeCo), a Phase 1 ESA is required for internal purposes. Specifically, one of three owners is proposing to sell their part of the business and they wish to investigate the environmental condition of the site.

On 9 August 2011, Mr Anthony Bell, the Chief Executive Officer of Harrison, commissioned CMJA to conduct a Phase 1 ESA at the site; in accordance with CMJA's proposal J1566.1L-rev2, dated 5 August 2011. Additionally, on 29 September 2011, Mr Bell approved an extension of works as part of the Phase 1 ESA (as recommended by CMJA), in accordance with CMJA's proposal J1566.3L, dated 16 September 2011.

This report presents the findings of CMJA's Phase 1 ESA.

Note: It is not the purpose of this assessment to ascertain whether the operations on site are compliant with NSW statutory requirements or industry best practice – this is the responsibility of Harrison as part of its ongoing due diligence – rather, it is the purpose of this assessment to ascertain whether the facility has potentially given rise to contamination of the soil and/or groundwater.

1.2 Project Objectives

The objectives of this project were:

- to obtain historical and current information on the site occupation and use;
- to read any previous groundwater monitoring reports provided by Harrison;
- to identify aquifer and aquitard units in the geological profile beneath the site;
- to assess the hydraulic gradient and groundwater flow direction across the site;
- to identify any potential sources of contamination;
- to assess the nature and the lateral and vertical extent of any existing groundwater contamination;
- to assess the potential for off-site migration of any identified contamination;
- to provide a qualitative assessment of risks associated with any identified groundwater contamination; and

1.3 Scope of Work

To meet the project objectives, the following scope of work was undertaken.

- Carry out historical and current land title search, to identify previous and current site owners and uses.
- Review historical aerial photography – supplied by the Department of Lands.
- Identify adjacent land uses.

- Carry out desktop assessment of the local groundwater conditions (predominantly based on EIS reports and NSW Office of Water data).
- Conduct site walkover inspection for identification of potential contaminants of concern and likely contamination pathways.
- Obtain current site photographs.
- Interview Mr Anthony Bell (CEO), Mr Graeme Harrison (Director) and Mr Frank van der Zanden (Operations Manager) of Harrison.
- Assess environmental conditions at the site, including topography, geology, hydrogeology, soil type, surface water drainage, and flood potential.
- Search for Warringah Council (Council) development application (DA) and building application (BA); and any provisions of s149 (5) planning certificate.
- Coordinate and assist Harrison with the recovery of groundwater monitoring wells installed by EIS. A total of seven groundwater monitoring wells were recovered.
- Develop all recovered monitoring wells using a (decontaminated) stainless steel bailer.
- Arrange for a licensed surveyor to survey all seven groundwater monitoring wells in order to determine their location (easting and northing) and elevation (metres above Australian Height Datum).
- Measure the standing water level (SWL) within each monitoring well using an electric water level meter.
- Assess the flow direction and hydraulic gradient of groundwater based on survey and SWL data.
- Purge groundwater and collect groundwater samples from six wells, with a duplicate sample being obtained from one of the wells for quality assurance/quality control (QA/QC) purposes.
- Measure the field physio-chemical parameters of groundwater (i.e. temperature, electrical conductivity, pH, redox potential and dissolved oxygen) during purging and prior to sampling of each well.
- Submit samples to a NATA accredited laboratory for analysis for:
    - TPH,
    - volatile organic compounds (VOC), and
    - semi-volatile organic compounds (SVOC).
- Review and interpretation of analytical results.
- Prepare this Phase 1 ESA report, incorporating the results of the investigation and recommendations.

1.4 Report Format

Section 1 of this report provides background information, the project objectives and the scope of work undertaken.

Section 2 sets out basic identification details and location of the site; and briefly describes the site's use, topography and drainage, geology, and hydrogeological setting.

Section 3 provides site history information, including a historical photograph review and summary of previous groundwater investigations and Section 4 provides details of CMJA's site visit.

Section 5 summarises key areas of potential concern on site, whilst Section 6 outlines the contaminants of concern in groundwater, and the criteria applicable to the assessment.

Section 7 discusses the groundwater assessment, including well development details, sampling methodology, inferred groundwater flow direction and analytical results.

Section 8 outlines field and laboratory QA/QC and presents an assessment against data quality indicators.

Section 9 presents the conclusions and recommendations of the Phase 1 ESA.

1.5 Limitations and Intellectual Property Matters

This report has been prepared by C. M. Jewell & Associates Pty Limited for the use of the client identified in Section 1.1, for the specific purpose described in that section. The project objectives and scope of work outlined in Sections 1.2 and 1.3 were developed for that purpose, taking into consideration any client requirements and budgetary constraints.

The work has been carried out, and this report prepared, utilising the standards of skill and care normally expected of professional scientists practising in the fields of hydrogeology and contaminated land management in Australia. The level of confidence of the conclusions reached is governed, as in all such work, by the scope of the investigation carried out and by the availability and quality of existing data. Where limitations or uncertainties in conclusions are known, they are identified in this report. However, no liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been assessed or predicted using the adopted scope of investigation and the data derived from that investigation. An information sheet – 'Important Information about your Environmental Site Assessment' – is provided with this report. The report should be read in conjunction with that information sheet.

Where data collected by others have been used to support the conclusions of this report, those data have been subjected to reasonable scrutiny but have essentially, and necessarily, been used in good faith. Liability cannot be accepted for errors in data collected by others.

This report, the original data contained in the report, and its findings and conclusions remain the intellectual property of C. M. Jewell & Associates Pty Ltd. A licence to use the report for the specific purpose identified in Section 1.1 is granted to the persons identified in that section on the condition of receipt of full payment for the services involved in the preparation of the report.

This report should not be used by other persons or for other purposes than those identified in Section 1.1, and should not be reproduced except in full and with the permission of C. M. Jewell & Associates Pty Ltd.

2.0 SITE CONDITIONS

2.1 Site Identification

The site is located at 75 Old Pittwater Road, Brookvale, NSW. Brookvale is a suburb located in northern Sydney and is part of the northern beaches region. The site location and setting is illustrated on Figure 1.

At the date of this report, the description of the site is Lot 2 in DP600059 and Lot A in DP166808.

The site lies within the Warringah Council Local Government Area in the Parish of Manly Cove, County of Cumberland, and is currently zoned IN1 General Industrial.

The property covers an area of approximately 2.6 hectares. Australian Map Grid (AMG) coordinates for the centre of the site are approximately $_{3}39125$ metres east and $_{62}62375$ metres north within grid Zone 56.

2.2 Site Description

The site is covered with concrete pavement, asphalt and gravel roads, gravel and grassy vegetation.

There are ten key structures located on site; these are listed in Table 1; whilst the site layout is illustrated on Figure 2.

TABLE 1
Key Structures on Site

Structure Identification	Location
1. Office building	North-west corner of site, adjacent to Harrison carpark.
2. Laboratory (former farm house)	Adjacent to western boundary, south of office building.
3. A.S. Harrison Trading Company Warehouse	South-west portion of site, south of laboratory, north of Harrison Manufacturing Company warehouse, west of factory.
4. Harrison Manufacturing Company Warehouse	South-west portion of site, south of A.S. Harrison Trading Company Warehouse, west of factory.
5. Factory	South-east portion of site, east of warehouses, west of amenity buildings.
6. Amenity building	South-east corner of site, east of factory, adjacent to Brookvale Creek.
7. Amenity building	South-east corner of site, east of factory, adjacent to Brookvale Creek.
8. Tank Farm	East of factory.
9. Biopond	Adjacent to the north-east corner of the factory
10. Biopond	South of the Tank Farm, east of the factory.

Note: The road surrounding the factory is predominantly compacted gravel.

Additionally:

- Two cooling towers, a scrubber system, a gas storage area, a dangerous goods storage area and a transformer (in a locked and bunded area) surround the factory.
- A drainage system is located within and surrounding the factory.
- An electrical substation is located east of the office building.
- A large part of the site is used to store new motor vehicles.

2.3 Current Site Use

The site predominantly operates as a chemical manufacturing facility, in particular, the manufacturing of grease and mineral oil-based lubricants.

A large part of the site is used to store over 100 new motor vehicles for two car companies; and other lessees (discussed in Section 3.1) utilise part of the office block.

2.4 Surrounding Area

At the date of this report, the site is bounded as outlined below.

To the north	Old Pittwater Road, beyond which is an office block and an industrial cable manufacturer.
To the east	Brookvale Creek, beyond which is a warehouse that is used for linen distribution.
To the south	Warringah Mall and a pre-school.
To the west	Engineering facility, and a china and glassware importing company.

The current surrounding land uses are not considered to be significant issues of concern.

2.5 Topography and Drainage

The site lies at an elevation of approximately 15 metres above Australian Height Datum (AHD) and generally slopes down to the east, toward Brookvale Creek.

Drainage of the site on gravel and grassy surfaces, e.g. the car storage areas and the gravel roadway surrounding the factory, occurs through surface infiltration. A drainage system predominantly operates within and in areas around the factory. Within the factory, any runoff enters a drainage system that discharges into the oil/water separator tanks located within the bunded area on site.

Runoff from the factory roof enters a drainage system that discharges into Brookvale Creek (identified on Figure 2), whilst runoff from the northern forecourt of the factory enters a separate drainage system that also discharges into Brookvale Creek.

Photograph 1: Factory forecourt drainage point

Photograph 2: Discharge point into Brookvale Creek from forecourt of factory

Photograph 3: Discharge point into Brookvale Creek from roof of factory

2.6 Geology

The Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1) 1983, indicates that the site is underlain by the Mid-Triassic age Hawkesbury Sandstone, which here contains predominantly medium to coarse grained quartz sandstone, with very minor shale and laminite lenses.

Based on EIS's borehole logs, it appears that the site is generally underlain by fill material, sand and clayey sand. The depth of fill material ranges from 0.0 to 4.0 metres, and is composed of silty sand, sandy clay and/or gravelly sand. Traces of ash, glass, brick, slag and concrete were also identfied within the some of the fill material.

2.7 Hydrogeology

2.7.1 Groundwater Regime

Beneath the site, groundwater is present within the Hawkesbury Sandstone at depths of 2 to 3 metres below ground surface.

Generally within the Hawkesbury Sandstone, groundwater flow conditions are variable. Much of the Hawkesbury Sandstone has low primary permeability, although exceptions do occur. Hydraulic conductivity is often enhanced along bedding plane fractures, joints and faults, and these are the features likely to be the primary groundwater flow pathways in the area.

Elsewhere, water-bearing zones in the Hawkesbury Sandstone have been encountered mostly at depths of 10 to 50 metres, with some to a maximum of 150 metres.

Beneath the site, it is likely that the Hawkesbury Sandstone hosts a shallow unconfined aquifer with dual permeability, i.e. both intergranular and fracture flow occur. It is likely that groundwater flows to the east, with shallow flow discharging to Brookvale Creek, and deeper flow discharging close to the coast.

Regionally, reported borehole yields are in the range of 0.1 to 4.0 litres per second (L/s), most being of the order of 0.4 L/s. The water is generally of good quality, ranging in salinity from 200 to 8400 milligrams per litre (mg/L) total salts and in hardness from 50 to 130 mg/L. Iron content is often high, and typically at the lower end of this range in outcrop areas. The water is often slightly acidic.

2.7.2 Local Registered Groundwater Wells

Groundwater beneath the site is regulated by the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources, which commenced in July 2011. This groundwater is part of the Sydney Basin Central groundwater source.

Groundwater from this source may only be taken subject to the grant of an aquifer access licence and works approval for the bore or other abstraction works.

A search of the NSW Office of Water (NOW) groundwater works natural resource database identified six registered groundwater wells located within 2 kilometres of the site.

Details of each groundwater well are described in Table 2, whilst Figure 3 shows the locations of the local registered groundwater wells.

Appendix B presents the groundwater works summary for the six registered boreholes.

TABLE 2
Local Registered Groundwater Wells

Groundwater Well No.	Use	SWL (m)	Well Depth (m)	Screened Zone (m)	Geology*
GW108144	Recreation (groundwater)	15.0	150.0	18.0 – 36.0 132.0 – 138.0	0.0 – 4.0: sand 4.0 – 15.0: red clay bands 15.0 – 21.0: sandstone yellow 21.0 – 25.0: shale 25.0 – 68.0: sandstone/shale 68.0 – 75.0: shale 75.0 – 86.0: sandstone/shale 86.0 – 91.0: shale 91.0 – 131.0: sandstone/shale 131.0 – 143.0: shale 143.0 – 146.0: sandstone/shale 146.0 – 150.0: shale
GW107745	Domestic	9.0	15.0	11.0 – 12.0	0.0 – 15.0: sand
GW108944	Domestic	13.0	120.0	Unknown	Geology not provided
GW020066	Waste Disposal	Unknown	106.6	Unknown	0.0 – 0.3: topsoil 0.3 – 5.18: clay 5.18 – 9.44: clay shale 9.44 – 11.27: pipe clay white 11.27 – 11.88: driller 11.88 – 14.02: pipe clay white 14.02 – 14.63: sandstone clay 14.63 – 33.83: sandstone 33.83 – 34.44: clay white sandstone decomposed 34.44 – 54.86: sandstone grey 54.86 – 60.96: sandstone white 60.96 – 62.17: sandstone shale 62.17 – 64.0: sandstone 64.0 – 67.05: shale 67.05 – 104.54: sandstone 104.54 – 106.6: shale grey (water supply)
GW020108	Waste Disposal	Unknown	134.10	Unknown	0.0 – 0.3: topsoil 0.3 – 2.74: clay red 2.74 – 3.35: pipe clay white 3.35 – 4.26: driller 4.26 – 6.09: sandstone 6.09 – 7.62: clay 7.62 – 12.8: sandstone clay 12.8 – 33.52: sandstone 33.52 – 37.79: clay grey shale 37.79 – 51.51: sandstone 51.51 – 53.64: clay white 53.64 – 57.91: clay grey shale 57.91 – 61.56: sandstone hard 61.56 – 67.97: sandstone clay seams 67.97 – 102.1: sandstone 102.1 – 103.63: shale 103.63 – 134.1: sandstone

TABLE 2
Local Registered Groundwater Wells

Groundwater Well No.	Use	SWL (m)	Well Depth (m)	Screened Zone (m)	Geology*
GW035775	Waste Disposal	Unknown	146.30	Unknown	0.0 – 0.3: topsoil 0.3 – 4.26: clay red 4.26 – 5.18: driller 5.18 – 7.62: clay white 7.62 – 8.22: clay grey 8.22 – 16.15: sandstone clay 16.15 – 35.05: sandstone 35.05 – 39.92: shale clay 39.92 – 55.77: sandstone 55.77 – 56.69: clay 56.69 – 57.6: shale clay 57.6 – 62.78: sandstone 62.78 – 76.2: sandstone clay seams 76.2 – 113.38: sandstone 113.38 – 116.43: shale 116.43 – 129.84: sandstone 129.84 – 133.50: sandstone shale 133.50 – 137.46: sandstone 137.46 – 137.76: shale 137.76 – 146.30: sandstone clay seams

Notes: SWL Standing Water Level
* As described in drillers logs

Standing water level (SWL) measurements obtained from EIS in October 2006 ranged from 2.3 metres below ground level (bgl) to 3.2 metres bgl.

Note: The borehole logs provided by EIS also included approximate SWL's for BH1 to BH7 and BH101 to BH112.

2.8 Meteorology

Records collected by the Bureau of Meteorology (BOM) indicate that annual rainfall is approximately 1213.7 millimetres. This has been averaged from data received from the Sydney Observatory Hill weather station (located approximately 11.7 km from site), over a period of 153 years.

The area received approximately 228 millimetres of rainfall in the three months prior to the groundwater sampling event (BOM 2011). This figure is based on data received from the Frenchs Forest Road weather station.

3.0 SITE HISTORY

3.1 NSW Land Titles Search

On 15 August 2011, CMJA conducted historical land title searches for Lot 2 in DP600059 and Lot A in DP166808, through the Department of Lands. The searches provided the name of the current site owner and lessees but offered minimal information regarding previous ownerships and site usage. The following details were provided.

Lot 2 in DP600059 (as of 5 November 2003):

- Owned by Harrison Investments Pty Ltd.
- Lease to Energy Australia of Substation No. 15986, together with right of way and easement for electricity purposes.
- Easement to drain water 2 metres wide and variable affecting the part(s) shown so burdened in DP1017692.

  Note: The easement extends a short distance along part of the south-western boundary of the site.
- Lease to Wilfred Docker & Co Pty of suite 1AAA (part of office block).
- Lease to Outshine Cleaning Company Pty Ltd of suite 1GA (part of office block).

  Note: Harrison indicated that Outshine Cleaning Company no longer occupied part of the office block.
- Lease to A.C.C. Austpac Chemicals and Commodities Pty Ltd of suites 1C & 1E (part of office block.

  Note: Harrison indicated that Austpac Chemicals and Commodities no longer occupied part of the office block.

Lot A in DP166808 (date not available):

- Owned by Harrison Investments Pty Ltd.

Copies of the historical documents are provided as Appendix C.

3.2 Site History as provided by Harrison Staff

The following site history has been provided by Mr Anthony Bell (CEO), Mr Graeme Harrison (Director) and Mr Frank van der Zanden (Operations Manager) of Harrison.

- Harrison purchased the site in 1959.
- Fill material was imported to site approximately 30 to 35 years ago. No documentation regarding the fill material could be located and the placement of this material is undefined.
- A foundry formally operated on part of the land west of the site. It is understood that foundry operations ceased in the late 1990s.

Laboratory

- The laboratory building was previously used as a farmhouse.

HMC and ASH Warehouses

- HMC and ASH operate from two large warehouses on site.
- The HMC warehouse was constructed in 2005, following approval of a development application (submitted to Council on 18 October 2004) for the construction of a packaging warehouse on site.
- The ASH warehouse was constructed in 1987.

Tank Farm

- The bunded area was installed in the early 1960s.
- Supply Side Pty Ltd assessed the integrity of the bund and the bund sump in August 2006, and no major problems were identified. However, it was identified in the assessment that:
  - as is common with such installations, there is evidence of minor slippage/movement at some stage since the concrete was formed;
  - there are numerous minor cracks in both the base of the bund and in the bund wall, there are also a number of hydraulic cuts, with uncertain depth; and
  - the associated weirs overflow to the roadway gully and discharge into bioponds.

3.3 Search of Development Applications

CMJA requested a search of development applications and building applications submitted to Council. In response, Council provided CMJA with the following information.

DA2008/1742

New - Construction of stormwater upgrade works for Warringah Mall and watercourse bank stabilisation works
Lodged: 18/12/2008
Address: 75 Old Pittwater Road, Brookvale NSW 2100
Address: 30 / 0 Old Pittwater Road, Brookvale NSW 2100
Address: 145 Old Pittwater Road, Brookvale NSW 2100
Address: 2741 / 9999 Condamine Street, Manly Vale NSW 2093
Address: 2742 / 9999 Condamine Street, Manly Vale NSW 2093
Applicant: AMP Capital Investors Ltd, c/- AMP Capital Shopping Centres
Development Application Referral Body: Department Of Water & Energy NSW
Owner: AMP Warringah Mall Pty Ltd
Owner: Westfield Management Ltd

DA2004/1324

Converted DA - Construction of a Warehouse (identified as HMC Warehouse)
Lodged: 18/10/2004
Address: 75 Old Pittwater Road, Brookvale NSW 2100
Applicant: Infort Pty Ltd
Owner: Harrison Investments Pty Ltd

BA5002/5075

Converted BA - Add N
Lodged: 10/06/1994
Address: 75 Old Pittwater Road, Brookvale NSW 2100
Applicant: Harrison Manufacturing Pty Ltd

BA5002/4993
Converted BA - Add N Date Type Note 02/11/1994
Final Inspected by: DB Notes: Satisfactory 13/09/1994
Drainage Stormwater Inspected by: DB Notes: Satisfactory
Lodged: 30/05/1994
Address: 75 Old Pittwater Road, Brookvale NSW 2100
Applicant: Dulcie Laurel Anderson
Owner: Harrison Investments Pty Ltd

3.4 Historical Photographs

Historical photographs from the Warringah area were supplied by the Department of Lands.

The information provided in Table 3 is site-specific and based on CMJA's review of aerial photographs that were taken between 1930 and 2009.

TABLE 3
Review of Aerial Photographs

Date	Summary
6 March 1930	The site and land to the west was relatively undeveloped and appeared to be used for agriculture. However, some development had occurred to the north-east and south-east of the site. Brookvale Creek and Old Pittwater Road are distinguishable. The low resolution of this photo makes further interpretation difficult.
21 June 1956	The site appeared to be operating as a market garden, based on the number of building structures present, site history information and that there was evidence of land clearing and segmenting for garden beds. The building structures included: • Two small buildings in the north-western corner (positioned where the office building is currently located); • Farm house (currently used as a laboratory); • Two small buildings in the south-eastern corner (one currently used as an amenities building); • Two small buildings along the western boundary of the site (positioned where warehouses are currently located). The land in close proximity of the site appeared to be used for agricultural purposes. Land to the west of the site remained relatively undeveloped, however all other surrounding land had been developed for predominantly residential and industrial purposes.
1961 (date unspecified)	The factory was present on the south-eastern corner of the site and one of the small buildings in the south-eastern corner had been removed. A driveway was evident from Old Pittwater Road to and surrounding the factory, however the site remained uncapped. A number of larger building structures had been constructed on land in close proximity to the site.
11 April 1978	The two small buildings in the north-western corner of the site had been replaced by the office building. The carpark adjacent to the office building could be identified. The tank farm was present and a number of building structures were located east of the factory. Areas of the site appeared to be capped, most notably, the carpark and the northern part of the driveway. The south-western corner of the site was being used to store motor vehicles and the two small buildings along the western boundary had been removed. The site appeared to be located in an industrial setting.
4 October 1994	The ASH Warehouse was present west of the factory. The ground surface between the factory and the oil fill point appeared to be capped.
10 December 2005	A building footprint for the HMC Warehouse could be identified.
1 January 2009 (Google Earth)	The HMC Warehouse had been constructed. The motor vehicle storage area had extended to incorporate land surrounding the laboratory. All other current structures on site could be identified i.e. cooling towers, scrubber system and the dangerous goods storage area.

3.5 Previous Groundwater Monitoring on Site

EIS carried out five groundwater monitoring events at the site between May 2005 and September 2008. For each event, EIS:

- purged each monitoring well four times using a disposable polyethylene bailer prior to sampling; and
- submitted all samples to a NATA accredited laboratory where they were analysed for TPH, BTEX, PAH and phenols.

  Note: All samples were placed in ice cooled Esky's and sent to the laboratory on the day of sampling or otherwise refrigerated for next day despatch, accompanied by chain of custody documentation

Results of the analysis for the five groundwater monitoring events are summarised below.

The locations of the groundwater monitoring wells are identified on Figure 4 (*Note:* the location of BH110 is unknown). Borehole logs for all monitoring wells are provided as Appendix A.

Event 1: 12 May 2005

EIS collected twelve groundwater samples on 12 May 2005 and analytical results were as follows:

- TPH (C_6-C_9) concentrations in BH101, BH102, BH103, BH104 and BH113 were above the adopted criteria (referenced in Section 6.3).
- The TPH (C_{10}-C_{36}) concentration in BH106 was above the adopted criteria.
- All other contaminant concentrations were below the LOR.

Note: Harrison indicated that materials that contain C_6-C_9 hydrocarbon chains are not handled in significant volumes and only lubricating oils in the higher carbon number ranges are processed on site.

Event 2: 6 – 9 December 2005

EIS collected twelve groundwater samples from 6 to 9 December 2005 and analytical results were as follows:

- TPH (C_6-C_9) concentrations in BH101, BH102, BH103, BH104, BH111, BH112 and BH113 were above the adopted criteria.
- All other contaminant concentrations were below the LOR.

Note: The technical manager of Harrison was advised by a member of the Board of Directors that a foundry previously operated on land adjacent to (west of) the site. The foundry operated for approximately 20 years and ceased operations in the late 1990s.

Event 3: 17 –18 October 2005

EIS collected eleven groundwater samples from 17 to 18 October 2005 and analytical results were as follows:

- TPH (C_6-C_9) concentrations in BH102, BH103, BH104 and BH113 were above the adopted criteria.
- All other contaminant concentrations were below the LOR.

Event 4: 13 – 14 September 2007

EIS collected eleven groundwater samples from 13 to 14 September 2007 and analytical results were as follows:

- TPH (C_6-C_9) concentrations in BH102, BH103, BH104 and BH113 were above the adopted criteria.
- All other contaminant concentrations were below the LOR.

Event 5: 9 September 2008

EIS collected ten groundwater samples on 9 September 2008 and analytical results were as follows:

- TPH (C_6-C_9) concentrations in BH102, BH103, BH104 and BH113 were above the adopted criteria.
- All other contaminant concentrations were below the LOR.

4.0 SITE VISIT

On 17 August 2011, Lesley Randall of CMJA conducted a site visit, where three site walkovers were undertaken (inside and outside of building structures).

4.1 Site Visit Observations

The following was observed throughout the site visit.

Office Building

- The office building was inspected and no significant issues of concern were identified.

Laboratory

- A small-scale oil and grease manufacturing system operates within the laboratory.
- All waste oils and chemicals from the laboratory are disposed of in designated bins and removed by licenced contractors.
- The floor of the laboratory is paved and sealed, and appears to be in good condition. Overall, no significant issues of concern were identified to be associated with the laboratory.

HMC and ASH Warehouses

- The warehouses were predominantly used to store packaged goods.
- The warehouses were inspected and no significant issues of concern were identified.

Factory

- The factory is used as a chemical manufacturing facility; in particular, the manufacturing of grease and mineral oil-based lubricants.
- Approximately 100 empty drums are removed from site four days a week.

  Note: Drums are cleaned by Harrison staff on site, i.e. emptied and wiped on the outside using a kerosene-dampened rag.
- The drums are used to store additives, base and mineral oils and grease.
- Waste oil drums are predominantly stored within the bunded area.
- Waste grease drums are predominantly stored outside, along the southern wall of the factory.
- All waste oil and grease drums are removed by licenced contractors.
- Runoff from the factory is drained to a water treatment plant located on the western side of the factory (adjacent to scrubber system) and the oil/water separator on site.

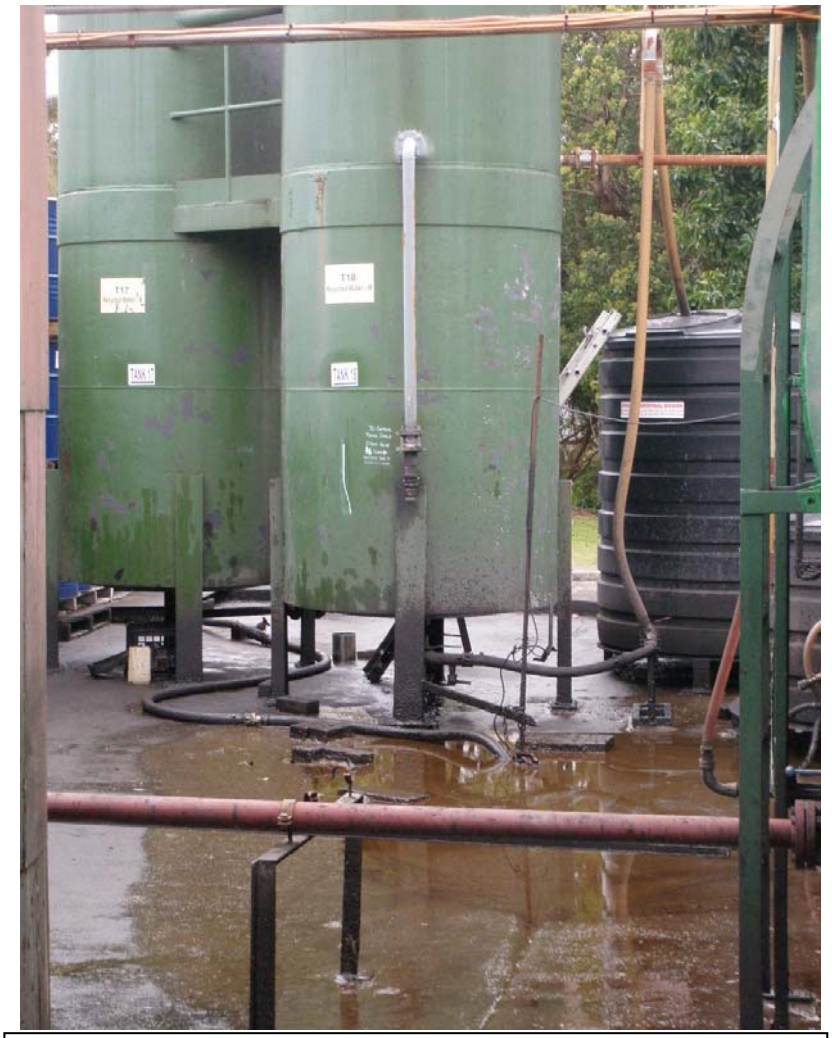
Amenity Buildings

- The amenity buildings were inspected and no significant issues of concern were identified.

Photograph 4: Waste grease drums stored outside, along the southern wall of the factory

Tank Farm

- A tank farm is located adjacent to the factory, within a bunded area. There is evidence of rainfall pooling in some areas of the bund, with an oil sheen covering the surfaces of the pools.
- The bunded tank farm holds a total of twenty tanks.
- Two above ground oil/water separator tanks are located within the bunded area.
- Two recycled water tanks are located within the bunded area.
- The tank volumes range from 7250 to 55,000 litres (excluding the oil/water and recycled water tanks).
- A bund sump is located at the northern end of the bunded area.
- An oil fill point is located adjacent to (east of) the tank farm – beyond the bunded area.
- Trucks connect pipes to specific fill points to fill tanks in tank farm.
- A drain is situated beneath the oil fill point and any spillage is directed into the oil/water separator. Staining of the concrete below the fill points is evident.
- Pipelines from the fill point travel above head and into a designated tank within the tank farm. The contents of the tanks are then transferred via pipelines (above-head) to the grease and oil making room inside the factory. There is no evidence of leakage from the above head pipelines.
- An electric submersible pump is located inside the bund sump to pump water into the oil/water separator.
- The contents within the oil and water separators are left to settle for a given period of time, allowing for the oil and water to separate. A licenced contractor then removes the oil that settles on the surface, and the water at the base of the tanks is transferred to the recycled water tanks.



Photograph 5: Recycled water tanks within bunded area

Photograph 6: Truck in the process of filling tank (within tank farm) at oil fill point

Photograph 7: Bund sump located at the northern end of the bunded area

Bioponds

- There are two bioponds on site located adjacent to north-east corner of factory and south of the tank farm.

  Note: The biopond located south of the tank farm was dry.

- It is CMJA's understanding that the bioponds predominantly receive:
  - stormwater runoff from the despatch area between the tank farm and the factory;
  - stormwater runoff from inside the bund;
  - wash from inside the factory (grease room) after floor is cleaned; and
  - recycled water from recycled water tanks.
- Each biopond is fitted with oil specific absorbent snakes around the overflows and as the water filters through, if any oil were to make it into the beds, it would be manually pumped out.

  Note: The absorbent snakes appeared to be in poor condition.

- It is understood that any oil entering the bioponds that is not absorbed, is manually removed.

Photograph 8: Dry biopond with absorbent snake, located south of tank farm

Other Associated Structures

- Two cooling towers operate to cool oil pipework. Water within the cooling towers is either treated monthly (by external contractor) or evaporates.
- A scrubber system was installed to control air pollution. The wastewater from the scrubber system is pH treated and discharged to sewers.
- A dangerous goods and decanting area south of the bunded area stores solvents and part drums that are to be re-used on site.

All associated structures were inspected and no significant issues of concern were identified.

Brookvale Creek

Brookvale Creek runs along the eastern border of the site. The fluvial path has been modified (i.e. piped and channelised) as a result of industrial and commercial development to the east of Old Pittwater Road, including Warringah Mall.

Brookvale Creek flows into Manly Creek, eventually discharging into the north-western section of Manly Lagoon.

There is evidence of significant erosion along the banks of Brookvale Creek.

There are three discharge sources for flow from the site into Brookvale Creek:

1. From the HMC Warehouse and along the southern perimeter of the site.
2. From the forecourt of the factory.
3. From the roof of the factory.

Photograph 9: Erosion along the bank of Brookvale Creek

5.0 SUMMARY OF CONCERNS

Factory

As part of the manufacturing process within the factory, waste oil and grease are produced as a by-product and deposited in drums. These waste oil drums are stored inside the bunded area (capped surface), whilst the waste grease drums are stored outside on an unpaved surface. Therefore, a potential pathway exists for contaminant migration through the unpaved surface.

Note: There was no evidence of a leakage from any of the waste grease drums.

Although no significant issues were observed within the factory, given the types of manufacturing operations and the duration of manufacturing on site, CMJA considers that a potential exists for the facility to give rise to contamination.

Tank Farm

Although no significant issues were observed within the tank farm, given:

- the types and volumes of liquids stored,
- the duration of operations on site,
- the results of the integrity assessment of the bunded area undertaken by Supply Side, and
- the integrity of the bund has not been assessed for over five years,

it is considered that a potential exists for the tank farm to give rise to contamination.

Note: It is not the purpose of this investigation to ascertain whether the bund is functioning correctly – this is the responsibility of Harrison as part of its ongoing due diligence – rather, it is the purpose of this investigation to ascertain whether the bunded area has potentially given rise to contamination of the soil and/or groundwater.

Additionally, although no significant cracks or fractures were identified within close proximity of the oil fill point, given the stained concrete observed below the fill points and around the drain, a potential may exist for the oil fill point to give rise to contamination.

Bioponds

The integrity and serviceability of the absorbent snakes located within each of the bioponds is unclear. From the site visit observations, the absorbent snakes present within the bioponds appeared to be in poor condition and required replacement.

As there is no physical barrier lining the bioponds and the condition of the absorbent snakes appeared to be poor, CMJA considers that a potential pathway exists for contaminants to migrate and impact groundwater quality.

Other Concerns

Other environmental concerns include:

- The historical practices between 1959 and the early 1960s remain unclear.
- The undocumented fill material identified in EIS's borehole logs.

6.0 CONTAMINANTS OF CONCERN

6.1 Potential Contaminant Sources

On the basis of historical information and site observations, CMJA has identified the following potential contaminant sources:

- The factory and its general use as a chemical manufacturing facility.
- The tank farm and associated oil fill point.
- The two bioponds.
- Historical practices.
- Undocumented fill material.

6.2 Potential Contaminant Groups of Concern

On the basis of the identified potential contaminant sources, CMJA assessed the contaminant groups if concern within groundwater as:

- total petroleum hydrocarbons (TPH).
- volatile organic compounds (VOC).
- semi-volatile organic compounds (SVOC).

6.3 Assessment Criteria

The applicable assessment criteria for groundwater are those guideline levels set out in:

- The *Australian Drinking Water Guidelines* (ANZECC/ARMCANZ 2004).
- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*
- The NSW EPA's *Guidelines for Assessing Service Station Site*s (1994).
- The Office of Legislative Drafting and Publishing's *Airports (Environment Protection) Regulations* (1997).

These criteria are listed in Table 4. Additionally, the criteria adopted for this investigation are also shown.

TABLE 4
Assessment Criteria (µg/L)

Analyte	*Australian Drinking Water Guidelines* (2004)		*ANZECC* (2000) Table 3.4.1: Trigger values for the protection of 95% of species in freshwater	*Guidelines for Assessing Service Station Sites* (1994) Table 4: Protection of fresh aquatic ecosystems	*Airports (Environment Protection) Regulations* (1997): Accepted limit for freshwater	Adopted Criteria
	Health	*Aesthetic* ^				
Physio-Chemical Parameters						
pH		6.5 – 8.5	6.5 – 7.5			6.5 – 7.5
Total Petroleum Hydrocarbons						
TPH C_6-C_9					150	150
TPH C_{10}-C_{36}					600	600
Monocyclic Aromatic Hydrocarbons						
Benzene	1		950	300	300	1
Toluene	800	25		300	300	25
Ethylbenzene	300	3		140	140	3
Para xylene			200			200
Ortho-xylene			350			350
Total Xylene	600	20		380∞		†
Styrene	30	4				4
Polycyclic Aromatic Hydrocarbons						
Naphthalene			16			16
Benzo(a)pyrene	0.01			0.01*		0.01
Total PAH				3		3
Halogenated Aliphatic Compounds						
1.1.2-Trichloroethane			6500			6500
1.2-Dichloroethane	3					3
Carbon Tetrachloride	3					3
Vinyl chloride	0.3					0.3
Halogenated Aromatic Compounds						
1.2.3-Trichlorobenzene				0.9		0.9
Phenolic Compounds						
2-Chlorophenol	300	0.1				0.1
2.4-Dichlorophenol	200	0.3		0.2		0.2
2.4.6-Trichlorophenol	20	2	20			2
Pentachlorophenol			10	0.05		0.05
Phenols (total)				50		50
Chlorinated Hydrocarbons						
1.2-Dichlorobenzene				2.5		2.5
1.2.4-Trichlorobenzene				0.5		0.5
1.3-Dichlorobenzene				2.5		2.5
1.4-Dichlorobenzene				4		4
Hexachlorobenzene				0.007		0.007
Hexachlorobutadiene	0.7			0.1		0.1
Hexachloroethane			360			360
Pentachlorobenzene				0.03		0.03
Phthalate Esters						
Di-n-butyl phthalate				4		4
Nitroaromatics and Ketones						
2.4-Dinitrotoluene			65			65
Nitrobenzene			550			550
Anilines and Benzidines						
Aniline			250			250
Organochlorine and Organophosphorus Pesticides						
Aldrin				0.01		0.01
Dieldrin				0.002		0.002
Endrin			0.02	0.003		0.003

TABLE 4 Assessment Criteria (µg/L)						
Analyte	***Australian Drinking Water Guidelines* (2004)**		***ANZECC* (2000) Table 3.4.1: Trigger values for the protection of 95% of species in freshwater**	***Guidelines for Assessing Service Station Sites* (1994) Table 4: Protection of fresh aquatic ecosystems**	***Airports (Environment Protection) Regulations* (1997): Accepted limit for freshwater**	**Adopted Criteria**
	Health	***Aesthetic*** ^				
Heptachlor				0.01		0.01
Chlorpyrifos			0.01	0.001		0.001
Diazinon			0.01			0.01
Dimethoate			0.15			0.15
Malathion			0.05	0.07		0.05

Notes: µg/L micrograms per litre
∞ Netherlands 1994 Maximum Permissible Concentration for total xylenes.
^ Aesthetic values are not listed if the compound does not cause aesthetic problems or if the value determined from health considerations is the same or lower.
† In the first instance, the criterion for ortho-xylene and the criterion for para-xylene has been adopted.
* Protection of drinking water – Health based criteria (NHMRC/AWRC).

7.0 GROUNDWATER ASSESSMENT

7.1 Recovery of Monitoring Wells

On 5 October 2011, Harrison conducted a search for the groundwater monitoring wells installed on site by EIS, as requested by CMJA. The wells recovered were BH1, BH4, BH101, BH102 and BH106, with BH111 and BH112 able to be recovered if necessary.

Following an additional search by CMJA, monitoring wells BH2, BH107 and BH113 were recovered.

Note: BH106 had been damaged close to the surface and therefore, was unable to be developed.

All other wells on site were not able to be located or had been destroyed.

Figure 5 identifies those seven groundwater monitoring wells that were located and in good condition.

7.2 Well Development

On 12 October 2011, Lesley Randall of CMJA developed the seven available groundwater monitoring wells using a stainless steel hand bailer.

Note: The PVC casing of BH4 had been damaged and therefore, had to be developed using a plastic disposable bailer.

The primary purpose of well development was to remove sediment from within the well prior to sampling. Sediment present within the well can create a positive bias to the analysis if analytes were to bond with solid particles.

The volume of water that could be purged from each well during development varied from less than 10 litres to greater than 200 litres.

Note: BH101 and BH113 had higher recharge rates and could not be purged dry.

Fine to medium grained sand was present at the base of each well, in particular, BH1, BH2 and BH107.

7.3 Survey of Monitoring Well

On 12 October 2011, David Stutchbury of Stutchbury Jaques Pty Ltd surveyed the groundwater monitoring wells on site.

Survey data and other monitoring well details are presented in Table 5.

TABLE 5
Groundwater Monitoring Well Details

Borehole ID	Easting	Northing	Elevation (mAHD RL)	Location	Screen Length (m)	Well Depth (m)
BH1	339271.65	6262553.60	12.31	Located north-east of the tank farm, adjacent to waste bins.	2.0 – 4.5	4.5
BH2	339284.46	6262521.82	12.47	Located east of the tank farm.	0 – 1.5	4.0
BH4	339213.19	6262531.44	12.98	Located west of the factory.	2.0 – 4.0	4.0
BH101	339257.54	6262552.04	12.32	Located adjacent to the biopond positioned north-east of the factory.	2.0 – 5.0	5.0
BH102	339274.85	6262558.70	12.34	Located north-east of the tank farm, along Brookvale Creek.	2.0 – 4.5	4.5
BH107	339298.80	6262497.17	12.12	Located south-east of the tank farm.	2.0 – 4.5	4.5
BH113	339193.67	6262577.29	12.60	Located north-west of the factory.	-	-

Notes: - Data not available
Levels for boreholes have been taken from the top of PVC pipe
Origin of MGA Co-ordinates:
PM 8734 339205.29 6262677.15
SSM 19752 339069.61 6262637.58
Origin of Levels:
PM 87333 RL 8.99 AHD

7.4 Sampling Methodology

Lesley Randall of CMJA conducted groundwater sampling on 27 October 2011, using a micropurge (low flow/minimal drawdown) technique.

The principle underlying the micropurge technique is that provided a monitoring well is pumped at a rate within the aquifer's capacity to deliver water to the well (so that there is minimal drawdown experienced above the pumping point), then inflow to the borehole should be laminar, horizontal and drawn exclusively from the screened interval. Under these conditions, water is not drawn from storage in the bore casing.

Prior to purging, the SWL within the well was measured with an electric water level metre; the measurement was then recorded on the relevant documentation.

Well purge record sheets (field documentation) are presented in Appendix D.

Throughout purging and sampling, a peristaltic pump was used to withdraw water from the well. The pump tubing was carefully lowered to a position midway between the upper and lower depths of the screened interval, and anchored at the top of the monument, thus avoiding movement of the tubing and ensuring laminar flow throughout the sampling event. Flow rates were typically between 200 and 400 millilitres per minute.

The outflow tube from the pump was connected to a base-fed flow-cell, where all physiochemical parameters were measured during purging using a TPS FLMV90 multi-parameter meter.

Purging of the well continued until measurements of electrical conductivity, pH, temperature, redox potential and dissolved oxygen had stabilised within the following ranges.

Electrical conductivity ± 3%

pH ± 0.1 pH units

Temperature ± 0.1 degree Celsius

Redox potential ± 10 millivolts

Dissolved oxygen ± 0.1 ppm

Once this had been achieved, samples for laboratory analysis were obtained directly from the pump discharge line and placed within the appropriate laboratory-supplied pre-treated containers; these containers were then placed within an insulated ice-filled cool box.

Note: Monitoring wells BH1, BH2 and BH4 were purged dry.

Disposable gloves were used for sample collection and handling, with a new pair used for each sample. Additionally, dedicated tubing was used for each monitoring well.

Sample preservation and containers are described below in Table 6.

TABLE 6
Sample Preservation

Bottle Type$^{\pi}$	Preservation	Field Filtered	TPH C_{10} – C_{36}	TPH C_6 – C_9	VOC and SVOC
2 x100-ml amber glass	Refrigerate	No	✓		
2 x 40-ml vials	HCL^	No		✓	✓

Notes: $^{\pi}$ supplied and pre-treated by the laboratory
^ hydrochloric acid

All samples were transported in an ice-filled cool-box and delivered directly, under chain-of-custody, to Australian Laboratory Services Pty Ltd (ALS) in Smithfield, NSW; copies of the completed chain-of-custody and associated sample-receipt-advice documentation are provided in Appendix E.

7.5 Groundwater Flow Direction

Table 7 presents the standing water level measurements (SWL) from each monitoring well, taken on 12 October 2011 and 27 October 2011, and the reduced water level (RWL) from the 27 October 2011 monitoring event.

Note: SWL measurements were recorded using an electric water level meter.

TABLE 7
Standing Water Level Measurements

Borehole ID	SWL (mTOC) 12 Oct 2011	SWL (mTOC) 27 Oct 2011	RWL (mAHD) 27 Oct 2011
BH1	3.56	3.55	8.76
BH2	3.35	3.38	9.09
BH4	2.93	3.02	9.96
BH101	2.53	2.62	9.70
BH102	3.46	3.56	8.78
BH107	2.95	2.99	9.13
BH113	2.26	2.34	10.26

Notes: RWL reduced water level
mTOC metres below top of casing
mAHD metres above Australian Height Datum

In Table 7, the SWL is shown first as metres below the top of the well casing, and then as a reduced level in metres above the AHD. The RWL of the groundwater is calculated by subtracting the SWL (mTOC) from the elevation of the survey point at the top of the well casing.

BH113 is considered to be the upgradient well, while BH1 is considered to be downgradient.

Based on RWL data, the groundwater flow direction across the site is east-south-east (toward Brookvale Creek), at an approximate hydraulic gradient of 0.02.

Figure 5 illustrates how the groundwater flow direction relates to the site and monitoring well locations; groundwater flow direction is perpendicular to the contours.

7.6 Analytical Results

Field measurements and analytical results for the groundwater samples collected on 27 October 2011 are presented in Table 8.

Copies of certificates of analysis are provided as Appendix F.

TABLE 8
Field Measurements and Laboratory Results

Analyte	Units	LOR	Adopted Criteria	BH1	BH2	BH4	BH101	BH107	BH113	DUP:1
Field Physio-Chemical Parameters										
pH	pH	0.01	6.5 – 7.5	5.80	6.50	6.25	5.43	6.03	5.98	-
Electrical Conductivity	µS/cm	1		241	463	369	315	398	152.5	-
Redox*	mv	1		304	305	275	301	297	274	-
Temperature	ºC	0.1		18.5	19.6	18.7	18.5	18.7	18.2	-
Dissolved Oxygen	ppm	0.01		2.97	3.22	2.19	1.47	1.79	1.45	-
Monocyclic Aromatic Hydrocarbons										
Benzene	µg/L	1	1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	25	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	µg/L	2	3	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Styrene	µg/L	5	4	<5	<5	<5	<5	<5	<5	<5
ortho-Xylene	µg/L	2	350	<2	<2	<2	<2	<2	<2	<2
Isopropylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
n-Propylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.3.5-Trimethylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
sec-Butylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2.4-Trimethylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
tert-Butylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
p-Isopropyltoluene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
n-Butylbenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Oxygenated Compounds										
Vinyl Acetate	µg/L	50		<50	<50	<50	<50	<50	<50	<50
2-Butanone (MEK)	µg/L	50		<50	<50	<50	<50	<50	<50	<50
4-Methyl-2-pentanone (MIBK)	µg/L	50		<50	<50	<50	<50	<50	<50	<50
2-Hexanone (MBK)	µg/L	50		<50	<50	<50	<50	<50	<50	<50
Sulfonated Compounds										
Carbon disulfide	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Fumigants										
2.2-Dichloropropane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2-Dichloropropane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
cis-1.3-Dichloropropylene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
trans-1.3-Dichloropropylene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2-Dibromoethane (EDB)	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Halogenated Aliphatic Compounds										
Dichlorodifluoromethane	µg/L	50		<50	<50	<50	<50	<50	<50	<50
Chloromethane	µg/L	50		<50	<50	<50	<50	<50	<50	<50
Vinyl chloride	µg/L	50	0.3	<50	<50	<50	<50	<50	<50	<50
Bromomethane	µg/L	50		<50	<50	<50	<50	<50	<50	<50
Chloroethane	µg/L	50		<50	<50	<50	<50	<50	<50	<50
Trichlorofluoromethane	µg/L	50		<50	<50	<50	<50	<50	<50	<50
1.1-Dichloroethene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Iodomethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
trans-1.2-Dichloroethene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.1-Dichloroethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
cis-1.2-Dichloroethene	µg/L	5		311	<5	<5	37	23	92	99

TABLE 8
Field Measurements and Laboratory Results

Analyte	Units	LOR	Adopted Criteria	BH1	BH2	BH4	BH101	BH107	BH113	DUP:1
1.1.1-Trichloroethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.1-Dichloropropylene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Carbon Tetrachloride	µg/L	5	3	<5	<5	<5	<5	<5	<5	<5
1.2-Dichloroethane	µg/L	5	3	<5	<5	<5	<5	<5	<5	<5
Trichloroethene	µg/L	5		10	<5	9	40	<5	111	119
Dibromomethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.1.2-Trichloroethane	µg/L	5	6500	<5	<5	<5	<5	<5	<5	<5
1.3-Dichloropropane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Tetrachloroethene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.1.1.2-Tetrachloroethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
trans-1.4-Dichloro-2-butene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
cis-1.4-Dichloro-2-butene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.1.2.2-Tetrachloroethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2.3-Trichloropropane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Pentachloroethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2-Dibromo-3-chloropropane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Halogenated Aromatic Compounds										
Chlorobenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Bromobenzene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
2-Chlorotoluene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
4-Chlorotoluene	µg/L	5		<5	<5	<5	<5	<5	<5	<5
1.2.3-Trichlorobenzene	µg/L	5	0.9	<5	<5	<5	<5	<5	<5	<5
Trihalomethanes										
Chloroform	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Bromodichloromethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Dibromochloromethane	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Bromoform	µg/L	5		<5	<5	<5	<5	<5	<5	<5
Phenolic Compounds										
Phenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2-Chlorophenol	µg/L	2	0.1	<2	<2	<2	<2	<2	<2	<2
2-Methylphenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
3- & 4-Methylphenol	µg/L	4		<4	<4	<4	<4	<4	<4	<4
2-Nitrophenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2.4-Dimethylphenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2.4-Dichlorophenol	µg/L	2	0.2	<2	<2	<2	<2	<2	<2	<2
2.6-Dichlorophenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Chloro-3-Methylphenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2.4.6-Trichlorophenol	µg/L	2	2	<2	<2	<2	<2	<2	<2	<2
2.4.5-Trichlorophenol	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Pentachlorophenol	µg/L	4	0.05	<4	<4	<4	<4	<4	<4	<4
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	2	16	<2	<2	<2	<2	<2	<2	<2
2-Methylnaphthalene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2-Chloronaphthalene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Acenaphthylene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Acenaphthene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Fluorene	µg/L	2		<2	<2	<2	<2	<2	<2	<2

TABLE 8
Field Measurements and Laboratory Results

Analyte	Units	LOR	Adopted Criteria	BH1	BH2	BH4	BH101	BH107	BH113	DUP:1
Phenanthrene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Anthracene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Fluoranthene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Pyrene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-2-Fluorenyl Acetamide	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Benz(a)anthracene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Chrysene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Benzo(b) & Benzo(k)fluoranthene	µg/L	4		<4	<4	<4	<4	<4	<4	<4
7.12-Dimethylbenz(a)anthracene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	2	0.01	<2	<2	<2	<2	<2	<2	<2
3-Methylcholanthrene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Indeno(1.2.3.cd)pyrene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Dibenz(a.h)anthracene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Benzo(g.h.i)perylene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Total PAH	µg/L	2	3	<2	<2	<2	<2	<2	<2	<2
Phthalate Esters										
Dimethyl phthalate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Diethyl phthalate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Di-n-butyl phthalate	µg/L	2	4	<2	<2	<2	<2	3	<2	<2
Butyl benzyl phthalate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
bis(2-ethylhexyl) phthalate	µg/L	5		6	<5	9	<5	44	<5	<5
Di-n-octylphthalate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Nitrosamines										
N-Nitrosomethylethylamine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosodiethylamine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosopyrrolidine	µg/L	4		<4	<4	<4	<4	<4	<4	<4
N-Nitrosomorpholine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosodi-n-propylamine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosopiperidine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosodibutylamine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
N-Nitrosodiphenyl & Diphenylamine	µg/L	4		<4	<4	<4	<4	<4	<4	<4
Methapyrilene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Nitroaromatics and Ketones										
2-Picoline	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Acetophenone	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Nitrobenzene	µg/L	2	550	<2	<2	<2	<2	<2	<2	<2
Isophorone	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2.6-Dinitrotoluene	µg/L	4		<4	<4	<4	<4	<4	<4	<4
2.4-Dinitrotoluene	µg/L	4	65	<4	<4	<4	<4	<4	<4	<4
1-Naphthylamine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Nitroquinoline-N-oxide	µg/L	2		<2	<2	<2	<2	<2	<2	<2
5-Nitro-o-toluidine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Azobenzene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
1.3.5-Trinitrobenzene	µg/L	2		<2	<2	<2	<2	<2	<2	<2

TABLE 8
Field Measurements and Laboratory Results

Analyte	Units	LOR	Adopted Criteria	BH1	BH2	BH4	BH101	BH107	BH113	DUP:1
Phenacetin	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Aminobiphenyl	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Pentachloronitrobenzene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Pronamide	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Dimethylaminoazobenzene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Chlorobenzilate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Haloethers										
Bis(2-chloroethyl) ether	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Bis(2-chloroethoxy) methane	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Chlorophenyl phenyl ether	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Bromophenyl phenyl ether	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Chlorinated Hydrocarbons										
1.3-Dichlorobenzene	µg/L	2	2.5	<2	<2	<2	<2	<2	<2	<2
1.4-Dichlorobenzene	µg/L	2	4	<2	<2	<2	<2	<2	<2	<2
1.2-Dichlorobenzene	µg/L	2	2.5	<2	<2	<2	<2	<2	<2	<2
Hexachloroethane	µg/L	2	360	<2	<2	<2	<2	<2	<2	<2
1.2.4-Trichlorobenzene	µg/L	2	0.5	<2	<2	<2	<2	<2	<2	<2
Hexachloropropylene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Hexachlorobutadiene	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Hexachlorocyclopentadiene	µg/L	10	0.1	<10	<10	<10	<10	<10	<10	<10
Pentachlorobenzene	µg/L	2	0.03	<2	<2	<2	<2	<2	<2	<2
Hexachlorobenzene (HCB)	µg/L	4	0.007	<4	<4	<4	<4	<4	<4	<4
Anilines and Benzidines										
Aniline	µg/L	2	250	<2	<2	<2	<2	<2	<2	<2
4-Chloroaniline	µg/L	2		<2	<2	<2	<2	<2	<2	<2
2-Nitroaniline	µg/L	4		<4	<4	<4	<4	<4	<4	<4
3-Nitroaniline	µg/L	4		<4	<4	<4	<4	<4	<4	<4
Dibenzofuran	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4-Nitroaniline	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Carbazole	µg/L	2		<2	<2	<2	<2	<2	<2	<2
3.3`-Dichlorobenzidine	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Organochlorine Pesticides										
alpha-BHC	µg/L	2		<2	<2	<2	<2	<2	<2	<2
beta-BHC	µg/L	2		<2	<2	<2	<2	<2	<2	<2
gamma-BHC	µg/L	2		<2	<2	<2	<2	<2	<2	<2
delta-BHC	µg/L	2		<2	<2	<2	3	<2	<2	<2
Heptachlor	µg/L	2	0.01	<2	<2	<2	<2	<2	<2	<2
Aldrin	µg/L	2	0.01	<2	<2	<2	<2	<2	<2	<2
Heptachlor epoxide	µg/L	2		<2	<2	<2	<2	<2	<2	<2
alpha-Endosulfan	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4.4`-DDE	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Dieldrin	µg/L	2	0.002	<2	<2	<2	<2	<2	<2	<2
Endrin	µg/L	2	0.003	<2	<2	<2	<2	<2	<2	<2
beta-Endosulfan	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4.4`-DDD	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Endosulfan sulfate	µg/L	2		<2	<2	<2	<2	<2	<2	<2
4.4`-DDT	µg/L	4		<4	<4	<4	<4	<4	<4	<4

TABLE 8
Field Measurements and Laboratory Results

Analyte	Units	LOR	Adopted Criteria	BH1	BH2	BH4	BH101	BH107	BH113	DUP:1
Organophosphorus Pesticides										
Dichlorvos	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Dimethoate	µg/L	2	0.15	<2	<2	<2	<2	<2	<2	<2
Diazinon	µg/L	2	0.01	<2	<2	<2	<2	<2	<2	<2
Chlorpyrifos-methyl	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Malathion	µg/L	2	0.05	<2	<2	<2	<2	<2	<2	<2
Fenthion	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Chlorpyrifos	µg/L	2	0.001	<2	<2	<2	<2	<2	<2	<2
Pirimphos-ethyl	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Chlorfenvinphos	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Prothiofos	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Ethion	µg/L	2		<2	<2	<2	<2	<2	<2	<2
Total Petroleum Hydrocarbons										
C_6 - C_9 Fraction	µg/L	20	150	390	<20	<20	90	40	210	230
C_{10} - C_{14} Fraction	µg/L	50		<50	<50	<50	100	100	<50	<50
C_{15} - C_{28} Fraction	µg/L	100		<100	<100	1360	410	1260	<100	<100
C_{29} - C_{36} Fraction	µg/L	50		<50	<50	660	<50	570	<50	<50
C_{10} - C_{36} Fraction (sum)	µg/L	50	600	<50	<50	2020	510	1930	<50	<50

Notes: LOR limit of reporting
µS/cm microsiemens per centimetre
mv millivolts
* oxidation/reduction potential relative to Ag/AgCl electrode
ppm parts per million
µg/L micrograms per litre
Bold type indicates exceedances of the adopted criteria

As presented in Table 8, concentrations of TPH at BH1, BH4, BH107 and BH113 were above the *Airports (Environmental Protection) Regulation* fresh water trigger values. Specifically, BH1 and BH113 had elevated concentrations of TPH C_6–C_9 and BH4 and BH101 had high concentrations of TPH C_{15}–C_{28} and TPH C_{29}–C_{36}.

Exceeding concentrations of hydrocarbon fraction C_6–C_9 ranged from 210 µg/L (BH113) to 390 µg/L (BH1), while the exceeding concentrations of the C_{10}–C_{36} fraction ranged from 1930 µg/L (BH107) to 2020 µg/L (BH4).

The volatile PAH compound naphthalene, was absent from all samples analysed and therefore does not constitute to the TPH C_{10}–C_{36} fraction. BTEX concentrations were also below the limit of reporting for all samples analysed.

The groundwater is considered to be slightly acidic, with pH values ranging from 5.43 to 6.50.

All other contaminant concentrations were below the adopted criteria and/or the limit of reporting, and are not considered to be of concern.

The distribution of TPH in groundwater is illustrated in the attached Figure 6.

7.7 Discussion

Groundwater analysis indicated that TPH was the only contaminant of concern to exceed the adopted assessment criteria.

Specifically:

- TPH C_6–C_9 (petrol) fractions at BH1 (390 μg/L) and BH113 (230 μg/L); and
- TPH C_{15}–C_{28} (light fuel oil / lubricant oil) and C_{29}–C_{36} (mineral oil / lubricant oil) fractions at BH4 (total 2020 μg/L) and BH107 (total 1930 μg/L).

As identified in Section 2.4, Brookvale Creek is located to the east and Warringah Mall is located to the south of the site. Based on the identified groundwater flow direction (east-south-east) and the position of BH4 and BH107, there is a potential for off-site migration.

However, this is not considered to be of significant concern for the following reasons:

- In the absence of BTEX, there is minimal risk to human health (may be some aesthetic issues, i.e. taste, odour). As a result, there is no requirement for notification to the EPA.
- There was no evidence of phase-separated hydrocarbons (PSH) in any of the groundwater monitoring wells throughout the investigation. Specifically, phase-separated hydrocarbons were not observed on any of the water level measurement or sampling equipment used, or in the samples obtained. The low dissolved-phase concentrations measured support these observations.

Note: The monitoring wells installed by EIS appear to be appropriately constructed for PSH detection, with the screened zones extending above the SWL measured in each well.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

The purpose of a quality assurance/quality control (QA/QC) program is to ensure that the data produced are of known quality and to satisfy the project objectives, as outlined in Section 1.2. This QA/QC program provides a system for ongoing control and evaluation of data quality and provides an estimate of data quality in terms of accuracy, precision, representativeness, comparability and completeness for use in data interpretation.

An assessment of the QA/QC results obtained is provided below, followed by a short explanation of each DQI.

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured.

Precision is a measure of the agreement between duplicate or replicate samples.

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical constituent in the matrix sample.

Comparability is a qualitative assessment made to express the confidence with which one data set may be compared with another.

Completeness is defined as the percentage of total measurements made which are judged to be valid.

8.1 Field QA/QC

The field duplicate was collected as follows:

- 1 inter and/or intra-laboratory duplicate, at a frequency of 10% (1 in 10).

Samples were sent to ALS in Smithfield, for analysis.

The assessment of precision includes the calculation of relative percentage differences (RPDs) between primary and duplicate samples. The identification of QA samples is shown below.

Primary Sample ID	Blind Duplicate ID
BH113	Dup: 1

The control limit for the RPD values was $\pm$ 40 per cent (%).

All RPD values are within the +/- 40% difference and therefore, meet with laboratory threshold values for RPD calculations.

Acceptable precision was achieved in this Phase 1 investigation.

8.2 Laboratory QA/QC

ALS is accredited by NATA and undertakes laboratory QA/QC in accordance with the recommendations of NEPM 1999 Schedule B(3).

The laboratory QA/QC report is provided in Appendix G.

Laboratory QC samples included surrogates, method blanks, duplicates, laboratory control samples, and matrix spikes and recoveries.

- *Laboratory duplicate samples*: The analytical laboratory collects duplicate samples from one sub-sample submitted for analytical testing. A laboratory duplicate provides data on the analytical batch and makes it possible to assess the analytical precision (repeatability) of the test result.
- *Laboratory control samples*: The analytical laboratory re-runs a sample from the batch submitted for analytical testing. The laboratory control sample provides data on the analytical batch and makes it possible to assess the analytical precision (repeatability) of the test result.
- *Spiked samples*: An authentic field sample is spiked by adding an aliquot of known concentration of the target analyte(s), prior to sample extraction and analysis. Using this procedure, the effect of the sample matrix on extraction and analytical techniques can be quantified. Acceptable recovery limits vary for different analytes but generally fall between 70 and 130 per cent.
- *Method blanks*: Laboratory blanks consist of reagents specific to each individual analytical method; these are prepared and analysed by the laboratory in the same manner as the regular samples. The preparation and analysis of laboratory blanks enables the measurement of incidental or accidental contamination within the laboratory.

A review of the QC sample frequency and results for soil and groundwater samples follows.

- *Method blanks* – Frequency rate 5 per cent. All were all free of contaminants.
- *Duplicates* – Frequency rate 10 per cent, with all RPDs within the recommended control limit of 0 to 20 or 0 to 50 per cent.
- *Matrix spikes* – Frequency rate 5 per cent, with all RPDs within the recommended control limit.
- *Laboratory control spikes* – Frequency rate 5 per cent, with all laboratory control samples within the upper or lower recovery limits.

The data set generated during this Phase 1 investigation is thus considered to be satisfactory.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

The site currently operates as a chemical manufacturing facility, in particular, for the manufacturing of grease and mineral oil-based lubricants. The facility has been operating for approximately 50 years.

A groundwater flow direction of east-south-east has been inferred based on RWL data, at an approximate hydraulic gradient of 0.02. BH113 is considered to be the upgradient well, while BH1 is considered to be the downgradient well.

Groundwater sampling from previously installed monitoring wells BH1, BH2, BH4, BH101, BH107 and BH113, indicated that TPH was the only contaminant of concern to exceed the adopted criteria.

Specifically:

- TPH C_6–C_9 (petrol) fractions at BH1 (390 μg/L) and BH113 (230 μg/L); and
- TPH C_{15}–C_{28} (light fuel oil / lubricant oil) and C_{29}–C_{36} (mineral oil / lubricant oil) fractions at BH4 (total 2020 μg/L) and BH107 (total 1930 μg/L).

The source/s of the TPH C_6–C_9 cannot be determined with confidence. However, it is possible that the TPH C_6–C_9 may have originated from vehicle activity across the site and which is entering groundwater via surface water runoff, given:

- that petrol is not used or stored in significant volumes on the site;
- the proximity of BH1 and BH113 to the driveway and car parking areas; and
- the, shallow, elevation of groundwater.

The source of the TPH C_{15}–C_{28} and the TPH C_{29}–C_{36} is likely to be from the facility, given the proximity of BH4 to the factory and the (downgradient) location of BH107.

It is understood that synthetic and semi-synthetic lubricating oils that contain polar organic compounds are used on site. These compounds are much more water soluble than hydrocarbons and if present in groundwater, are reported by the laboratory as TPH. Although significant volumes of these compounds are not used in the manufacturing process (an estimated 370 litres per year), due to their higher mobility, they may constitute to the dissolved-phase concentrations seen in the C_{10}-C_{36} range.

TPH C_6–C_9, TPH C_{15}–C_{28}, and TPH C_{29}–C_{36} potentially include a large number of compounds with varying risk profiles. However, for this site, no specific risk factors have been identified – and the most common risk factors due to BTEX and PAH compounds have been excluded, given their absence. Indeed, in the absence of BTEX, the hydrocarbon mixture is assessed to have a low risk profile and the TPH C_6–C_9 concentrations reported are not considered to be of concern at an industrial site.

Accordingly, the reported TPH concentrations (in groundwater) do not warrant remediation, nor is there a duty to report the identified TPH to the EPA.

Note: Groundwater should not be extracted for any purpose without further assessment.

9.2 Recommendations

Recommendations are provided below.

9.2.1 Short Term

(a) Management Practices

It is recommended that management review on site practises and infrastructure, as outlined below.

Large Scale Practices

- Inspect the tank farm drainage system and associated interceptor, and rectify any issues identified.
- Inspect test the bund, and rectify any issues identified.
- Review the location of the oil fill point with respect to the bunded area, and rectify as necessary.

Small Scale Practices

- Review vehicle activity across the site, to include visually monitoring potentially petrol / oil impacted surface water runoff from the access roads and car parks following rainfall.
- Use drip trays beneath oil containing / processing equipment, where necessary.
- Promptly repair any oil leaks.
- Visually monitor surface water run-off across the site as a whole, following a significant storm event.

(b) On-going Groundwater Monitoring and Review

Repeat the groundwater monitoring event twice during the next twelve month period, in order to assess whether the employed management practices have addressed the identified TPH groundwater contamination. Samples should be obtained from BH1, BH2, BH4, BH101, BH107 and BH113, and analysed for TPH.

Note: Harrison should ensure that the abovementioned monitoring wells remain accessible, and are suitably protected such that a vehicle cannot drive over them. It is recommended that each of the wells be fenced off (for protection) and flagged (visible to all motor vehicles). Furthermore, headworks should be rectified so that surface water cannot enter a well.

The results should be reviewed following the monitoring event, and action taken as appropriate.

9.2.2 Long Term

(a) Annual Review and On-going Groundwater Monitoring

Following a year of monitoring the analytical results should be reviewed, and the monitoring program and management practices adjusted accordingly.

If TPH concentrations have declined, it may be appropriate to reduce groundwater monitoring to annually. (*Note*: It is considered that a groundwater monitoring program should be maintained for the life of the facility.)

If TPH concentrations show an increasing trend, it may be necessary to undertake the following:

- Install additional groundwater wells (e.g. upgradient of BH113, along the western site boundary) in order to identify the source of the contamination.
- Monitor groundwater more frequently (e.g. every three months).

- Implement additional procedures / measures in order to address any outstanding environmental issues and to ensure that environmental issues do not arise in the future.

(b) On-going Management Practices

It is recommended that management incorporates groundwater monitoring into its Environmental Management Plan:

- Routinely monitoring groundwater (as outlined above).
- Routinely inspecting the bund, the tank farm drainage system and the associated interceptor (at least annually).
- Ensuring that oil containing / processing equipment is regularly inspected for leaks, and leaks are promptly repaired.
- Ensuring that an adequate spill response procedure is in place, to include the provision of spill response equipment.
- Maintaining and protecting the groundwater monitoring wells.
- Minimising vehicle use and parking on unpaved areas of the site.
- Visually monitor site drainage.

REFERENCES

ANZECC 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand

ANZECC 1992, *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites,* Australian and New Zealand Environmental and Conservation Council/National Health and Medical Research Council.

Imray, Paula and A. Langley 2000, *Health-Based Soil Investigation Levels*, National Environment Protection Measure on the Assessment of Site Contamination, Schedule B, Guideline 7A.

NEPM 1999, *Guideline on Risk Based Assessment of Groundwater Contamination,* National Environment Protection Measure on the Assessment of Site Contamination, Schedule B(6).

NSW DEC 2006, *Guidelines for the NSW Site Auditor Scheme*, 2nd edition, NSW Department of Environment and Conservation, Sydney NSW.

NSW EPA 1997, *Guidelines for Consultants Reporting on Contaminated Sites*, NSW Environment Protection Authority, Chatswood NSW.

NSW EPA 1995, *Sampling Design Guidelines*, NSW Environment Protection Authority, Chatswood NSW.

NSW EPA 1994, *Guidelines for Assessing Service Station Sites*, NSW Environment Protection Authority, Chatswood NSW.

NSW Legislation 2001, *Occupational Health and Safety Regulation 2001***,** NSW Legislation, NSW Government.

Taylor, Roscoe and A. Langley 2000, *Exposure Scenarios and Exposure Settings*, National Environment Protection Measure on the Assessment of Site Contamination, Schedule B, Guideline 7B.

WorkCover 2005, *Storage and Handling of Dangerous Goods: Code of Practice 2005*, WorkCover NSW.

CMJA
C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

Important Information About Your Environmental Site Assessment

These notes will help you to interpret your hydrogeological and Environmental Site Assessment (ESA) reports.

Why are ESAs conducted?

An ESA is conducted to assess the environmental condition of a site. It is usually, but not always, carried out in one of the following circumstances.

- As a pre-purchase assessment, on behalf of either purchaser or vendor, when a property is to be sold.
- As a pre-development assessment, if a property or area of land is to be redeveloped, or if its use is to change (for example, from a factory to a residential subdivision) – to meet a requirement for development approval.
- As a pre-development assessment of a 'greenfield' (undeveloped) site - to establish baseline conditions and to assess environmental, geological and hydrological constraints to the proposed development.
- As an audit of the environmental effects of an ongoing operation.

Each type of assessment requires its own specific approach. In all cases, however, the aim is to identify and if possible quantify the risks posed by unrecognised contamination. Such risks may be financial (for example, clean-up costs or limitations on site use), or physical (for example, health risks to site users or the public).

What are the limitations of an ESA?

Although the information provided by an ESA can reduce exposure to these risks, no ESA, however diligently carried out, can eliminate risks altogether. Even a rigorous professional assessment may not detect all contamination on a site. The following paragraphs explain why.

ESA 'findings' are professional estimates

The ground surface conceals a complex 3-dimensional subsurface environment. Subsurface materials, whether placed by geological processes or human activities, are always heterogeneous. Large variations in lithology and hydraulic properties can occur over short distances. Surface observation, and data obtained from boreholes and test pits, can never give us a complete picture of the subsurface.

All data from sampling and laboratory testing must be interpreted by a qualified professional – a geologist, engineer or scientist. They then render an opinion - about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development, and appropriate remediation measures.

Interpretation and professional judgement are thus essential to the assessment process.

Accuracy depends on the scope of work

Site assessment identifies actual subsurface conditions only at those specific points where samples are taken and when they are taken. The accuracy of the entire process depends on sampling frequency and sampling methods - yet the extent of sampling and soil analysis must necessarily be limited.

Sampling generally targets those areas where contamination is considered to be most likely, on the basis of visual observation and the site's history. This approach does maximise the probability of identifying contaminants, but it may not identify contamination in unexpected locations or from unexpected sources.

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. For example, there may be contaminants in areas not surveyed or sampled; furthermore, they may migrate to areas that showed no signs of contamination at the time of sampling.

Conditions between sample locations can only be inferred – from estimates of geological and hydrogeological conditions, and from the nature and extent of identified contamination. Soil, rock and aquifer conditions are often variable, and so the distribution of contaminants across a site can be difficult to assess. Actual conditions in areas not sampled may differ from predictions.

The accuracy of an assessment is therefore limited by the scope of work undertaken.

Statistical tools can be helpful, but the validity of conclusions still depends entirely on the degree to which the original data reflect site conditions.

Uncertainty is also inevitable when it comes to assessing chemical fate and transport in groundwater and surface water systems, and calculating human health and environmental exposure risks. It is inevitable, too, when estimating remediation performance and time frames.

Your CMJA report includes a statement of the uncertainty associated with this particular project; you should read it carefully.

We can offer solutions

We cannot prevent the unanticipated, but we can minimise its impact. For this reason we recommend that you retain CMJA's services through the remediation and development stages. We can identify differences from predicted conditions, conduct additional tests as required, and recommend solutions for problems encountered on site.

Don't rely on out-of-date information

Subsurface conditions are changed by natural processes and the activity of people. Your ESA report is based on conditions that existed at the time of subsurface exploration. Don't make decisions on the basis of an ESA report whose adequacy may have been affected by time. Speak with CMJA to learn if additional tests are advisable.

If things change, contact us

Every report is based on a unique set of project-specific factors. If any one of these factors changes after the report is produced, its conclusions and recommendations may no longer be appropriate for the site.

Your environmental report should not be used:

- if the nature of the proposed development is changed - for example, if a residential development is proposed instead of a commercial one;
- if the size or configuration of the proposed development is altered;
- if the location or orientation of the proposed structure is modified;
- if there is a change of ownership; or
- for application to an adjacent site.

To help avoid expensive problems, talk to CMJA. We will help you to determine how any factors that have changed since the date of the report may affect its recommendations.

Your ESA report is prepared specifically for you

Every hydrogeological study and ESA report is prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even for another consulting civil engineer. A report should not be used by anyone other than the client, and it should not be used for any purpose other than that originally intended. Any such proposed use must first be discussed with CMJA.

Beware of misinterpretation

Costly problems can occur if plans are based on misinterpretations of an ESA. These problems can be avoided if CMJA is retained to work with appropriate design professionals. We will explain the relevant findings and review the adequacy of plans and specifications.

Logs and laboratory data should not be separated from the report

Final borehole or test pit logs are developed by CMJA's environmental scientists, engineers or geologists, using field logs (assembled by site personnel) and laboratory evaluation of field samples. Our reports usually include only the final logs, which must not under any circumstances be redrawn for inclusion in other documents.

Similarly, our reports often include field and laboratory data, and laboratory reports. These data should not be reproduced separately from the main report, which provides guidance on their interpretation and limitations.

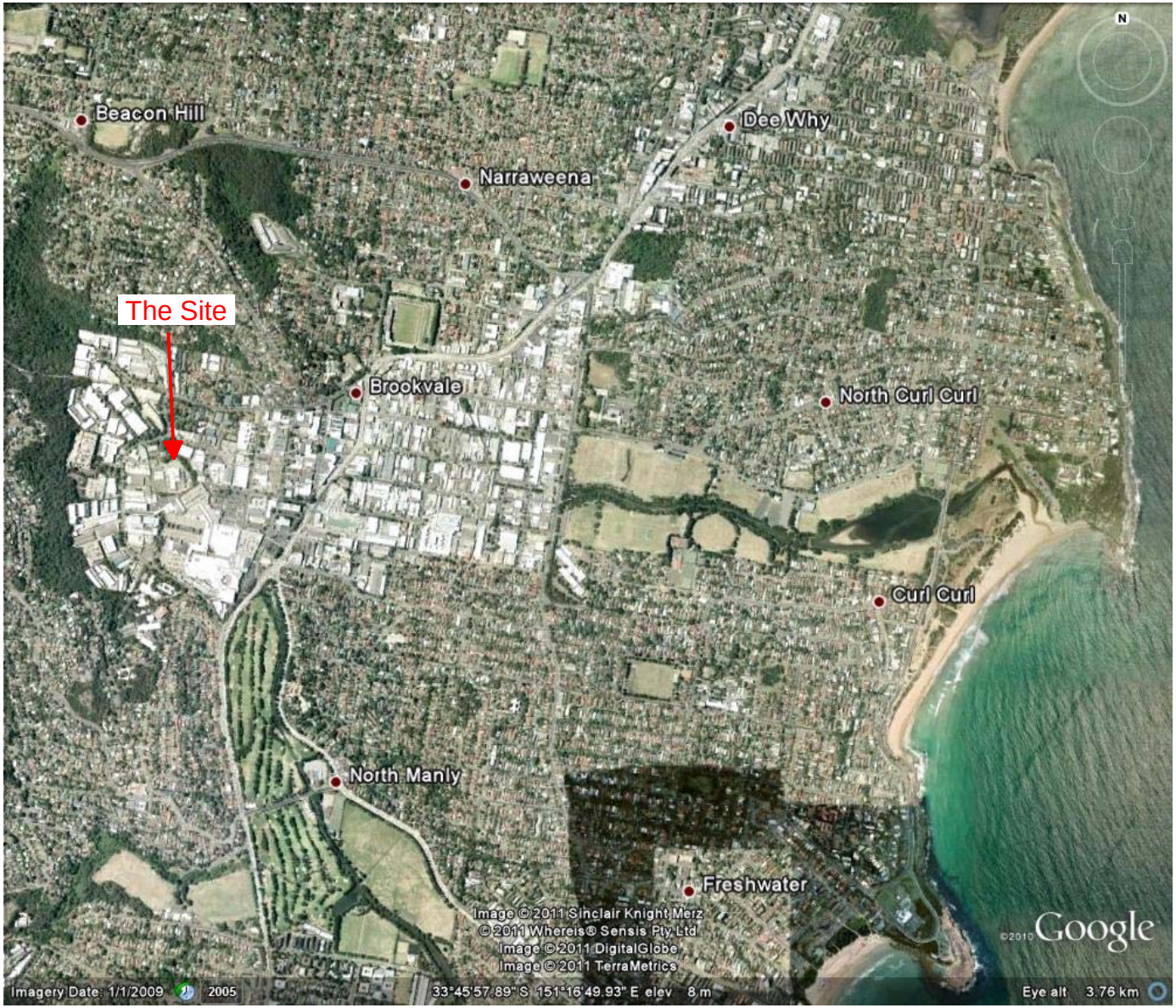
To reduce the likelihood of misinterpretation, only the complete report should be made available for the use of persons or organisations involved in the project, such as contractors. Consult CMJA before distributing reports, and we will assist with any additional interpretation that is required.

Always read responsibility clauses closely

To avoid misunderstandings, our report includes qualifying statements that explain the level of certainty associated with our findings and recommendations, and responsibility clauses that indicate where our responsibilities to clients and other parties begin and end.

These qualifying statements and responsibility clauses are an important part of your report. Please read them carefully. They are not there to transfer our responsibilities to others but to help all parties understand where individual responsibilities lie.

These notes were prepared by C. M. Jewell & Associates Pty Ltd (CMJA) using guidelines prepared by the National Ground Water Association (NGWA) and other sources.



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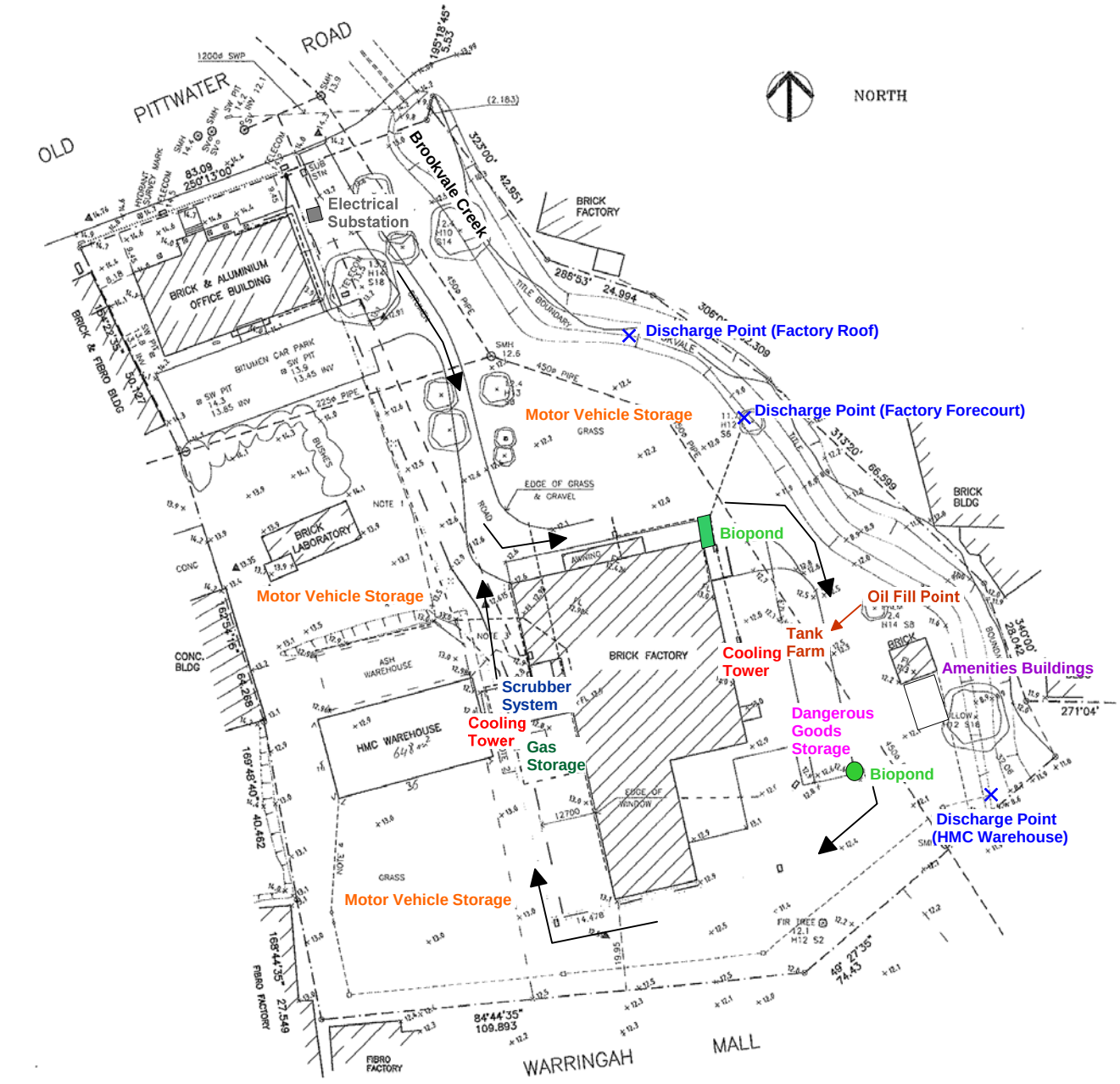
Document: J1566.2R
Rev: 0
Date: 24-Aug-11
Author: LER

Figure 1
Site Location and Setting

Phase 1 Environmental Site Assessment - 75 Old Pittwater Road, Brookvale



SITE PLAN 1:500

SCALE 1 : 500 10 0 10 20 30 40 50m

LEGEND:

WATER SERVICES:
- SEWERS
- WATER MAINS
- FIRE MAINS
- DRAINS
- STORM-WATER

PMG/TELECOM
- OLD
- NEW

ELECTRICAL POWER

NATURAL GAS

NOTES

1. NYLON GAS LINE ASSUMED ROUTE FROM ROADWAY THROUGH TO ASH WAREHOUSE. NO TRACE WIRE OR TAPE ON 80MM LINE.
2. NEW DIVERTED GAS LINE FROM NORTH OF ASH WAREHOUSE TO FACTORY. 50MM NYLON C/W TAPE AND TRACE. (SECTION UNDER ASH & HMC WAREHOUSES DISCONNECTED).
3. 415V POWER SUPPLY TO ASH WAREHOUSE RUNS APPROX 175MM UNDER TOP OF CONCRETE (IN CONDUIT).
4. STORMWATER DRAIN AND PITS FOR HMC WAREHOUSE. SEE PROJECT DRAWINGS FOR DEPTHS.
5. WATER MAIN ACROSS DRIVEWAY ONLY 200MM UNDER TOP OF SLAB.

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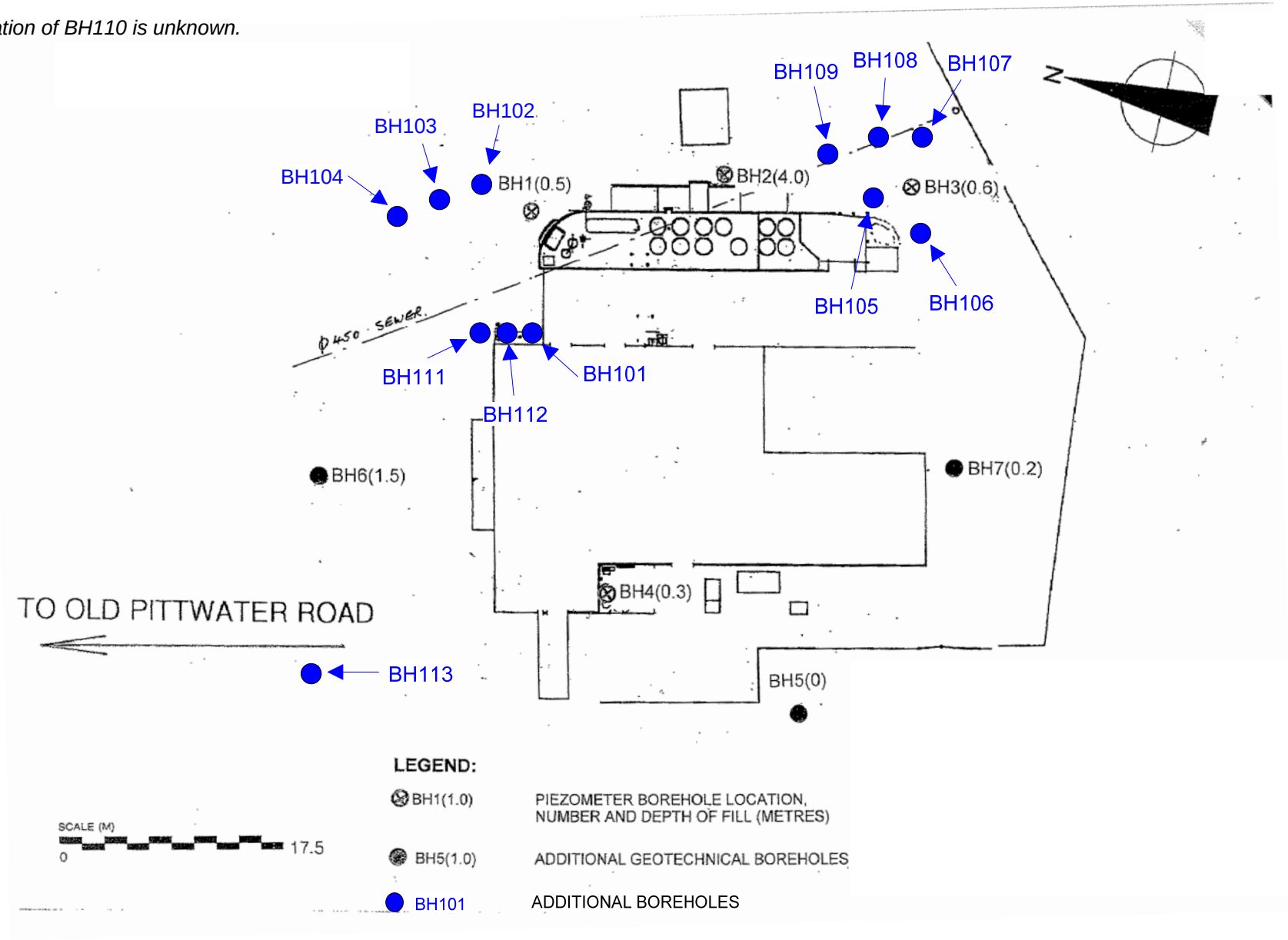
Figure 3
Local Registered Groundwater Wells

Note: The location of BH110 is unknown.



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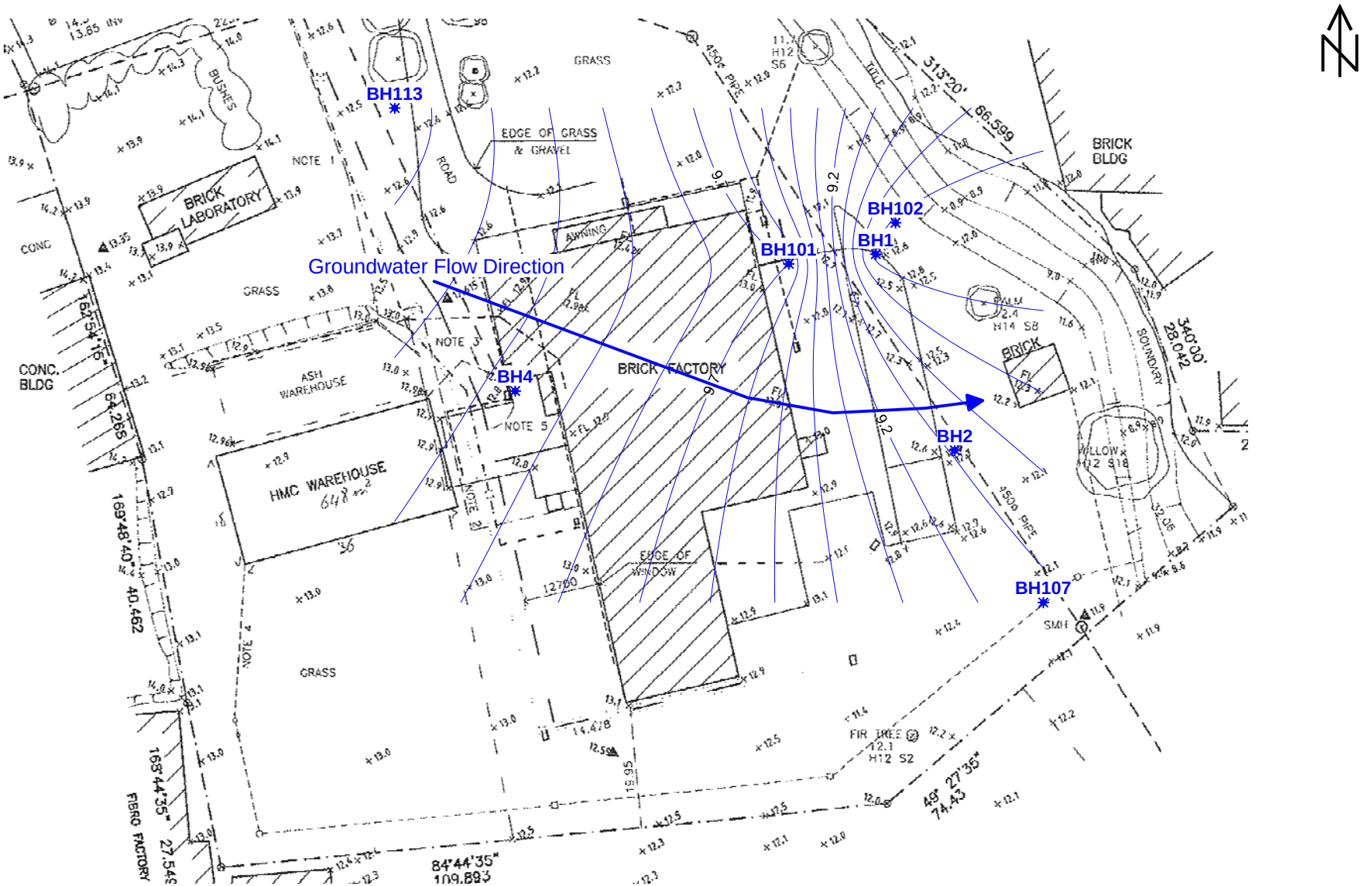
Rev: 0
Date: 13-Sep-11
Author: LER

Figure 4
EIS Monitoring Well Locations



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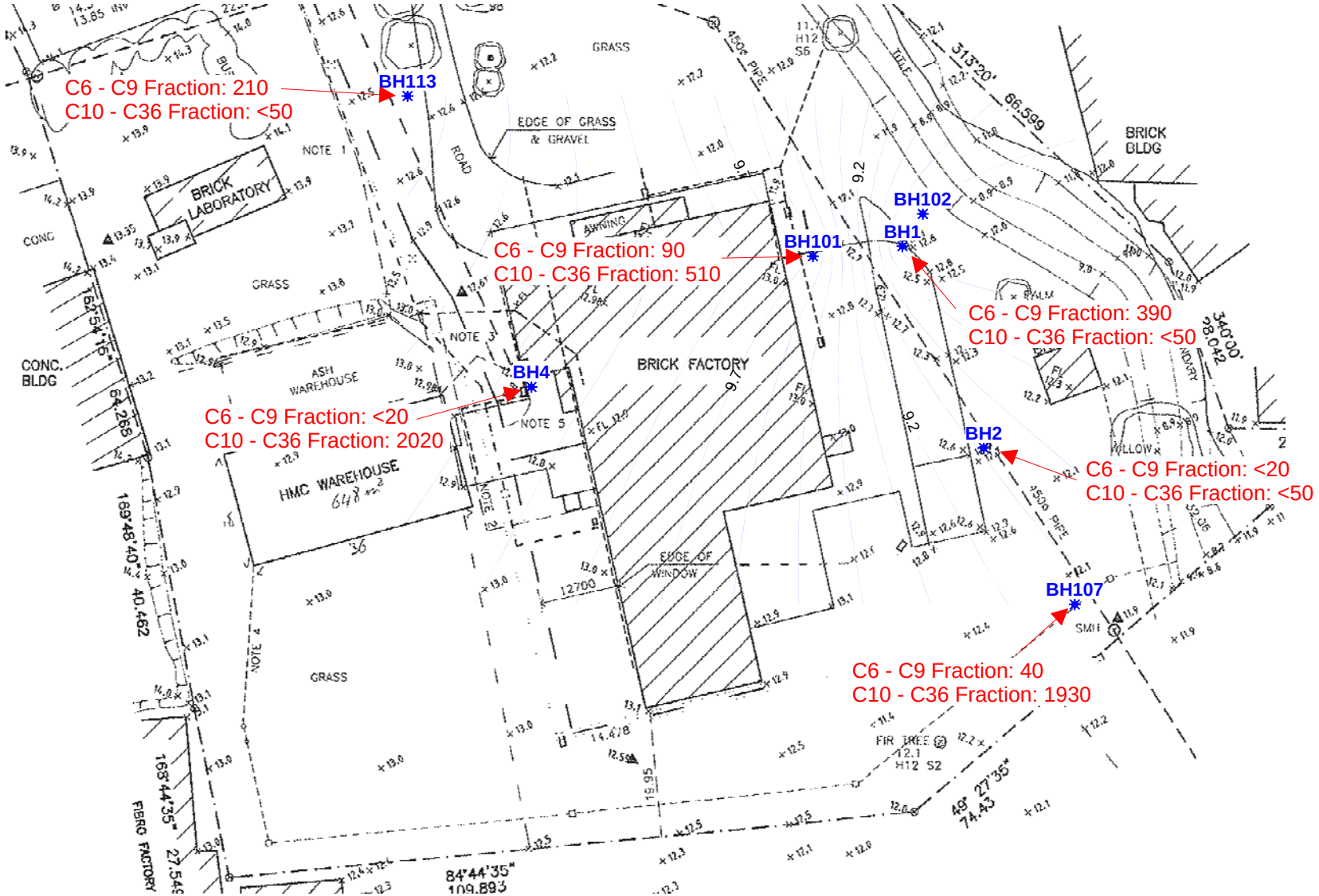
Rev: 0
Date: 28-Oct-11
Author: LER

Figure 5
Inferred Groundwater Flow Direction



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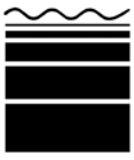
Rev: 0
Date: 4-Nov-11
Author: LER

Figure 6
Distribution of TPH Concentrations in Groundwater



APPENDIX A
Borehole Logs

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

Borehole No. 1 1/1

BOREHOLE LOG

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: A.K./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, brown.	M			
					N = 6 3,3,3	1		CL	SANDY CLAY: medium plasticity, brown mottled grey.	MC > PL	St	150 190 150	
					N = 15 6,7,8	2		SC	CLAYEY SAND: fine to medium grained, grey mottled red, as above, but grey.	M	MD		
▼ AFTER 2 HRS					N = 19 7,9,18	3							
						4							
						5			END OF BOREHOLE AT 4.5m				50mm PVC PIPE INSTALLED. HAND SLOTTED PVC 4.5 TO 2.0m. 2mm SAND TO 2m, BENTONITE CHIPS TO 1.5m CUTTINGS TO 0.2m, CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

Borehole No. 2 1/1

BOREHOLE LOG

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: A.K./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	ASPHALTIC CONCRETE: 100mm.t				
					N = 8 3,4,4				FILL: Sandy clay, medium plasticity, brown, with a trace of ash.	M	-	-	
						1							
					N = 4 1,2,2	2							
▼ AFTER 3 HRS						3				W			SPT HAMMER SUNK UNDER OWN WEIGHT. NO SAMPLE RECOVERY
						4			END OF BOREHOLE AT 4.0m				50mm PVC PIPE INSTALLED. HAND SLOTTED PVC TO 1.5m, 2mm SAND TO 1.5m, BENTONITE CHIPS TO 1m, CUTTINGS TO 0.2m. CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

Borehole No. 3 1/1

BOREHOLE LOG

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: A.K./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
AFTER 2 HRS ▼					N = 5 1,2,3	0			FILL: Silty sand, fine to medium grained, grey mottled light grey.				
					N = 15 5,7,8	1							
					N = 30 5,12,18	2				W			
						3			END OF BOREHOLE AT 3.45m				50mm PVC PIPE INSTALLED. HAND SLOTTED PVC 3.0m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE CHIPS TO 0.5m, CUTTINGS TO 0.2m, CONCRETE COLLAR AND GATIC COVER
						4							
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

12

Borehole No. 4 1/1

BOREHOLE LOG

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: A.K./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Gravelly sand, fine to medium grained, grey.	M			
					N = 6 2,2,4	1		SC	CLAYEY SAND: fine to medium grained, grey.	M	L-	-	
					N = 11 5,6,5	2		SP	SAND: fine to medium grained, light grey.		MD		
▼ AFTER 1 HR					N = 7 2,3,4	3				W	L		
						4			END OF BOREHOLE AT 4.0m				50mm PVC PIPE INSTALLED HAND SLOTTED FROM 4m TO 2m, 2mm SAND FROM 4m TO 2m, BENTONITE CHIPS TO 1.5m, CUTTINGS TO 0.2m, CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES
CONSULTING ENVIRONMENTAL ENGINEERS

13

BOREHOLE LOG

Borehole No. 5 1/1

Client: HARRISON MANUFACTURING CO PTY LTD
Project: PROPOSED WAREHOUSE
Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**
Date: 4-6-03 **Datum:**
Logged/Checked by: N.S./DB

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION					N = 7 5,4,3	0		SP	SAND: fine to medium grained, dark brown, with clayey sand.	D-M	L		GRASS COVER POSSIBLY FILL
					N = 6 2,3,3	1		SC	CLAYEY SAND: fine to medium grained, brown.	M			
AFTER 3 HRS ▼					N = 17 4,8,9	2		CL	SANDY CLAY: low plasticity, brown.	MC > PL	(St)		
					N = 12 6,5,7	3		SP	SAND: fine to medium grained, mottled brown, dark grey with silt and clay.	M-W	MD		HYDROCARBON ODOUR
ON COMPLETION						4				W			
					N = 10 2,3,7			SP	SAND: fine to coarse grained, grey and light grey.				
								CH	SILTY CLAY: high plasticity, dark grey, with sand.	MC > PL	(St)		
▶						5		SP	SAND: fine to medium grained, grey, with clay and a trace of silt.	W	L		
					N = 8 2,3,5	6			SAND: medium grained, light grey, with a trace of silt.				
						7		SM	SILTY SAND: fine grained, light grey.				

END OF BOREHOLE AT 7.0m

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

Borehole No. 6 1/3

BOREHOLE LOG

Client: HARRISON MANUFACTURING CO PTY LTD

Project: PROPOSED WAREHOUSE

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: N.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL/TOPSOIL: Silty sand, fine grained, dark grey, trace of clay and rootlets.	M			GRASS COVER APPEARS POORLY COMPACTED
	■		■		N = 3 1,2,1	1							
			■		N > 7 2,2,5/0mm REFUSAL			SP	SAND: fine to medium grained, grey.	M	VL		SPT REFUSAL ON TREE ROOT
ON COMPLETION						2							
			■		N = 4 1,2,2	3			as above, but medium to coarse grained, light grey.	M-W	L		
▶						4							
			■		N = 12 1,6,6					W			
								ML	ORGANIC CLAYEY SILT: low plasticity, dark grey, with possible tree root.	MC > PL	(St)		
						5		SP	SAND: medium to coarse grained, light grey.	W	VL		
						6							
					N = 2 0,1,1	7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

Borehole No. 7 1/1

BOREHOLE LOG

Client: HARRISON MANUFACTURING CO PTY LTD

Project: PROPOSED WAREHOUSE

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 4-6-03 **Datum:**

Logged/Checked by: N.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Sandy gravel, fine to medium grained, dark grey.				
								SP	SAND: fine to medium grained, brown, with a trace of silt and clay.	M	VL	-	
					N = 2 2,1,1	1							
											L		
ON COMPLET-ION					N = 6 3,3,3	2							
						3			as above, but grey, with clayey sand and silty sand bands.				
					N = 8 2,4,4	4							
					N = 11 5,5,6				SAND: fine to medium grained, brown.	W	MD		
						5			END OF BOREHOLE AT 4.95m				
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 101 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			CONCRETE BLOCK/SLAB: 150mm.t				
								-	FILL: Silty sandy clay, medium plasticity, brown, fine to medium grained sand, with a trace of concrete.	MC<PL	-	-	
								SM	SILTY SAND: fine to medium grained, red brown.	M	-	-	
						1							
						2		CL	SILTY SANDY CLAY: low to medium plasticity, grey brown, with fine to medium grained sand.	MC>PL			
▶						3							
▼						4							
						5			END OF BOREHOLE AT 5.0m				50mm PVC STANDPIPE INSTALLED TO 5.0m. SLOTTED 5.0m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 102 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, brown, with sandstone and igneous cobbles and a trace of rootlets and glass.	M			GRASS COVER
								CL	SILTY SANDY CLAY: low plasticity, brown mottled grey black.	MC<PL	-	-	
						1		SM	SILTY CLAYEY SAND: fine to coarse grained, grey black, with low plasticity clay.	M			
▶						2							
▼						3		SM	SILTY SAND: fine to coarse grained, grey black.	W			
						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 103 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, brown mottled red, with a trace of sandstone and ironstone gravel.	M			GRASS COVER
						1			FILL: Silty sand, fine to medium grained, brown black, with a trace of glass, brick, ash and slag.				ODOUR OF PETROLEUM HYDROCARBON
▼						2		SM	SILTY CLAYEY SAND: fine to medium grained, grey black, with low plasticity clay.	W	-	-	
						3							
						4							
						5			END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE CHIPS TO 0.8m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 104 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, brown, with sandstone cobbles and a trace of brick fragments.	M			GRASS COVER
						1							
						2		SM	SILTY CLAYEY SAND: fine to coarse grained, brown mottled red, with low plasticity clay.	M	-	-	
▶						3			SILTY SAND: fine to coarse grained, grey mottled brown.				
▼						4			END OF BOREHOLE AT 4.0m				50mm PVC STANDPIPE INSTALLED TO 4.0m. SLOTTED 4.0m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE CHIPS TO 0.8m CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 105 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, dark brown, with a trace of rootlets.	M			GRASS COVER
								SM	SILTY CLAYEY SAND: fine to coarse grained, brown mottled grey, with low plasticity clay.	M	-	-	
						1			as above, but grey mottled brown.	W			
								SM	SILTY SAND CLAY: medium plasticity, brown mottled grey red, with fine to coarse grained sand.	MC>PL			
▶						3							
▼													
						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 106 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, grey black, with a trace of igneous gravel and rootlets.	M			GRASS COVER
								SM		W			
									SILTY CLAYEY SAND: fine to coarse grained, brown, with low plasticity clay.				
▶						1		CL	SILTY SANDY CLAY: medium plasticity, brown mottled red.	MC>PL			
▼						2		SC	SILTY CLAYEY SAND: fine to coarse grained, grey.	W			
						3							
						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 107 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, dark brown, with igneous gravel, brick fragments and a trace of rootlets.	M			GRASS COVER
								SM	SILTY CLAYEY SAND: fine to coarse grained, brown mottled grey red, with medium plasticity clay.	M			
						1							
						2			as above, but brown mottled red with shell fragments.				
▶						3			as above, but grey.				
▼						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.8m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 108 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./[illegible]

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, dark brown, with igneous and sandstone gravel, cement and a trace of brick fragments.	M			GRASS COVER
						1		SM	SILTY CLAYEY SAND: fine to coarse grained, brown mottled red.	M	-	-	
								CL	SILTY SANDY CLAY: medium plasticity, brown mottled red.	MC≈PL			
▼ ▶						2							
						3		SM	SILTY SAND: fine to coarse grained, grey.	W			
						4							
						5			END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE CHIPS TO 0.7m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 109 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, dark brown, with igneous and sandstone gravel and brick fragments.	M			GRASS COVER
								SM	SILTY CLAYEY SAND: fine to coarse grained, brown mottled grey red.	M	-	-	
▶						1							
						2							
								SM	SILTY SAND: fine to coarse grained, grey mottled brown.	W			
▼						3							
						4							
						5			END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 110 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to coarse grained, dark grey black, with sandstone cobbles and a trace of rootlets.	W			GRASS COVER
						1			FILL: Silty sandy clay, medium plasticity, dark grey black, fine to medium grained sand.	MC < PL			
						2		SM	SILTY SAND: fine to coarse grained, grey.	W	-	-	
▶						3							
▼						4							
						5			END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 2.0m. 2mm SAND TO 2.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 111 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			CONCRETE: 200mm.t				
									FILL: Silty sand, fine to coarse grained, brown mottled grey, with a trace of concrete.	M	-	-	
								SC	SILTY CLAYEY SAND: fine to medium grained, grey mottled brown.	M	-	-	
▼						1							
▶						2			as above, but dark grey.	W			
									as above, but brown mottled grey.				
						3							
						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE TO 0.7m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 112 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HARRISON MANUFACTURING PTY LTD

Project: EXISTING INDUSTRIAL DEVELOPMENT

Location: 75 OLD PITTWATER ROAD, BROOKVALE, NSW

Job No. E17659FK **Method:** SPIRAL AUGER JK350 **R.L. Surface:**

Date: 11-3-05 **Datum:**

Logged/Checked by: V.B./A.K./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			CONCRETE: 200mm.t				
									FILL: Silty sand, fine to coarse grained, dark brown, with a trace of concrete.	M	-	-	
								SC	SILTY CLAYEY SAND: fine to coarse grained, brown mottled grey and red.	M	-	-	
						1							
						2			as above, but red mottled grey.	W			
▼								SM	SILTY SAND: fine to coarse grained, grey mottled brown.				
▶						3							
						4							
									END OF BOREHOLE AT 4.5m				50mm PVC STANDPIPE INSTALLED TO 4.5m. SLOTTED 4.5m TO 1.0m. 2mm SAND TO 1.0m, BENTONITE CHIPS TO 1.5m, CUTTING TO 0.2m CONCRETE COLLAR AND GATIC COVER
						5							
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
ABN 17 003 550 801

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (eg sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

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

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

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

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

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soil for Engineering Purposes'*. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

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

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'*, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

Jeffery and Katauskas Pty Ltd
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GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL


FILL


TOPSOIL


CLAY (CL, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CH)


SILTY CLAY (CL, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML)


PEAT AND ORGANIC SOILS

ROCK


CONGLOMERATE


SANDSTONE


SHALE


SILTSTONE, MUDSTONE, CLAYSTONE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

DEFECTS AND INCLUSIONS


CLAY SEAM


SHEARED OR CRUSHED SEAM


BRECCIATED OR SHATTERED SEAM/ZONE


IRONSTONE GRAVEL


ORGANIC MATERIAL

OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

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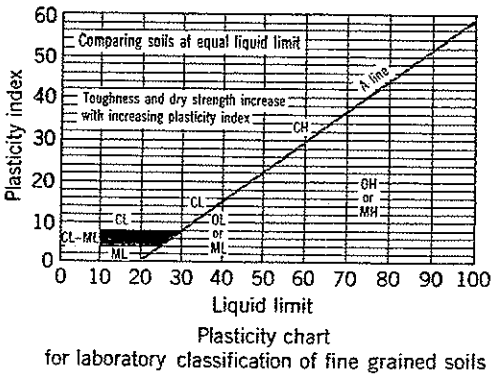
UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)					Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes		*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols Use grain size curve in identifying the fractions as given under field identification $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *GW* Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits above "A" line, with *PI* greater than 7
			Predominantly one size or a range of sizes with some intermediate sizes missing		*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)		*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)		*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes		*SW*	Well graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *SW* Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols Atterberg limits below "A" line with *PI* greater than 7
			Predominantly one size or a range of sizes with some intermediate sizes missing		*SP*	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)		*SM*	Silty sands, poorly graded sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)		*SC*	Clayey sands, poorly graded sand-clay mixtures		
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size	Identification Procedures on Fraction Smaller than 380 μm Sieve Size							
		Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)				
	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)	
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity		
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays		
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity		
Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture				*Pt*	Peat and other highly organic soils		



Plasticity chart
for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

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LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.
		Extent of borehole collapse shortly after drilling.
		Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers.
	M	MOIST - does not run freely but no free water visible on soil surface.
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa
	S	SOFT - Unconfined compressive strength 25-50kPa
	F	FIRM - Unconfined compressive strength 50-100kPa
	St	STIFF - Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa
	H	HARD - Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose: <15 / 0-4
	L	Loose: 15-35 / 4-10
	MD	Medium Dense: 35-65 / 10-30
	D	Dense: 65-85 / 30-50
	VD	Very Dense: >85 / >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

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ABN 17 003 550 801

LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL	0.03	Easily remoulded by hand to a material with soil properties.
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low:	L	0.3	A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium Strength:	M	1	A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
High:	H	3	A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
Very High:	VH	10	A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

APPENDIX B

Licences for Local Registered Groundwater Wells

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW020066

Works Details (top)

GROUNDWATER NUMBER	GW020066
LIC-NUM	10BL012712
AUTHORISED-PURPOSES	WASTE DISPOSAL
INTENDED-PURPOSES	WASTE DISPOSAL
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Federal Govt
COMMENCE-DATE	
COMPLETION-DATE	1962-05-01
FINAL-DEPTH (metres)	106.60
DRILLED-DEPTH (metres)	106.70
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	603 - SYDNEY BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9130-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6263770.00
EASTING	337861.00
LATITUDE	33 45' 14"
LONGITUDE	151 14' 58"
GS-MAP	0055A4

AMG-ZONE	56
COORD-SOURCE	GD.,PR. MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	UNKNOWN FROM HYDSYS

Licensed (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	X 3392

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Corrugated Galvanised Iron	0.00	12.10	152			(Unknown)

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
104.50	106.60	2.10	Fractured						(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.30	0.30	Topsoil		
0.30	5.18	4.88	Clay		
5.18	9.44	4.26	Clay Shale		
9.44	11.27	1.83	Pipe Clay White		
11.27	11.88	0.61	Driller		
11.88	14.02	2.14	Pipe Clay White		
14.02	14.63	0.61	Sandstone Clay		
14.63	33.83	19.20	Sandstone		
33.83	34.44	0.61	Clay White Sandstone Decomposed		
34.44	54.86	20.42	Sandstone Grey		
54.86	60.96	6.10	Sandstone White		
60.96	62.17	1.21	Sandstone Shale		

62.17	64.00	1.83	Sandstone
64.00	67.05	3.05	Shale
67.05	104.54	37.49	Sandstone
104.54	106.68	2.14	Shale Grey Water Supply

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW020108

Works Details (top)

GROUNDWATER NUMBER	GW020108
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	WASTE DISPOSAL
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1963-03-01
FINAL-DEPTH (metres)	134.10
DRILLED-DEPTH (metres)	134.10
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9130-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6263822.00
EASTING	337909.00
LATITUDE	33 45' 12"
LONGITUDE	151 14' 60"
GS-MAP	0055A4

AMG-ZONE	56
COORD-SOURCE	GD.,PR. MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	UNKNOWN FROM HYDSYS

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	3.60	152			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.30	0.30	Topsoil		
0.30	2.74	2.44	Clay Red		
2.74	3.35	0.61	Pipe Clay White		
3.35	4.26	0.91	Driller		
4.26	6.09	1.83	Sandstone		
6.09	7.62	1.53	Clay		
7.62	12.80	5.18	Sandstone Clay		
12.80	33.52	20.72	Sandstone		
33.52	37.79	4.27	Clay Grey Shale		
37.79	51.51	13.72	Sandstone		
51.51	53.64	2.13	Clay White		
53.64	57.91	4.27	Clay Grey Shale		
57.91	61.56	3.65	Sandstone Hard		
61.56	67.97	6.41	Sandstone Clay Seams		
67.97	102.10	34.13	Sandstone		
102.10	103.63	1.53	Shale		
103.63	134.11	30.48	Sandstone		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW035775

Works Details (top)

GROUNDWATER NUMBER	GW035775
LIC-NUM	10BL013059
AUTHORISED-PURPOSES	WASTE DISPOSAL
INTENDED-PURPOSES	WASTE DISPOSAL
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1963-03-01
FINAL-DEPTH (metres)	146.30
DRILLED-DEPTH (metres)	146.30
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	603 - SYDNEY BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9130-3N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6263822.00
EASTING	337964.00
LATITUDE	33 45' 12"
LONGITUDE	151 15' 2"
GS-MAP	0055A4

AMG-ZONE	56
COORD-SOURCE	GD.,PR. MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	UNKNOWN FROM HYDSYS

Licensed (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	N/A

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	8.20	152			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.30	0.30	Topsoil		
0.30	4.26	3.96	Clay Red		
4.26	5.18	0.92	Driller		
5.18	7.62	2.44	Clay White		
7.62	8.22	0.60	Clay Grey		
8.22	16.15	7.93	Sandstone Clay		
16.15	35.05	18.90	Sandstone		
35.05	39.92	4.87	Shale Clay		
39.92	55.77	15.85	Sandstone		
55.77	56.69	0.92	Clay		
56.69	57.60	0.91	Shale Clay		
57.60	62.78	5.18	Sandstone		
62.78	76.20	13.42	Sandstone Clay Seams		
76.20	113.38	37.18	Sandstone		
113.38	116.43	3.05	Shale		
116.43	129.84	13.41	Sandstone		

129.84	133.50	3.66	Sandstone Shale
133.50	137.46	3.96	Sandstone
137.46	137.76	0.30	Shale
137.76	146.30	8.54	Sandstone Clay Seams

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW107745

Works Details (top)

GROUNDWATER NUMBER	GW107745
LIC-NUM	10BL165912
AUTHORISED-PURPOSES	DOMESTIC
INTENDED-PURPOSES	DOMESTIC
WORK-TYPE	Spear
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2005-10-13
FINAL-DEPTH (metres)	15.00
DRILLED-DEPTH (metres)	15.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	SCURR
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	9.00
SALINITY	270.00
YIELD	0.80

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9130-2N
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6262009.00
EASTING	339873.00
LATITUDE	33 46' 12"
LONGITUDE	151 16' 15"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GIS - Geographic Information System
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	16//249823

Licensed (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	16 249823

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	15.00	125			Auger
1	1	Casing	PVC Class 12	-0.30	9.00	114			Screwed and Glued; Driven into Hole; Open End
1	1	Opening	Screen	11.00	12.00	55			Other; A: .2mm; Screwed

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
9.00	15.00	6.00		9.00		0.80			270.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	15.00	15.00	sand		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW108144

Works Details (top)

GROUNDWATER NUMBER	GW108144
LIC-NUM	10BL601916
AUTHORISED-PURPOSES	RECREATION (GROUNDWATER)
INTENDED-PURPOSES	RECREATION (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2005-01-20
FINAL-DEPTH (metres)	150.00
DRILLED-DEPTH (metres)	150.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BROOKVALE OVAL
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	15.00
SALINITY	200.00
YIELD	1.00

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6263189.00
EASTING	340078.00
LATITUDE	33 45' 34"
LONGITUDE	151 16' 24"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	1 114027

Licensed (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	1 114027

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	18.00	168			Rotary Air
1		Hole	Hole	18.00	150.00	160			Down Hole Hammer
1	1	Casing	Steel	0.20	18.00	168	158.4		Welded; Driven into Hole
1	1	Casing	PVC Class 9	0.20	150.00	140			Glued; Seated on Bottom
1	1	Opening	Slots - Horizontal	18.00	36.00	140			PVC Class 9; Sawn; SL: .04mm; A: 3mm
1	1	Opening	Slots	132.00	138.00				Sawn

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
18.00	20.00	2.00			24.00	0.50	24.00	1.00	160.00
131.00	132.00	1.00		15.00	134.00	1.00	134.00	2.00	200.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	4.00	4.00	SAND		

4.00	15.00	11.00	RED CLAY BANDS
15.00	21.00	6.00	SANDSTONE YELLOW
21.00	25.00	4.00	SHALE
25.00	68.00	43.00	SANDSTONE/SHALE
68.00	75.00	7.00	SHALE
75.00	86.00	11.00	SANDSTONE/SHALE
86.00	91.00	5.00	SHALE
91.00	131.00	40.00	SANDSTONE/SHALE
131.00	143.00	12.00	SHALE
143.00	146.00	3.00	SANDSTONE/SHALE
146.00	150.00	4.00	SHALE

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 24, 2011

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW108944

Works Details (top)

GROUNDWATER NUMBER	GW108944
LIC-NUM	10BL601921
AUTHORISED-PURPOSES	DOMESTIC
INTENDED-PURPOSES	DOMESTIC
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2008-06-19
FINAL-DEPTH (metres)	120.00
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	DEPT OF EDUCATION & TRAINING
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	13.00
SALINITY	352.00
YIELD	0.50

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6262146.00
EASTING	339220.00
LATITUDE	33 46' 7"
LONGITUDE	151 15' 50"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	1//611147

Licensed (top)

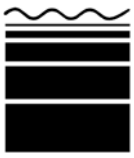
COUNTY	CUMBERLAND
PARISH	MANLY COVE
PORTION-LOT-DP	1 611147

Water Bearing Zones (top)

no details

Drillers Log (top)

no details



APPENDIX C
Historical Land Title Documents

Espreon Online Information System

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 2/600059

SEARCH DATE	TIME	EDITION NO	DATE
15/8/2011	3:00 PM	27	5/11/2003

LAND

LOT 2 IN DEPOSITED PLAN 600059
AT BROOKVALE
LOCAL GOVERNMENT AREA WARRINGAH
PARISH OF MANLY COVE COUNTY OF CUMBERLAND
TITLE DIAGRAM DP600059

FIRST SCHEDULE

HARRISON INVESTMENTS PTY LIMITED

SECOND SCHEDULE (6 NOTIFICATIONS)

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2 2186823 LEASE TO ENERGY AUSTRALIA OF SUBSTATION NO 15986 TOGETHER WITH RIGHT OF WAY AND EASEMENT FOR ELECTRICITY PURPOSES. EXPIRES 31.12.2044
3 DP1017692 EASEMENT TO DRAIN WATER 2 METRE(S) WIDE AND VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN DP1017692
4 7789176 LEASE TO WILFRED DOCKER & CO PTY LIMITED OF SUITE 1AAA, 75 OLD PITTWATER RD, BROOKVALE. EXPIRES: 31/5/2003. OPTION OF RENEWAL: 1 YEAR.
5 9380412 LEASE TO OUTSHINE CLEANING COMPANY PTY LIMITED BEING SUITE 1GA, 75 OLD PITTWATER RD, BROOKVALE. EXPIRES: 26/1/2006. OPTION OF RENEWAL: THREE YEARS.
6 AA131509 LEASE TO A.C.C. AUSTPAC CHEMICALS & COMMODITIES PTY LIMITED OF SUITES 1C & 1E, 75 OLD PITTWATER RD, BROOKVALE. EXPIRES: 30/11/2005. OPTION OF RENEWAL: 2 YEARS.

NOTATIONS

NOTE: THE CERTIFICATE OF TITLE FOR THIS FOLIO OF THE REGISTER DOES NOT INCLUDE SECURITY FEATURES INCLUDED ON COMPUTERISED CERTIFICATES OF TITLE ISSUED FROM 4TH JANUARY, 2004. IT IS RECOMMENDED THAT STRINGENT PROCESSES ARE ADOPTED IN VERIFYING THE IDENTITY OF THE PERSON(S) CLAIMING A RIGHT TO DEAL WITH THE LAND COMPRISED IN THIS FOLIO.
UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

J1566 PRINTED ON 15/8/2011

Espreon Online Information System
NSW LPI Historical Search

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
15/8/2011 3:14PM

FOLIO: 2/600059

First Title(s): SEE PRIOR TITLE(S)
Prior Title(s): VOL 13833 FOL 194

Recorded	Number	Type of Instrument	C.T. Issue
28/3/1988		TITLE AUTOMATION PROJECT	LOT RECORDED FOLIO NOT CREATED
31/8/1988		CONVERTED TO COMPUTER FOLIO	FOLIO CREATED CT NOT ISSUED
24/10/1988	X915126	LEASE	EDITION 1
30/1/1989	Y4918	LEASE	EDITION 2
13/6/1989	Y396523	LEASE	EDITION 3
6/2/1990	Y805096	LEASE	
6/2/1990	Y805097	LEASE	EDITION 4
22/10/1990	Z282371	LEASE	EDITION 5
4/12/1990	Z348733	LEASE	EDITION 6
24/5/1993	I356013	LEASE	
24/5/1993	I356014	LEASE	EDITION 7
6/6/1995	O286707	DISCHARGE OF MORTGAGE	EDITION 8
21/8/1995	O473404	LEASE	EDITION 9
26/9/1995	O563169	LEASE	EDITION 10
13/11/1995	O683406	LEASE	EDITION 11
21/5/1996	2172535	LEASE	EDITION 12
30/5/1996	2186823	LEASE	EDITION 13
13/2/1997	2835225	LEASE	EDITION 14
3/7/1997	3200341	LEASE	EDITION 15
13/11/1997		AMENDMENT: LOCAL GOVT AREA	

END OF PAGE 1 - CONTINUED OVER

J1566 PRINTED ON 15/8/2011

Espreon Online Information System
NSW LPI Historical Search

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
15/8/2011 3:14PM

FOLIO: 2/600059 PAGE 2

Recorded	Number	Type of Instrument	C.T. Issue
15/4/1998	3916698	LEASE	EDITION 16
15/4/1998	3917785	DEPARTMENTAL DEALING	EDITION 17
18/6/1998	5063607	LEASE	EDITION 18
24/8/1998	5216191	LEASE	EDITION 19
24/1/2000	6509671	LEASE	EDITION 20
29/3/2000	6678901	LEASE	EDITION 21
14/11/2000	DP1017692	DEPOSITED PLAN	EDITION 22
22/11/2000	7234072	LEASE	EDITION 23
20/7/2001	7789176	LEASE	EDITION 24
8/5/2002	8570479	LEASE	EDITION 25
2/4/2003	9380412	LEASE	EDITION 26
5/11/2003	AA131509	LEASE	EDITION 27

*** END OF SEARCH ***

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: A/166808

SEARCH DATE	TIME	EDITION NO	DATE
15/8/2011	3:31 PM	-	-

VOL 3077 FOL 102 IS THE CURRENT CERTIFICATE OF TITLE

LAND

LOT A IN DEPOSITED PLAN 166808
LOCAL GOVERNMENT AREA WARRINGAH
PARISH OF MANLY COVE COUNTY OF CUMBERLAND
TITLE DIAGRAM DP166808

FIRST SCHEDULE

HARRISON INVESTMENTS PTY LIMITED (T H648294)

SECOND SCHEDULE (1 NOTIFICATION)

1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

J1566 PRINTED ON 15/8/2011

Espreon Online Information System
NSW LPI Historical Search

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

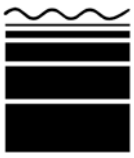
SEARCH DATE
15/8/2011 3:27PM

FOLIO: A/166808

First Title(s): SEE PRIOR TITLE(S)
Prior Title(s): VOL 3077 FOL 102

Recorded	Number	Type of Instrument	C.T. Issue
2/9/1989		TITLE AUTOMATION PROJECT	LOT RECORDED FOLIO NOT CREATED
9/5/1990		CONVERTED TO COMPUTER FOLIO	FOLIO CREATED CT NOT ISSUED
22/8/1997		AMENDMENT: LOCAL GOVT AREA	

*** END OF SEARCH ***



APPENDIX D
Purge Record Sheets

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH1

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 10:30am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 3.55 m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		18·7	18·5							
pH		5·84	5·80							
Specific conductivity µs		250	241							
Dissolved oxygen % sat		2·55	2·97							
Redox potential		301	304							
Turbidity										
No. of litres removed		2	3							

Total Volume of Water Removed: litres

Comments: Purged dry, allowed time to recharge.

GENERAL DATA

Weather: Overcast, humid

Type and size of well purging equipment:

Physical description of water: turbid, light brown

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH2

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 11:30am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 3.38m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		19.4	19.4	19.6						
pH		6.44	6.45	6.50						
Specific conductivity µs		408	444	463						
Dissolved oxygen % sat		3.10	2.69	2.22						
Redox potential		307	305	305						
Turbidity										
No. of litres removed		2	3	4						

Total Volume of Water Removed: litres

Comments: Purged dry, allowed time to recharge.

GENERAL DATA

Weather: cloudy, overcast

Type and size of well purging equipment: .....

Physical description of water: slightly turbid, light sandy yellow

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH4

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 9:30am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 3.02m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		18.7	18.7							
pH		6.25	6.25							
Specific conductivity µs		379	369							
Dissolved oxygen % sat		2.38	2.19							
Redox potential		277	275							
Turbidity										
No. of litres removed		2	3							

Total Volume of Water Removed: litres

Comments: Purged dry, allowed time to recharge.

GENERAL DATA

Weather: Sunny, warm

Type and size of well purging equipment:

Physical description of water: slightly turbid

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH101

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 11am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 2.62 m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		18.8	18.6	18.5	18.5					
pH		5.51	5.48	5.44	5.43					
Specific conductivity µs		346	335	320	315					
Dissolved oxygen % sat		2.20	1.80	1.59	1.47					
Redox potential		304	302	301	301					
Turbidity										
No. of litres removed		2	3	4	5					

Total Volume of Water Removed: litres

Comments:

GENERAL DATA

Weather: Overcast, humid, slight breeze

Type and size of well purging equipment: .....

Physical description of water: clear to slightly turbid

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH107

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 10am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 2.99m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		18.6	18.7	18.7						
pH		6.04	6.04	6.03						
Specific conductivity µs		392	397	398						
Dissolved oxygen % sat		2.17	1.91	1.79						
Redox potential		298	297	297						
Turbidity										
No. of litres removed		2	3	4						

Total Volume of Water Removed: litres

Comments:

GENERAL DATA

Weather: Overcast, humid

Type and size of well purging equipment: .....

Physical description of water: turbid, light brown

C. M. Jewell & Associates Pty Ltd
Water and Environmental Management
ABN 54 056 283 295

QA-F14 Well Purge Field Chemistry Record

Job No: J1566 Project Name: Phase 1 Investigation

Facility/Location: Harrison, Brookvale Measured by: LER

Date: 27 October 2011 Well Designation: BH113

Purging Method: Micropurge technique - Peristaltic Pump

Start Time: 8:30am Hrs Finish Time: Hrs

PURGE DATA

Depth to Top of Sediment Before Purging: .....m After Purging: .....m

Total Well Depth (actual depth w/o sediment): .....m

Casing Stick-up (TOC to Ground Surface): .....m (or)Casing Recess (Ground Surface to TOC): .....m

Screen Length:.....m Depth to Top Screen Slot: .....m

Depth from TOC to Static Water Before Purging: 2.34 m

Length of Water Column:.....m Water Level is:.....m above/below top screen slot

Well Diameter: .....mm Borehole/sandpack diameter: .....mm

Volume of Water in Well and Sandpack before Purging:.....litres (assuming 20 per cent pore space)

Volume of Water to Remove for Purging: .....litres

Depth from TOC to Static Water 24 hours after Purging: .....m

Note: Purging must continue until at least three well volumes (including saturated filter annulus) of water have been removed, or, all available water has been evacuated from the well (i.e.. unable to fill bailer after ten minutes' wait for recharge). A sample should be obtained after the well has recharged to at least 80% of original volume. Alternatively, for micropurging using a bladder pump or peristaltic pump, purging at 100 to 400 mL/minute, with minimal drawdown, must continue until at least five parameters have stabilised.

FIELD MEASUREMENTS

Parameter	Equipment Used	Reading Number								
		1	2	3	4	5	6	7	8	9
Temperature °C		18·3	17·9	18·2						
pH		5·92	5·96	5·98						
Specific conductivity µs		155·2	155·3	152·5						
Dissolved oxygen % sat		1·88	1·60	1·45						
Redox potential		265	270	274						
Turbidity										
No. of litres removed		2	3	4						

Total Volume of Water Removed: litres

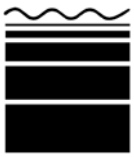
Comments:

GENERAL DATA

Weather: Overcast, slight breeze, warm

Type and size of well purging equipment: .....

Physical description of water: Turbid, dark brown



APPENDIX E

Chain of Custody and Sample Receipt Documentation

ALS Sydney: 277-289 Woodpark Road, Smithfield, NSW 2164. Phone (02) 8784 8555; Facsimile (02 8784 8500. Email Samples.Sydney@alsenviro.com

3.11.11

CMJA

CHAIN OF CUSTODY DOCUMENTATION

Australian Laboratory Services Pty Ltd

CLIENT: C.M. Jewell & Associates Pty Ltd
ADDRESS / OFFICE: P.O.Box 10, Wentworth Falls, Australia 2782
PROJECT MANAGER (PM): Lesley Randall
PROJECT ID: J1566
SITE: 75 Old Pittwater Road, Brookvale, NSW P.O. NO.:
RESULTS REQUIRED : **Normal TAT** QUOTE NO.: SY/274/10

SAMPLER: Lesley Randall
MOBILE: 0428 619 804
PHONE: 47 59 3251
EMAIL REPORT TO: lesley@cm-jewell.com.au
EMAIL INVOICE TO: (if different to report)

ANALYSIS REQUIRED including SUITES (note - suite codes must be listed to attract suite prices)

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE 3.6
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DIPOSAL:
Extra sample volume provided for each sample.

Notes: e.g Highly contaminated samples
e.g "High PAHs expected"
Extra Volume for QC or trace LORs etc.

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION					
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles	TPH	VOC	SVOC	
1	BH1	Water	27/10/2011		AG, V	4	X	X	X	
2	BH2	Water	27/10/2011		AG, V	4	X	X	X	
3	BH4	Water	27/10/2011		AG, V	4	X	X	X	
4	BH101	Water	27/10/2011		AG, V	4	X	X	X	
5	BH107	Water	27/10/2011		AG, V	4	X	X	X	
6	BH113	Water	27/10/2011		AG, V	4	X	X	X	
7	Dup:1	Water	27/10/2011		AG, V	4	X	X	X	

Environmental Division
Sydney
Work Order
ES1123445

COCES1123445
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COCES1123445
COCES1123445
COCES1123445

Telephone : +61-2-8784 8555

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: Lesley Randall	Date: 27/10/2011	Name:	Date: 27/10	Con' Note No:
Of: C.M Jewell & Associates	Time:	Of:	Time: 1330	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserveed Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bad for Acid Sulphate Soils; B = Unpreserved Bag.

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order	: **ES1123445**		
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS LESLEY RANDALL	Contact	: Client Services
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: lesley@cm-jewell.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1566	Page	: 1 of 2
Order number	: ----		
C-O-C number	: ----	Quote number	: ES2010CMJEWE0284 (SY/274/10)
Site	: 75 OLD PITTWATER ROAD BROOKVAL		
Sampler	: LR	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Dates

Date Samples Received	: 27-OCT-2011	Issue Date	: 28-OCT-2011 09:26
Client Requested Due Date	: 03-NOV-2011	Scheduled Reporting Date	: **03-NOV-2011**

Delivery Details

Mode of Delivery	: Carrier	Temperature	: 3.6'C - Ice present
No. of coolers/boxes	: 1 HARD	No. of samples received	: 7
Security Seal	: Intact.	No. of samples analysed	: 7

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exist.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - TPH TPH (fractions)	WATER - W-23 SVOC/VOC
ES1123445-001	27-OCT-2011 13:30	BH1	✓	✓
ES1123445-002	27-OCT-2011 13:30	BH2	✓	✓
ES1123445-003	27-OCT-2011 13:30	BH4	✓	✓
ES1123445-004	27-OCT-2011 13:30	BH101	✓	✓
ES1123445-005	27-OCT-2011 13:30	BH107	✓	✓
ES1123445-006	27-OCT-2011 13:30	BH113	✓	✓
ES1123445-007	27-OCT-2011 13:30	DUP:1	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

MS LESLEY RANDALL

- *AU Certificate of Analysis - NATA (COA)	Email	lesley@cm-jewell.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lesley@cm-jewell.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lesley@cm-jewell.com.au
- A4 - AU Sample Receipt Notification - Environmental (SRN)	Email	lesley@cm-jewell.com.au
- A4 - AU Tax Invoice (INV)	Print	MS LESLEY RANDALL
- Chain of Custody (CoC) (COC)	Email	lesley@cm-jewell.com.au
- EDI Format - ENMRG (ENMRG)	Email	lesley@cm-jewell.com.au

APPENDIX F
Certificate of Analysis

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1123445**	Page	: 1 of 15
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS LESLEY RANDALL	Contact	: Client Services
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: lesley@cm-jewell.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1566	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-OCT-2011
Sampler	: LR	Issue Date	: 03-NOV-2011
Site	: 75 OLD PITTWATER ROAD BROOKVAL		
		No. of samples received	: 7
Quote number	: SY/274/10	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EP074: Level of reporting raised for toluene due to ambient background levels in the laboratory.**
- **EP075: 'Sum of PAH' is the sum of the USEPA 16 priority PAHs**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
Client sampling date / time				27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<5	<5	<5	<5	<5
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
Styrene	100-42-5	5	µg/L	<5	<5	<5	<5	<5
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
Isopropylbenzene	98-82-8	5	µg/L	<5	<5	<5	<5	<5
n-Propylbenzene	103-65-1	5	µg/L	<5	<5	<5	<5	<5
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	<5	<5	<5
sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	<5	<5	<5
1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	<5	<5	<5
tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	<5	<5	<5
p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	<5	<5	<5
n-Butylbenzene	104-51-8	5	µg/L	<5	<5	<5	<5	<5
EP074B: Oxygenated Compounds								
Vinyl Acetate	108-05-4	50	µg/L	<50	<50	<50	<50	<50
2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	<50	<50	<50
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	<50	<50	<50
2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	<50	<50	<50
EP074C: Sulfonated Compounds								
Carbon disulfide	75-15-0	5	µg/L	<5	<5	<5	<5	<5
EP074D: Fumigants								
2.2-Dichloropropane	594-20-7	5	µg/L	<5	<5	<5	<5	<5
1.2-Dichloropropane	78-87-5	5	µg/L	<5	<5	<5	<5	<5
cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	<5	<5	<5
trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	<5	<5	<5
1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	<5	<5	<5
EP074E: Halogenated Aliphatic Compounds								
Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	<50	<50	<50
Chloromethane	74-87-3	50	µg/L	<50	<50	<50	<50	<50
Vinyl chloride	75-01-4	50	µg/L	<50	<50	<50	<50	<50
Bromomethane	74-83-9	50	µg/L	<50	<50	<50	<50	<50
Chloroethane	75-00-3	50	µg/L	<50	<50	<50	<50	<50
Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	<50	<50	<50
1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	<5	<5	<5
Iodomethane	74-88-4	5	µg/L	<5	<5	<5	<5	<5
trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	<5	<5	<5
1.1-Dichloroethane	75-34-3	5	µg/L	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP074E: Halogenated Aliphatic Compounds - Continued								
cis-1.2-Dichloroethene	156-59-2	5	µg/L	**311**	<5	<5	**37**	**23**
1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	<5	<5	<5
1.1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	<5	<5	<5
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	<5	<5	<5
1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	<5	<5	<5
Trichloroethene	79-01-6	5	µg/L	**10**	<5	**9**	**40**	<5
Dibromomethane	74-95-3	5	µg/L	<5	<5	<5	<5	<5
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	<5	<5	<5
1.3-Dichloropropane	142-28-9	5	µg/L	<5	<5	<5	<5	<5
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	<5	<5	<5
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	<5	<5	<5
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	<5	<5	<5
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	<5	<5	<5
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	<5	<5	<5
1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	<5	<5	<5
Pentachloroethane	76-01-7	5	µg/L	<5	<5	<5	<5	<5
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	<5	<5	<5
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	<5	<5	<5
Bromobenzene	108-86-1	5	µg/L	<5	<5	<5	<5	<5
2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	<5	<5	<5
4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	<5	<5	<5
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	<5	<5	<5
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	<5	<5	<5	<5
Bromodichloromethane	75-27-4	5	µg/L	<5	<5	<5	<5	<5
Dibromochloromethane	124-48-1	5	µg/L	<5	<5	<5	<5	<5
Bromoform	75-25-2	5	µg/L	<5	<5	<5	<5	<5
EP075A: Phenolic Compounds								
Phenol	108-95-2	2	µg/L	<2	<2	<2	<2	<2
2-Chlorophenol	95-57-8	2	µg/L	<2	<2	<2	<2	<2
2-Methylphenol	95-48-7	2	µg/L	<2	<2	<2	<2	<2
3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	<4	<4	<4
2-Nitrophenol	88-75-5	2	µg/L	<2	<2	<2	<2	<2
2.4-Dimethylphenol	105-67-9	2	µg/L	<2	<2	<2	<2	<2
2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	<2	<2	<2
2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	<2	<2	<2
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP075A: Phenolic Compounds - Continued								
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	<2	<2	<2
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	<2	<2	<2
Pentachlorophenol	87-86-5	4	µg/L	<4	<4	<4	<4	<4
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	2	µg/L	<2	<2	<2	<2	<2
2-Methylnaphthalene	91-57-6	2	µg/L	<2	<2	<2	<2	<2
2-Chloronaphthalene	91-58-7	2	µg/L	<2	<2	<2	<2	<2
Acenaphthylene	208-96-8	2	µg/L	<2	<2	<2	<2	<2
Acenaphthene	83-32-9	2	µg/L	<2	<2	<2	<2	<2
Fluorene	86-73-7	2	µg/L	<2	<2	<2	<2	<2
Phenanthrene	85-01-8	2	µg/L	<2	<2	<2	<2	<2
Anthracene	120-12-7	2	µg/L	<2	<2	<2	<2	<2
Fluoranthene	206-44-0	2	µg/L	<2	<2	<2	<2	<2
Pyrene	129-00-0	2	µg/L	<2	<2	<2	<2	<2
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	<2	<2	<2	<2
Benz(a)anthracene	56-55-3	2	µg/L	<2	<2	<2	<2	<2
Chrysene	218-01-9	2	µg/L	<2	<2	<2	<2	<2
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	<4	<4	<4	<4
7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	50-32-8	2	µg/L	<2	<2	<2	<2	<2
3-Methylcholanthrene	56-49-5	2	µg/L	<2	<2	<2	<2	<2
Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	<2	<2	<2	<2
Dibenz(a.h)anthracene	53-70-3	2	µg/L	<2	<2	<2	<2	<2
Benzo(g.h.i)perylene	191-24-2	2	µg/L	<2	<2	<2	<2	<2
^ **Sum of PAHs**	----	2	µg/L	<2	<2	<2	<2	<2
EP075C: Phthalate Esters								
Dimethyl phthalate	131-11-3	2	µg/L	<2	<2	<2	<2	<2
Diethyl phthalate	84-66-2	2	µg/L	<2	<2	<2	<2	<2
Di-n-butyl phthalate	84-74-2	2	µg/L	<2	<2	<2	<2	**3**
Butyl benzyl phthalate	85-68-7	2	µg/L	<2	<2	<2	<2	<2
bis(2-ethylhexyl) phthalate	117-81-7	5	µg/L	**6**	<5	**9**	<5	**44**
Di-n-octylphthalate	117-84-0	2	µg/L	<2	<2	<2	<2	<2
EP075D: Nitrosamines								
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	<2	<2	<2	<2
N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	<2	<2	<2	<2
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	<4	<4	<4	<4
N-Nitrosomorpholine	59-89-2	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP075D: Nitrosamines - Continued								
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	<2	<2	<2	<2
N-Nitrosopiperidine	100-75-4	2	µg/L	<2	<2	<2	<2	<2
N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	<2	<2	<2	<2
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	<4	<4	<4	<4
Methapyrilene	91-80-5	2	µg/L	<2	<2	<2	<2	<2
EP075E: Nitroaromatics and Ketones								
2-Picoline	109-06-8	2	µg/L	<2	<2	<2	<2	<2
Acetophenone	98-86-2	2	µg/L	<2	<2	<2	<2	<2
Nitrobenzene	98-95-3	2	µg/L	<2	<2	<2	<2	<2
Isophorone	78-59-1	2	µg/L	<2	<2	<2	<2	<2
2.6-Dinitrotoluene	606-20-2	4	µg/L	<4	<4	<4	<4	<4
2.4-Dinitrotoluene	121-14-2	4	µg/L	<4	<4	<4	<4	<4
1-Naphthylamine	134-32-7	2	µg/L	<2	<2	<2	<2	<2
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	<2	<2	<2	<2
5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	<2	<2	<2	<2
Azobenzene	103-33-3	2	µg/L	<2	<2	<2	<2	<2
1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<2	<2	<2	<2	<2
Phenacetin	62-44-2	2	µg/L	<2	<2	<2	<2	<2
4-Aminobiphenyl	92-67-1	2	µg/L	<2	<2	<2	<2	<2
Pentachloronitrobenzene	82-68-8	2	µg/L	<2	<2	<2	<2	<2
Pronamide	23950-58-5	2	µg/L	<2	<2	<2	<2	<2
Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	<2	<2	<2	<2
Chlorobenzilate	510-15-6	2	µg/L	<2	<2	<2	<2	<2
EP075F: Haloethers								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	<2	<2	<2	<2
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	<2	<2	<2	<2
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	<2	<2	<2	<2
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	<2	<2	<2	<2
EP075G: Chlorinated Hydrocarbons								
1.3-Dichlorobenzene	541-73-1	2	µg/L	<2	<2	<2	<2	<2
1.4-Dichlorobenzene	106-46-7	2	µg/L	<2	<2	<2	<2	<2
1.2-Dichlorobenzene	95-50-1	2	µg/L	<2	<2	<2	<2	<2
Hexachloroethane	67-72-1	2	µg/L	<2	<2	<2	<2	<2
1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<2	<2	<2	<2	<2
Hexachloropropylene	1888-71-7	2	µg/L	<2	<2	<2	<2	<2
Hexachlorobutadiene	87-68-3	2	µg/L	<2	<2	<2	<2	<2
Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	<10	<10	<10	<10

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP075G: Chlorinated Hydrocarbons - Continued								
Pentachlorobenzene	608-93-5	2	µg/L	<2	<2	<2	<2	<2
Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	<4	<4	<4	<4
EP075H: Anilines and Benzidines								
Aniline	62-53-3	2	µg/L	<2	<2	<2	<2	<2
4-Chloroaniline	106-47-8	2	µg/L	<2	<2	<2	<2	<2
2-Nitroaniline	88-74-4	4	µg/L	<4	<4	<4	<4	<4
3-Nitroaniline	99-09-2	4	µg/L	<4	<4	<4	<4	<4
Dibenzofuran	132-64-9	2	µg/L	<2	<2	<2	<2	<2
4-Nitroaniline	100-01-6	2	µg/L	<2	<2	<2	<2	<2
Carbazole	86-74-8	2	µg/L	<2	<2	<2	<2	<2
3.3`-Dichlorobenzidine	91-94-1	2	µg/L	<2	<2	<2	<2	<2
EP075I: Organochlorine Pesticides								
alpha-BHC	319-84-6	2	µg/L	<2	<2	<2	<2	<2
beta-BHC	319-85-7	2	µg/L	<2	<2	<2	<2	<2
gamma-BHC	58-89-9	2	µg/L	<2	<2	<2	<2	<2
delta-BHC	319-86-8	2	µg/L	<2	<2	<2	**3**	<2
Heptachlor	76-44-8	2	µg/L	<2	<2	<2	<2	<2
Aldrin	309-00-2	2	µg/L	<2	<2	<2	<2	<2
Heptachlor epoxide	1024-57-3	2	µg/L	<2	<2	<2	<2	<2
alpha-Endosulfan	959-98-8	2	µg/L	<2	<2	<2	<2	<2
4.4`-DDE	72-55-9	2	µg/L	<2	<2	<2	<2	<2
Dieldrin	60-57-1	2	µg/L	<2	<2	<2	<2	<2
Endrin	72-20-8	2	µg/L	<2	<2	<2	<2	<2
beta-Endosulfan	33213-65-9	2	µg/L	<2	<2	<2	<2	<2
4.4`-DDD	72-54-8	2	µg/L	<2	<2	<2	<2	<2
Endosulfan sulfate	1031-07-8	2	µg/L	<2	<2	<2	<2	<2
4.4`-DDT	50-29-3	4	µg/L	<4	<4	<4	<4	<4
EP075J: Organophosphorus Pesticides								
Dichlorvos	62-73-7	2	µg/L	<2	<2	<2	<2	<2
Dimethoate	60-51-5	2	µg/L	<2	<2	<2	<2	<2
Diazinon	333-41-5	2	µg/L	<2	<2	<2	<2	<2
Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	<2	<2	<2	<2
Malathion	121-75-5	2	µg/L	<2	<2	<2	<2	<2
Fenthion	55-38-9	2	µg/L	<2	<2	<2	<2	<2
Chlorpyrifos	2921-88-2	2	µg/L	<2	<2	<2	<2	<2
Pirimphos-ethyl	23505-41-1	2	µg/L	<2	<2	<2	<2	<2
Chlorfenvinphos	470-90-6	2	µg/L	<2	<2	<2	<2	<2
Prothiofos	34643-46-4	2	µg/L	<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH1	BH2	BH4	BH101	BH107
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30	27-OCT-2011 13:30
				ES1123445-001	ES1123445-002	ES1123445-003	ES1123445-004	ES1123445-005
EP075J: Organophosphorus Pesticides - Continued								
Ethion	563-12-2	2	µg/L	<2	<2	<2	<2	<2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**390**	<20	<20	**90**	**40**
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	**100**	**100**
C15 - C28 Fraction	----	100	µg/L	<100	<100	**1360**	**410**	**1260**
C29 - C36 Fraction	----	50	µg/L	<50	<50	**660**	<50	**570**
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	**2020**	**510**	**1930**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	**390**	<20	<20	**100**	**40**
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	**240**	**210**
>C16 - C34 Fraction	----	100	µg/L	<100	<100	**1770**	**390**	**1500**
>C34 - C40 Fraction	----	100	µg/L	<100	<100	**250**	<100	**300**
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	**2020**	**630**	**2010**
EP074S: VOC Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**95.0**	**115**	**112**	**113**	**111**
Toluene-D8	2037-26-5	0.1	%	**84.0**	**104**	**100**	**100**	**102**
4-Bromofluorobenzene	460-00-4	0.1	%	**87.2**	**107**	**111**	**105**	**101**
EP075S: Acid Extractable Surrogates								
2-Fluorophenol	367-12-4	0.1	%	**44.4**	**47.8**	**47.0**	**51.4**	**33.4**
Phenol-d6	13127-88-3	0.1	%	**26.8**	**28.3**	**26.8**	**30.5**	**30.3**
2-Chlorophenol-D4	93951-73-6	0.1	%	**64.8**	**66.9**	**66.0**	**71.3**	**73.2**
2.4.6-Tribromophenol	118-79-6	0.1	%	**67.9**	**56.6**	**68.6**	**91.4**	**56.2**
EP075T: Base/Neutral Extractable Surrogates								
Nitrobenzene-D5	4165-60-0	0.1	%	**80.0**	**81.0**	**80.9**	**87.5**	**115**
1.2-Dichlorobenzene-D4	2199-69-1	0.1	%	**48.5**	**52.7**	**43.4**	**50.0**	**72.3**
2-Fluorobiphenyl	321-60-8	0.1	%	**66.7**	**72.4**	**64.6**	**67.2**	**88.6**
Anthracene-d10	1719-06-8	0.1	%	**99.9**	**114**	**98.8**	**91.4**	**99.6**
4-Terphenyl-d14	1718-51-0	0.1	%	**93.6**	**105**	**89.0**	**90.1**	**98.4**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**94.2**	**114**	**112**	**112**	**110**
Toluene-D8	2037-26-5	0.1	%	**85.5**	**106**	**102**	**102**	**104**
4-Bromofluorobenzene	460-00-4	0.1	%	**86.9**	**106**	**106**	**104**	**100**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH113	DUP:1	----	----	----
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	----	----	----
				ES1123445-006	ES1123445-007	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<5	<5	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
Styrene	100-42-5	5	µg/L	<5	<5	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
Isopropylbenzene	98-82-8	5	µg/L	<5	<5	----	----	----
n-Propylbenzene	103-65-1	5	µg/L	<5	<5	----	----	----
1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	----	----	----
sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	----	----	----
1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	----	----	----
tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	----	----	----
p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	----	----	----
n-Butylbenzene	104-51-8	5	µg/L	<5	<5	----	----	----
EP074B: Oxygenated Compounds								
Vinyl Acetate	108-05-4	50	µg/L	<50	<50	----	----	----
2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	----	----	----
2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	----	----	----
EP074C: Sulfonated Compounds								
Carbon disulfide	75-15-0	5	µg/L	<5	<5	----	----	----
EP074D: Fumigants								
2.2-Dichloropropane	594-20-7	5	µg/L	<5	<5	----	----	----
1.2-Dichloropropane	78-87-5	5	µg/L	<5	<5	----	----	----
cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	----	----	----
trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	----	----	----
1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	----	----	----
EP074E: Halogenated Aliphatic Compounds								
Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	----	----	----
Chloromethane	74-87-3	50	µg/L	<50	<50	----	----	----
Vinyl chloride	75-01-4	50	µg/L	<50	<50	----	----	----
Bromomethane	74-83-9	50	µg/L	<50	<50	----	----	----
Chloroethane	75-00-3	50	µg/L	<50	<50	----	----	----
Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	----	----	----
1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	----	----	----
Iodomethane	74-88-4	5	µg/L	<5	<5	----	----	----
trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	----	----	----
1.1-Dichloroethane	75-34-3	5	µg/L	<5	<5	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH113 Client sampling date / time: 27-OCT-2011 13:30 ES1123445-006	Client sample ID: DUP:1 Client sampling date / time: 27-OCT-2011 13:30 ES1123445-007	----	----	----
EP074E: Halogenated Aliphatic Compounds - Continued								
cis-1.2-Dichloroethene	156-59-2	5	µg/L	**92**	**99**	----	----	----
1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	----	----	----
1.1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	----	----	----
Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	----	----	----
1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	----	----	----
Trichloroethene	79-01-6	5	µg/L	**111**	**119**	----	----	----
Dibromomethane	74-95-3	5	µg/L	<5	<5	----	----	----
1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	----	----	----
1.3-Dichloropropane	142-28-9	5	µg/L	<5	<5	----	----	----
Tetrachloroethene	127-18-4	5	µg/L	<5	<5	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	----	----	----
trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	----	----	----
cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	----	----	----
1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	----	----	----
Pentachloroethane	76-01-7	5	µg/L	<5	<5	----	----	----
1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	----	----	----
EP074F: Halogenated Aromatic Compounds								
Chlorobenzene	108-90-7	5	µg/L	<5	<5	----	----	----
Bromobenzene	108-86-1	5	µg/L	<5	<5	----	----	----
2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	----	----	----
4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	----	----	----
1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	----	----	----
EP074G: Trihalomethanes								
Chloroform	67-66-3	5	µg/L	<5	<5	----	----	----
Bromodichloromethane	75-27-4	5	µg/L	<5	<5	----	----	----
Dibromochloromethane	124-48-1	5	µg/L	<5	<5	----	----	----
Bromoform	75-25-2	5	µg/L	<5	<5	----	----	----
EP075A: Phenolic Compounds								
Phenol	108-95-2	2	µg/L	<2	<2	----	----	----
2-Chlorophenol	95-57-8	2	µg/L	<2	<2	----	----	----
2-Methylphenol	95-48-7	2	µg/L	<2	<2	----	----	----
3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	----	----	----
2-Nitrophenol	88-75-5	2	µg/L	<2	<2	----	----	----
2.4-Dimethylphenol	105-67-9	2	µg/L	<2	<2	----	----	----
2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	----	----	----
2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	----	----	----
4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	<2	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH113	DUP:1	----	----	----
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	----	----	----
				ES1123445-006	ES1123445-007	----	----	----
EP075A: Phenolic Compounds - Continued								
2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	----	----	----
2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	----	----	----
Pentachlorophenol	87-86-5	4	µg/L	<4	<4	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	2	µg/L	<2	<2	----	----	----
2-Methylnaphthalene	91-57-6	2	µg/L	<2	<2	----	----	----
2-Chloronaphthalene	91-58-7	2	µg/L	<2	<2	----	----	----
Acenaphthylene	208-96-8	2	µg/L	<2	<2	----	----	----
Acenaphthene	83-32-9	2	µg/L	<2	<2	----	----	----
Fluorene	86-73-7	2	µg/L	<2	<2	----	----	----
Phenanthrene	85-01-8	2	µg/L	<2	<2	----	----	----
Anthracene	120-12-7	2	µg/L	<2	<2	----	----	----
Fluoranthene	206-44-0	2	µg/L	<2	<2	----	----	----
Pyrene	129-00-0	2	µg/L	<2	<2	----	----	----
N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	<2	----	----	----
Benz(a)anthracene	56-55-3	2	µg/L	<2	<2	----	----	----
Chrysene	218-01-9	2	µg/L	<2	<2	----	----	----
Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	<4	----	----	----
7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	<2	----	----	----
Benzo(a)pyrene	50-32-8	2	µg/L	<2	<2	----	----	----
3-Methylcholanthrene	56-49-5	2	µg/L	<2	<2	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	<2	----	----	----
Dibenz(a.h)anthracene	53-70-3	2	µg/L	<2	<2	----	----	----
Benzo(g.h.i)perylene	191-24-2	2	µg/L	<2	<2	----	----	----
^ **Sum of PAHs**	----	2	µg/L	<2	<2	----	----	----
EP075C: Phthalate Esters								
Dimethyl phthalate	131-11-3	2	µg/L	<2	<2	----	----	----
Diethyl phthalate	84-66-2	2	µg/L	<2	<2	----	----	----
Di-n-butyl phthalate	84-74-2	2	µg/L	<2	<2	----	----	----
Butyl benzyl phthalate	85-68-7	2	µg/L	<2	<2	----	----	----
bis(2-ethylhexyl) phthalate	117-81-7	5	µg/L	<5	<5	----	----	----
Di-n-octylphthalate	117-84-0	2	µg/L	<2	<2	----	----	----
EP075D: Nitrosamines								
N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	<2	----	----	----
N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	<2	----	----	----
N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	<4	----	----	----
N-Nitrosomorpholine	59-89-2	2	µg/L	<2	<2	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: BH113	DUP:1	----	----	----
				Client sampling date / time: 27-OCT-2011 13:30	27-OCT-2011 13:30	----	----	----
				ES1123445-006	ES1123445-007	----	----	----
EP075D: Nitrosamines - Continued								
N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	<2	----	----	----
N-Nitrosopiperidine	100-75-4	2	µg/L	<2	<2	----	----	----
N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	<2	----	----	----
N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	<4	----	----	----
Methapyrilene	91-80-5	2	µg/L	<2	<2	----	----	----
EP075E: Nitroaromatics and Ketones								
2-Picoline	109-06-8	2	µg/L	<2	<2	----	----	----
Acetophenone	98-86-2	2	µg/L	<2	<2	----	----	----
Nitrobenzene	98-95-3	2	µg/L	<2	<2	----	----	----
Isophorone	78-59-1	2	µg/L	<2	<2	----	----	----
2.6-Dinitrotoluene	606-20-2	4	µg/L	<4	<4	----	----	----
2.4-Dinitrotoluene	121-14-2	4	µg/L	<4	<4	----	----	----
1-Naphthylamine	134-32-7	2	µg/L	<2	<2	----	----	----
4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	<2	----	----	----
5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	<2	----	----	----
Azobenzene	103-33-3	2	µg/L	<2	<2	----	----	----
1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<2	<2	----	----	----
Phenacetin	62-44-2	2	µg/L	<2	<2	----	----	----
4-Aminobiphenyl	92-67-1	2	µg/L	<2	<2	----	----	----
Pentachloronitrobenzene	82-68-8	2	µg/L	<2	<2	----	----	----
Pronamide	23950-58-5	2	µg/L	<2	<2	----	----	----
Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	<2	----	----	----
Chlorobenzilate	510-15-6	2	µg/L	<2	<2	----	----	----
EP075F: Haloethers								
Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	<2	----	----	----
Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	<2	----	----	----
4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	<2	----	----	----
4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	<2	----	----	----
EP075G: Chlorinated Hydrocarbons								
1.3-Dichlorobenzene	541-73-1	2	µg/L	<2	<2	----	----	----
1.4-Dichlorobenzene	106-46-7	2	µg/L	<2	<2	----	----	----
1.2-Dichlorobenzene	95-50-1	2	µg/L	<2	<2	----	----	----
Hexachloroethane	67-72-1	2	µg/L	<2	<2	----	----	----
1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<2	<2	----	----	----
Hexachloropropylene	1888-71-7	2	µg/L	<2	<2	----	----	----
Hexachlorobutadiene	87-68-3	2	µg/L	<2	<2	----	----	----
Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	<10	----	----	----

Analytical Results

Sub-Matrix: WATER				Client sample ID	BH113	DUP:1	----	----	----
				Client sampling date / time	27-OCT-2011 13:30	27-OCT-2011 13:30	----	----	----
Compound	CAS Number	LOR	Unit		ES1123445-006	ES1123445-007	----	----	----
EP075G: Chlorinated Hydrocarbons - Continued									
Pentachlorobenzene	608-93-5	2	µg/L		<2	<2	----	----	----
Hexachlorobenzene (HCB)	118-74-1	4	µg/L		<4	<4	----	----	----
EP075H: Anilines and Benzidines									
Aniline	62-53-3	2	µg/L		<2	<2	----	----	----
4-Chloroaniline	106-47-8	2	µg/L		<2	<2	----	----	----
2-Nitroaniline	88-74-4	4	µg/L		<4	<4	----	----	----
3-Nitroaniline	99-09-2	4	µg/L		<4	<4	----	----	----
Dibenzofuran	132-64-9	2	µg/L		<2	<2	----	----	----
4-Nitroaniline	100-01-6	2	µg/L		<2	<2	----	----	----
Carbazole	86-74-8	2	µg/L		<2	<2	----	----	----
3.3`-Dichlorobenzidine	91-94-1	2	µg/L		<2	<2	----	----	----
EP075I: Organochlorine Pesticides									
alpha-BHC	319-84-6	2	µg/L		<2	<2	----	----	----
beta-BHC	319-85-7	2	µg/L		<2	<2	----	----	----
gamma-BHC	58-89-9	2	µg/L		<2	<2	----	----	----
delta-BHC	319-86-8	2	µg/L		<2	<2	----	----	----
Heptachlor	76-44-8	2	µg/L		<2	<2	----	----	----
Aldrin	309-00-2	2	µg/L		<2	<2	----	----	----
Heptachlor epoxide	1024-57-3	2	µg/L		<2	<2	----	----	----
alpha-Endosulfan	959-98-8	2	µg/L		<2	<2	----	----	----
4.4`-DDE	72-55-9	2	µg/L		<2	<2	----	----	----
Dieldrin	60-57-1	2	µg/L		<2	<2	----	----	----
Endrin	72-20-8	2	µg/L		<2	<2	----	----	----
beta-Endosulfan	33213-65-9	2	µg/L		<2	<2	----	----	----
4.4`-DDD	72-54-8	2	µg/L		<2	<2	----	----	----
Endosulfan sulfate	1031-07-8	2	µg/L		<2	<2	----	----	----
4.4`-DDT	50-29-3	4	µg/L		<4	<4	----	----	----
EP075J: Organophosphorus Pesticides									
Dichlorvos	62-73-7	2	µg/L		<2	<2	----	----	----
Dimethoate	60-51-5	2	µg/L		<2	<2	----	----	----
Diazinon	333-41-5	2	µg/L		<2	<2	----	----	----
Chlorpyrifos-methyl	5598-13-0	2	µg/L		<2	<2	----	----	----
Malathion	121-75-5	2	µg/L		<2	<2	----	----	----
Fenthion	55-38-9	2	µg/L		<2	<2	----	----	----
Chlorpyrifos	2921-88-2	2	µg/L		<2	<2	----	----	----
Pirimphos-ethyl	23505-41-1	2	µg/L		<2	<2	----	----	----
Chlorfenvinphos	470-90-6	2	µg/L		<2	<2	----	----	----
Prothiofos	34643-46-4	2	µg/L		<2	<2	----	----	----

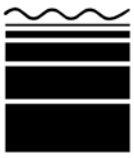
Analytical Results

Sub-Matrix: WATER				Client sample ID	BH113	DUP:1	----	----	----
				Client sampling date / time	27-OCT-2011 13:30	27-OCT-2011 13:30	----	----	----
Compound	CAS Number	LOR	Unit		ES1123445-006	ES1123445-007	----	----	----
EP075J: Organophosphorus Pesticides - Continued									
Ethion	563-12-2	2	µg/L		<2	<2	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		210	230	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	----	20	µg/L		230	240	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	----	----	----
EP074S: VOC Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		110	113	----	----	----
Toluene-D8	2037-26-5	0.1	%		101	97.8	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		103	104	----	----	----
EP075S: Acid Extractable Surrogates									
2-Fluorophenol	367-12-4	0.1	%		41.5	39.9	----	----	----
Phenol-d6	13127-88-3	0.1	%		26.0	22.5	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		63.3	57.9	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		62.5	55.0	----	----	----
EP075T: Base/Neutral Extractable Surrogates									
Nitrobenzene-D5	4165-60-0	0.1	%		76.8	74.6	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.1	%		42.6	43.3	----	----	----
2-Fluorobiphenyl	321-60-8	0.1	%		63.4	61.5	----	----	----
Anthracene-d10	1719-06-8	0.1	%		116	111	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		109	95.5	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		109	112	----	----	----
Toluene-D8	2037-26-5	0.1	%		102	99.4	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		101	101	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	78.3	133.2
Toluene-D8	2037-26-5	79.1	128.9
4-Bromofluorobenzene	460-00-4	80.8	123.7
EP075S: Acid Extractable Surrogates			
2-Fluorophenol	367-12-4	10.0	116.6
Phenol-d6	13127-88-3	10.0	69.0
2-Chlorophenol-D4	93951-73-6	20.9	129.7
2.4.6-Tribromophenol	118-79-6	10.0	150.7
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	29.4	141.7
1.2-Dichlorobenzene-D4	2199-69-1	23.6	120.7
2-Fluorobiphenyl	321-60-8	27.2	134.9
Anthracene-d10	1719-06-8	29.7	140.7
4-Terphenyl-d14	1718-51-0	27.6	143.6
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	73	133
4-Bromofluorobenzene	460-00-4	70	128



APPENDIX G
Quality Control Reports

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1123445**	Page	: 1 of 18
Client	: **C M JEWELL & ASSOC PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS LESLEY RANDALL	Contact	: Client Services
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: lesley@cm-jewell.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1566	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: 75 OLD PITTWATER ROAD BROOKVAL		
C-O-C number	: ----	Date Samples Received	: 27-OCT-2011
Sampler	: LR	Issue Date	: 03-NOV-2011
Order number	: ----		
		No. of samples received	: 7
Quote number	: SY/274/10	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Edwandy Fadjar	Organic Coordinator	Sydney Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP074: Toluene	108-88-3	2	µg/L	<5	<5	0.0	No Limit
		EP074: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP074: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	<5	0.0	No Limit
ES1123359-004	Anonymous	EP074: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP074: Toluene	108-88-3	2	µg/L	<5	<5	0.0	No Limit
		EP074: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP074: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP074: Styrene	100-42-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	<5	0.0	No Limit
EP074B: Oxygenated Compounds (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	0.0	No Limit
		EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP074B: Oxygenated Compounds (QC Lot: 2020707) - continued									
ES1123359-004	Anonymous	EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	<50	0.0	No Limit
		EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	<50	0.0	No Limit
EP074C: Sulfonated Compounds (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: Carbon disulfide	75-15-0	5	µg/L	<5	<5	0.0	No Limit
ES1123359-004	Anonymous	EP074: Carbon disulfide	75-15-0	5	µg/L	<5	<5	0.0	No Limit
EP074D: Fumigants (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: 2.2-Dichloropropane	594-20-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dichloropropane	78-87-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	0.0	No Limit
ES1123359-004	Anonymous	EP074: 2.2-Dichloropropane	594-20-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dichloropropane	78-87-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.3-Dichloropropylene	10061-01-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.3-Dichloropropylene	10061-02-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	<5	0.0	No Limit
EP074E: Halogenated Aliphatic Compounds (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Iodomethane	74-88-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1-Dichloroethane	75-34-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.3-Dichloropropane	142-28-9	5	µg/L	<5	<5	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<5	<5	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP074E: Halogenated Aliphatic Compounds (QC Lot: 2020707) - continued									
ES1123359-001	Anonymous	EP074: 1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloromethane	74-87-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: Bromomethane	74-83-9	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloroethane	75-00-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	0.0	No Limit
ES1123359-004	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Iodomethane	74-88-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1-Dichloroethane	75-34-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1-Dichloropropylene	563-58-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	<5	0.0	No Limit
		EP074: Trichloroethene	79-01-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromomethane	74-95-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.3-Dichloropropane	142-28-9	5	µg/L	<5	<5	0.0	No Limit
		EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	<5	0.0	No Limit
		EP074: cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Pentachloroethane	76-01-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloromethane	74-87-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Vinyl chloride	75-01-4	50	µg/L	<50	<50	0.0	No Limit
		EP074: Bromomethane	74-83-9	50	µg/L	<50	<50	0.0	No Limit
		EP074: Chloroethane	75-00-3	50	µg/L	<50	<50	0.0	No Limit
		EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	<50	0.0	No Limit
EP074F: Halogenated Aromatic Compounds (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP074F: Halogenated Aromatic Compounds (QC Lot: 2020707) - continued									
ES1123359-001	Anonymous	EP074: 1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	0.0	No Limit
ES1123359-004	Anonymous	EP074: Chlorobenzene	108-90-7	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromobenzene	108-86-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	<5	0.0	No Limit
		EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: 1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	<5	0.0	No Limit
EP074G: Trihalomethanes (QC Lot: 2020707)									
ES1123359-001	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<5	<5	0.0	No Limit
ES1123359-004	Anonymous	EP074: Chloroform	67-66-3	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	<5	0.0	No Limit
		EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	<5	0.0	No Limit
		EP074: Bromoform	75-25-2	5	µg/L	<5	<5	0.0	No Limit
EP075A: Phenolic Compounds (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Phenol	108-95-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.4-Dimethylphenol	105-67-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.4-Dichlorophenol	120-83-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.6-Dichlorophenol	87-65-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	<4	0.0	No Limit
		EP075: Pentachlorophenol	87-86-5	4	µg/L	<4	<4	0.0	No Limit
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Naphthalene	91-20-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acenaphthylene	208-96-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acenaphthene	83-32-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fluorene	86-73-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Phenanthrene	85-01-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Anthracene	120-12-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fluoranthene	206-44-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pyrene	129-00-0	2	µg/L	<2	<2	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 2021660) - continued									
ES1123445-002	BH2	EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chrysene	218-01-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dibenz(a.h)anthracene	53-70-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(g.h.i)perylene	191-24-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	<4	0.0	No Limit
EP075C: Phthalate Esters (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: bis(2-ethylhexyl) phthalate	117-81-7	5	µg/L	<5	9	60.6	No Limit
EP075D: Nitrosamines (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Methapyrilene	91-80-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	<4	0.0	No Limit
		EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	<4	0.0	No Limit
EP075E: Nitroaromatics and Ketones (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: 2-Picoline	109-06-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Acetophenone	98-86-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Nitrobenzene	98-95-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Isophorone	78-59-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Azobenzene	103-33-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<2	<2	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075E: Nitroaromatics and Ketones (QC Lot: 2021660) - continued									
ES1123445-002	BH2	EP075: Phenacetin	62-44-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pronamide	23950-58-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2.6-Dinitrotoluene	606-20-2	4	µg/L	<4	<4	0.0	No Limit
		EP075: 2.4-Dinitrotoluene	121-14-2	4	µg/L	<4	<4	0.0	No Limit
EP075F: Haloethers (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	<2	0.0	No Limit
EP075G: Chlorinated Hydrocarbons (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	<10	0.0	No Limit
		EP075: 1.4-Dichlorobenzene	106-46-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1.3-Dichlorobenzene	541-73-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1.2-Dichlorobenzene	95-50-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachloroethane	67-72-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	<4	0.0	No Limit
EP075H: Anilines and Benzidines (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Aniline	62-53-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dibenzofuran	132-64-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Carbazole	86-74-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 3.3`-Dichlorobenzidine	91-94-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	<4	0.0	No Limit
		EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	<4	0.0	No Limit
EP075I: Organochlorine Pesticides (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: alpha-BHC	319-84-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: beta-BHC	319-85-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: gamma-BHC	58-89-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: delta-BHC	319-86-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Heptachlor	76-44-8	2	µg/L	<2	<2	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075I: Organochlorine Pesticides (QC Lot: 2021660) - continued									
ES1123445-002	BH2	EP075: Aldrin	309-00-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	<2	0.0	No Limit
		EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4.4`-DDE	72-55-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dieldrin	60-57-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Endrin	72-20-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4.4`-DDD	72-54-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	<2	0.0	No Limit
		EP075: 4.4`-DDT	50-29-3	4	µg/L	<4	<4	0.0	No Limit
EP075J: Organophosphorus Pesticides (QC Lot: 2021660)									
ES1123445-002	BH2	EP075: Dichlorvos	62-73-7	2	µg/L	<2	<2	0.0	No Limit
		EP075: Dimethoate	60-51-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Diazinon	333-41-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	<2	0.0	No Limit
		EP075: Malathion	121-75-5	2	µg/L	<2	<2	0.0	No Limit
		EP075: Fenthion	55-38-9	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	<2	0.0	No Limit
		EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	<2	0.0	No Limit
		EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	<2	0.0	No Limit
		EP075: Prothiofos	34643-46-4	2	µg/L	<2	<2	0.0	No Limit
		EP075: Ethion	563-12-2	2	µg/L	<2	<2	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2020708)									
ES1123359-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES1123359-004	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2021656)									
ES1123445-002	BH2	EP071: C15 - C28 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	µg/L	<50	<50	0.0	No Limit
		EP071: C29 - C36 Fraction	----	50	µg/L	<50	<50	0.0	No Limit
ES1123445-004	BH101	EP071: C15 - C28 Fraction	----	100	µg/L	410	370	9.8	No Limit
		EP071: C10 - C14 Fraction	----	50	µg/L	100	80	24.2	No Limit
		EP071: C29 - C36 Fraction	----	50	µg/L	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2020708)									
ES1123359-001	Anonymous	EP080: C6 - C10 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES1123359-004	Anonymous	EP080: C6 - C10 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2021656)									
ES1123445-002	BH2	EP071: >C10 - C16 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: >C16 - C34 Fraction	----	100	µg/L	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	µg/L	<100	<100	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2021656) - continued									
ES1123445-004	BH101	EP071: >C10 - C16 Fraction	----	100	µg/L	240	190	25.0	No Limit
		EP071: >C16 - C34 Fraction	----	100	µg/L	390	350	10.5	No Limit
		EP071: >C34 - C40 Fraction	----	100	µg/L	<100	<100	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2020707)								
EP074: Benzene	71-43-2	1	µg/L	<1	10 µg/L	102	76	120
EP074: Toluene	108-88-3	2	µg/L	<5	10 µg/L	96.7	67	133
EP074: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	90.0	73	119
EP074: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	20 µg/L	101	74	122
EP074: Styrene	100-42-5	5	µg/L	<5	10 µg/L	90.2	71	121
EP074: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	100	77	121
EP074: Isopropylbenzene	98-82-8	5	µg/L	<5	10 µg/L	96.5	74	122
EP074: n-Propylbenzene	103-65-1	5	µg/L	<5	10 µg/L	90.6	67	123
EP074: 1.3.5-Trimethylbenzene	108-67-8	5	µg/L	<5	10 µg/L	98.1	69	123
EP074: sec-Butylbenzene	135-98-8	5	µg/L	<5	10 µg/L	91.4	70	124
EP074: 1.2.4-Trimethylbenzene	95-63-6	5	µg/L	<5	10 µg/L	92.5	70	122
EP074: tert-Butylbenzene	98-06-6	5	µg/L	<5	10 µg/L	92.4	71	123
EP074: p-Isopropyltoluene	99-87-6	5	µg/L	<5	10 µg/L	94.1	66	124
EP074: n-Butylbenzene	104-51-8	5	µg/L	<5	10 µg/L	92.4	61	127
EP074B: Oxygenated Compounds (QCLot: 2020707)								
EP074: Vinyl Acetate	108-05-4	50	µg/L	<50	100 µg/L	92.6	61.4	134
EP074: 2-Butanone (MEK)	78-93-3	50	µg/L	<50	100 µg/L	115	73.6	130
EP074: 4-Methyl-2-pentanone (MIBK)	108-10-1	50	µg/L	<50	100 µg/L	91.9	61	139
EP074: 2-Hexanone (MBK)	591-78-6	50	µg/L	<50	100 µg/L	96.7	61	139
EP074C: Sulfonated Compounds (QCLot: 2020707)								
EP074: Carbon disulfide	75-15-0	5	µg/L	<5	10 µg/L	94.8	72.8	127
EP074D: Fumigants (QCLot: 2020707)								
EP074: 2.2-Dichloropropane	594-20-7	5	µg/L	<5	10 µg/L	105	62	128
EP074: 1.2-Dichloropropane	78-87-5	5	µg/L	<5	10 µg/L	94.8	75	123
EP074: cis-1.3-Dichloropropylene	10061-01-5	10	µg/L	<10	10 µg/L	79.7	62	120
EP074: trans-1.3-Dichloropropylene	10061-02-6	10	µg/L	<10	10 µg/L	76.2	61	119
EP074: 1.2-Dibromoethane (EDB)	106-93-4	5	µg/L	<5	10 µg/L	92.9	70	124
EP074E: Halogenated Aliphatic Compounds (QCLot: 2020707)								
EP074: Dichlorodifluoromethane	75-71-8	50	µg/L	<50	100 µg/L	100	60.6	138
EP074: Chloromethane	74-87-3	50	µg/L	<50	100 µg/L	107	67.4	130
EP074: Vinyl chloride	75-01-4	50	µg/L	<50	100 µg/L	128	69.4	129
EP074: Bromomethane	74-83-9	50	µg/L	<50	100 µg/L	119	56	140
EP074: Chloroethane	75-00-3	50	µg/L	<50	100 µg/L	122	63	135

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP074E: Halogenated Aliphatic Compounds (QCLot: 2020707) - continued								
EP074: Trichlorofluoromethane	75-69-4	50	µg/L	<50	100 µg/L	134	61	135
EP074: 1.1-Dichloroethene	75-35-4	5	µg/L	<5	10 µg/L	122	66	128
EP074: Iodomethane	74-88-4	5	µg/L	<5	10 µg/L	90.1	70.2	128
EP074: trans-1.2-Dichloroethene	156-60-5	5	µg/L	<5	10 µg/L	114	70	124
EP074: 1.1-Dichloroethane	75-34-3	5	µg/L	<5	10 µg/L	113	72	126
EP074: cis-1.2-Dichloroethene	156-59-2	5	µg/L	<5	10 µg/L	110	74	126
EP074: 1.1.1-Trichloroethane	71-55-6	5	µg/L	<5	10 µg/L	109	65	121
EP074: 1.1-Dichloropropylene	563-58-6	5	µg/L	<5	10 µg/L	103	70	122
EP074: Carbon Tetrachloride	56-23-5	5	µg/L	<5	10 µg/L	108	63	121
EP074: 1.2-Dichloroethane	107-06-2	5	µg/L	<5	10 µg/L	127	74	130
EP074: Trichloroethene	79-01-6	5	µg/L	<5	10 µg/L	100	72	124
EP074: Dibromomethane	74-95-3	5	µg/L	<5	10 µg/L	103	70	124
EP074: 1.1.2-Trichloroethane	79-00-5	5	µg/L	<5	10 µg/L	98.7	75	127
EP074: 1.3-Dichloropropane	142-28-9	5	µg/L	<5	10 µg/L	106	79	125
EP074: Tetrachloroethene	127-18-4	5	µg/L	<5	10 µg/L	97.7	73	125
EP074: 1.1.1.2-Tetrachloroethane	630-20-6	5	µg/L	<5	10 µg/L	83.1	66	114
EP074: trans-1.4-Dichloro-2-butene	110-57-6	5	µg/L	<5	10 µg/L	80.4	54	128
EP074: cis-1.4-Dichloro-2-butene	1476-11-5	5	µg/L	<5	10 µg/L	81.8	70.6	128
EP074: 1.1.2.2-Tetrachloroethane	79-34-5	5	µg/L	<5	10 µg/L	91.5	67	131
EP074: 1.2.3-Trichloropropane	96-18-4	5	µg/L	<5	10 µg/L	112	70	134
EP074: Pentachloroethane	76-01-7	5	µg/L	<5	10 µg/L	84.4	71.8	126
EP074: 1.2-Dibromo-3-chloropropane	96-12-8	5	µg/L	<5	10 µg/L	71.0	66.4	136
EP074F: Halogenated Aromatic Compounds (QCLot: 2020707)								
EP074: Chlorobenzene	108-90-7	5	µg/L	<5	10 µg/L	91.2	79	121
EP074: Bromobenzene	108-86-1	5	µg/L	<5	10 µg/L	96.7	79	119
EP074: 2-Chlorotoluene	95-49-8	5	µg/L	<5	10 µg/L	96.0	75	121
EP074: 4-Chlorotoluene	106-43-4	5	µg/L	<5	10 µg/L	97.0	73	121
EP074: 1.2.3-Trichlorobenzene	87-61-6	5	µg/L	<5	10 µg/L	98.0	67	129
EP074G: Trihalomethanes (QCLot: 2020707)								
EP074: Chloroform	67-66-3	5	µg/L	<5	10 µg/L	114	71	127
EP074: Bromodichloromethane	75-27-4	5	µg/L	<5	10 µg/L	91.1	64	118
EP074: Dibromochloromethane	124-48-1	5	µg/L	<5	10 µg/L	79.3	65	115
EP074: Bromoform	75-25-2	5	µg/L	<5	10 µg/L	73.7	73.5	126
EP075A: Phenolic Compounds (QCLot: 2021660)								
EP075: Phenol	108-95-2	2	µg/L	<2	0.5 µg/L	30.1	25.5	64.1
EP075: 2-Chlorophenol	95-57-8	2	µg/L	<2	0.5 µg/L	# 61.7	63.1	105
EP075: 2-Methylphenol	95-48-7	2	µg/L	<2	0.5 µg/L	67.8	55.6	98.4
EP075: 3- & 4-Methylphenol	1319-77-3	4	µg/L	<4	1 µg/L	62.0	45	96.2
EP075: 2-Nitrophenol	88-75-5	2	µg/L	<2	0.5 µg/L	# 114	55.4	110

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report		
					Spike	Spike Recovery (%)	Recovery Limits (%)
				Result	Concentration	LCS	Low	High
EP075A: Phenolic Compounds (QCLot: 2021660) - continued								
EP075: 2.4-Dimethylphenol	105-67-9	2	µg/L	<2	0.5 µg/L	# 59.0	61.7	110
EP075: 2.4-Dichlorophenol	120-83-2	2	µg/L	<2	0.5 µg/L	63.6	61.9	109
EP075: 2.6-Dichlorophenol	87-65-0	2	µg/L	<2	0.5 µg/L	69.0	61.5	108
EP075: 4-Chloro-3-Methylphenol	59-50-7	2	µg/L	<2	0.5 µg/L	61.6	61.4	107
EP075: 2.4.6-Trichlorophenol	88-06-2	2	µg/L	<2	0.5 µg/L	62.0	57.6	112
EP075: 2.4.5-Trichlorophenol	95-95-4	2	µg/L	<2	0.5 µg/L	61.5	58	110
EP075: Pentachlorophenol	87-86-5	4	µg/L	<4	1 µg/L	66.8	2.39	110
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2021660)								
EP075: Naphthalene	91-20-3	2	µg/L	<2	0.5 µg/L	74.6	61	108
EP075: 2-Methylnaphthalene	91-57-6	2	µg/L	<2	0.5 µg/L	69.9	59	108
EP075: 2-Chloronaphthalene	91-58-7	2	µg/L	<2	0.5 µg/L	67.8	60.6	106
EP075: Acenaphthylene	208-96-8	2	µg/L	<2	0.5 µg/L	72.1	64	108
EP075: Acenaphthene	83-32-9	2	µg/L	<2	0.5 µg/L	74.2	65	108
EP075: Fluorene	86-73-7	2	µg/L	<2	0.5 µg/L	74.7	65.2	107
EP075: Phenanthrene	85-01-8	2	µg/L	<2	0.5 µg/L	76.9	66.7	108
EP075: Anthracene	120-12-7	2	µg/L	<2	0.5 µg/L	82.3	65.8	108
EP075: Fluoranthene	206-44-0	2	µg/L	<2	0.5 µg/L	78.7	64.9	109
EP075: Pyrene	129-00-0	2	µg/L	<2	0.5 µg/L	75.6	60.1	111
EP075: N-2-Fluorenyl Acetamide	53-96-3	2	µg/L	<2	0.5 µg/L	82.4	59.7	110
EP075: Benz(a)anthracene	56-55-3	2	µg/L	<2	0.5 µg/L	73.6	62.2	112
EP075: Chrysene	218-01-9	2	µg/L	<2	0.5 µg/L	76.2	59.3	114
EP075: Benzo(b) & Benzo(k)fluoranthene	205-99-2 207-08-9	4	µg/L	<4	1 µg/L	75.4	60.1	111
EP075: 7.12-Dimethylbenz(a)anthracene	57-97-6	2	µg/L	<2	0.5 µg/L	67.7	49.8	107
EP075: Benzo(a)pyrene	50-32-8	2	µg/L	<2	0.5 µg/L	75.0	59.2	112
EP075: 3-Methylcholanthrene	56-49-5	2	µg/L	<2	0.5 µg/L	75.5	60.1	110
EP075: Indeno(1.2.3.cd)pyrene	193-39-5	2	µg/L	<2	0.5 µg/L	78.0	59.6	110
EP075: Dibenz(a.h)anthracene	53-70-3	2	µg/L	<2	0.5 µg/L	78.8	57.2	109
EP075: Benzo(g.h.i)perylene	191-24-2	2	µg/L	<2	0.5 µg/L	76.2	60.6	110
EP075C: Phthalate Esters (QCLot: 2021660)								
EP075: Dimethyl phthalate	131-11-3	2	µg/L	<2	0.5 µg/L	74.3	64.3	112
EP075: Diethyl phthalate	84-66-2	2	µg/L	<2	0.5 µg/L	87.0	67.3	111
EP075: Di-n-butyl phthalate	84-74-2	2	µg/L	<2	0.5 µg/L	109	68.4	122
EP075: Butyl benzyl phthalate	85-68-7	2	µg/L	<2	0.5 µg/L	76.8	61.2	114
EP075: bis(2-ethylhexyl) phthalate	117-81-7	20	µg/L	<20	0.5 µg/L	130	72.8	135
EP075: Di-n-octylphthalate	117-84-0	2	µg/L	<2	0.5 µg/L	81.9	62.1	115
EP075D: Nitrosamines (QCLot: 2021660)								
EP075: N-Nitrosomethylethylamine	10595-95-6	2	µg/L	<2	0.5 µg/L	74.5	39.5	95.9
EP075: N-Nitrosodiethylamine	55-18-5	2	µg/L	<2	0.5 µg/L	74.7	60.6	113

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075D: Nitrosamines (QCLot: 2021660) - continued								
EP075: N-Nitrosopyrrolidine	930-55-2	4	µg/L	<4	0.5 µg/L	61.0	23.7	82.1
EP075: N-Nitrosomorpholine	59-89-2	2	µg/L	<2	0.5 µg/L	58.7	35.4	86.2
EP075: N-Nitrosodi-n-propylamine	621-64-7	2	µg/L	<2	0.5 µg/L	84.7	63.5	108
EP075: N-Nitrosopiperidine	100-75-4	2	µg/L	<2	0.5 µg/L	78.5	61.7	107
EP075: N-Nitrosodibutylamine	924-16-3	2	µg/L	<2	0.5 µg/L	88.6	62.5	108
EP075: N-Nitrosodiphenyl & Diphenylamine	86-30-6 122-39-4	4	µg/L	<4	1 µg/L	79.1	64.6	112
EP075: Methapyrilene	91-80-5	2	µg/L	<2	0.5 µg/L	43.6	4.21	94
EP075E: Nitroaromatics and Ketones (QCLot: 2021660)								
EP075: 2-Picoline	109-06-8	2	µg/L	<2	0.5 µg/L	44.2	11.4	100
EP075: Acetophenone	98-86-2	2	µg/L	<2	0.5 µg/L	73.0	68.3	112
EP075: Nitrobenzene	98-95-3	2	µg/L	<2	0.5 µg/L	70.5	68.3	112
EP075: Isophorone	78-59-1	2	µg/L	<2	0.5 µg/L	75.2	67.6	111
EP075: 2.6-Dinitrotoluene	606-20-2	4	µg/L	<4	0.5 µg/L	83.4	64.4	113
EP075: 2.4-Dinitrotoluene	121-14-2	4	µg/L	<4	0.5 µg/L	77.7	59.5	109
EP075: 1-Naphthylamine	134-32-7	2	µg/L	<2	0.5 µg/L	# 116	46.8	102
EP075: 4-Nitroquinoline-N-oxide	56-57-5	2	µg/L	<2	0.5 µg/L	57.2	8.93	98.7
EP075: 5-Nitro-o-toluidine	99-55-8	2	µg/L	<2	0.5 µg/L	62.0	58.3	106
EP075: Azobenzene	103-33-3	2	µg/L	<2	0.5 µg/L	84.9	66	112
EP075: 1.3.5-Trinitrobenzene	99-35-4	2	µg/L	<2	0.5 µg/L	84.1	39	105
EP075: Phenacetin	62-44-2	2	µg/L	<2	0.5 µg/L	69.3	57.8	101
EP075: 4-Aminobiphenyl	92-67-1	2	µg/L	<2	0.5 µg/L	79.3	60.1	112
EP075: Pentachloronitrobenzene	82-68-8	2	µg/L	<2	0.5 µg/L	77.5	59	109
EP075: Pronamide	23950-58-5	2	µg/L	<2	0.5 µg/L	84.0	62.7	109
EP075: Dimethylaminoazobenzene	60-11-7	2	µg/L	<2	0.5 µg/L	74.7	59.4	108
EP075: Chlorobenzilate	510-15-6	2	µg/L	<2	0.5 µg/L	77.4	57.7	110
EP075F: Haloethers (QCLot: 2021660)								
EP075: Bis(2-chloroethyl) ether	111-44-4	2	µg/L	<2	0.5 µg/L	80.6	69.1	112
EP075: Bis(2-chloroethoxy) methane	111-91-1	2	µg/L	<2	0.5 µg/L	72.4	66.2	111
EP075: 4-Chlorophenyl phenyl ether	7005-72-3	2	µg/L	<2	0.5 µg/L	74.7	64.7	109
EP075: 4-Bromophenyl phenyl ether	101-55-3	2	µg/L	<2	0.5 µg/L	71.3	61.6	108
EP075G: Chlorinated Hydrocarbons (QCLot: 2021660)								
EP075: 1.4-Dichlorobenzene	106-46-7	2	µg/L	<2	0.5 µg/L	61.0	42	114
EP075: 1.3-Dichlorobenzene	541-73-1	2	µg/L	<2	0.5 µg/L	59.7	39.1	113
EP075: 1.2-Dichlorobenzene	95-50-1	2	µg/L	<2	0.5 µg/L	61.0	41.3	112
EP075: Hexachloroethane	67-72-1	2	µg/L	<2	0.5 µg/L	59.3	31	114
EP075: 1.2.4-Trichlorobenzene	120-82-1	2	µg/L	<2	0.5 µg/L	60.6	42.9	115
EP075: Hexachloropropylene	1888-71-7	2	µg/L	<2	0.5 µg/L	66.4	23.8	111
EP075: Hexachlorobutadiene	87-68-3	2	µg/L	<2	0.5 µg/L	58.9	37.4	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075G: Chlorinated Hydrocarbons (QCLot: 2021660) - continued								
EP075: Hexachlorocyclopentadiene	77-47-4	10	µg/L	<10	0.5 µg/L	53.3	1.88	105
EP075: Pentachlorobenzene	608-93-5	2	µg/L	<2	0.5 µg/L	67.9	64.5	107
EP075: Hexachlorobenzene (HCB)	118-74-1	4	µg/L	<4	0.5 µg/L	68.6	65.7	110
EP075H: Anilines and Benzidines (QCLot: 2021660)								
EP075: Aniline	62-53-3	2	µg/L	<2	0.5 µg/L	72.4	10.9	89.7
EP075: 4-Chloroaniline	106-47-8	2	µg/L	<2	0.5 µg/L	# 42.9	44.4	106
EP075: 2-Nitroaniline	88-74-4	4	µg/L	<4	0.5 µg/L	81.1	60.9	110
EP075: 3-Nitroaniline	99-09-2	4	µg/L	<4	0.5 µg/L	64.6	51.5	96.9
EP075: Dibenzofuran	132-64-9	2	µg/L	<2	0.5 µg/L	73.2	65.3	108
EP075: 4-Nitroaniline	100-01-6	2	µg/L	<2	0.5 µg/L	62.4	48.9	99.5
EP075: Carbazole	86-74-8	2	µg/L	<2	0.5 µg/L	83.2	64.3	107
EP075: 3.3`-Dichlorobenzidine	91-94-1	2	µg/L	<2	0.5 µg/L	68.9	60.3	119
EP075I: Organochlorine Pesticides (QCLot: 2021660)								
EP075: alpha-BHC	319-84-6	2	µg/L	<2	0.5 µg/L	76.2	64.3	110
EP075: beta-BHC	319-85-7	2	µg/L	<2	0.5 µg/L	74.3	59	110
EP075: gamma-BHC	58-89-9	2	µg/L	<2	0.5 µg/L	76.4	63.7	112
EP075: delta-BHC	319-86-8	2	µg/L	<2	0.5 µg/L	80.0	60.2	113
EP075: Heptachlor	76-44-8	2	µg/L	<2	0.5 µg/L	81.4	57.9	108
EP075: Aldrin	309-00-2	2	µg/L	<2	0.5 µg/L	73.9	57	113
EP075: Heptachlor epoxide	1024-57-3	2	µg/L	<2	0.5 µg/L	74.0	60.3	112
EP075: alpha-Endosulfan	959-98-8	2	µg/L	<2	0.5 µg/L	96.3	52.5	115
EP075: 4.4`-DDE	72-55-9	2	µg/L	<2	0.5 µg/L	72.4	64.1	111
EP075: Dieldrin	60-57-1	2	µg/L	<2	0.5 µg/L	74.8	65	113
EP075: Endrin	72-20-8	2	µg/L	<2	0.5 µg/L	84.3	51.1	112
EP075: beta-Endosulfan	33213-65-9	2	µg/L	<2	0.5 µg/L	80.3	60.4	111
EP075: 4.4`-DDD	72-54-8	2	µg/L	<2	0.5 µg/L	73.8	59.8	115
EP075: Endosulfan sulfate	1031-07-8	2	µg/L	<2	0.5 µg/L	79.6	52.8	114
EP075: 4.4`-DDT	50-29-3	4	µg/L	<4	0.5 µg/L	77.2	41.3	114
EP075J: Organophosphorus Pesticides (QCLot: 2021660)								
EP075: Dichlorvos	62-73-7	2	µg/L	<2	0.5 µg/L	81.7	52	118
EP075: Dimethoate	60-51-5	2	µg/L	<2	0.5 µg/L	77.3	46.8	114
EP075: Diazinon	333-41-5	2	µg/L	<2	0.5 µg/L	87.3	54	116
EP075: Chlorpyrifos-methyl	5598-13-0	2	µg/L	<2	0.5 µg/L	79.4	54.1	116
EP075: Malathion	121-75-5	2	µg/L	<2	0.5 µg/L	90.9	57.6	118
EP075: Fenthion	55-38-9	2	µg/L	<2	0.5 µg/L	79.9	50.1	117
EP075: Chlorpyrifos	2921-88-2	2	µg/L	<2	0.5 µg/L	80.6	59.2	113
EP075: Pirimphos-ethyl	23505-41-1	2	µg/L	<2	0.5 µg/L	80.8	52.6	115
EP075: Chlorfenvinphos	470-90-6	2	µg/L	<2	0.5 µg/L	79.1	44.6	95.8
EP075: Prothiofos	34643-46-4	2	µg/L	<2	0.5 µg/L	72.8	56.8	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075J: Organophosphorus Pesticides (QCLot: 2021660) - continued								
EP075: Ethion	563-12-2	2	µg/L	<2	0.5 µg/L	81.3	48.6	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2020708)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	90.5	75	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2021656)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	86.3	58.9	131
EP071: C15 - C28 Fraction	----	100	µg/L	<100	2500 µg/L	101	73.9	138
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	105	62.7	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2020708)								
EP080: C6 - C10 Fraction	----	20	µg/L	<20	310 µg/L	88.3	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2021656)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	2500 µg/L	80.4	58.9	131
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	83.5	73.9	138
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
		50	µg/L	----	1500 µg/L	102	62.7	131

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 2020707)							
ES1123359-001	Anonymous	EP074: Benzene	71-43-2	25 µg/L	89.1	70	130
		EP074: Toluene	108-88-3	25 µg/L	85.9	70	130
EP074E: Halogenated Aliphatic Compounds (QCLot: 2020707)							
ES1123359-001	Anonymous	EP074: 1.1-Dichloroethene	75-35-4	25 µg/L	104	70	130
		EP074: Trichloroethene	79-01-6	25 µg/L	79.9	70	130
EP074F: Halogenated Aromatic Compounds (QCLot: 2020707)							
ES1123359-001	Anonymous	EP074: Chlorobenzene	108-90-7	25 µg/L	81.7	70	130
EP075A: Phenolic Compounds (QCLot: 2021660)							
ES1123445-003	BH4	EP075: Phenol	108-95-2	2 µg/L	36.5	20	130
		EP075: 2-Chlorophenol	95-57-8	2 µg/L	72.2	60	130
		EP075: 2-Nitrophenol	88-75-5	2 µg/L	78.1	60	130
		EP075: 4-Chloro-3-Methylphenol	59-50-7	2 µg/L	76.1	50	130
		EP075: Pentachlorophenol	87-86-5	2 µg/L	69.6	5	130
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 2021660)							
ES1123445-003	BH4	EP075: Acenaphthene	83-32-9	2 µg/L	66.9	60	130
		EP075: Pyrene	129-00-0	2 µg/L	74.9	60	130
EP075D: Nitrosamines (QCLot: 2021660)							
ES1123445-003	BH4	EP075: N-Nitrosodi-n-propylamine	621-64-7	2 µg/L	60.0	60	130
EP075E: Nitroaromatics and Ketones (QCLot: 2021660)							
ES1123445-003	BH4	EP075: 2.4-Dinitrotoluene	121-14-2	2 µg/L	81.2	60	130
EP075G: Chlorinated Hydrocarbons (QCLot: 2021660)							
ES1123445-003	BH4	EP075: 1.4-Dichlorobenzene	106-46-7	2 µg/L	66.2	40	130
		EP075: 1.2.4-Trichlorobenzene	120-82-1	2 µg/L	70.7	40	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2020708)							
ES1123359-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	110	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2021656)							
ES1123445-003	BH4	EP071: C10 - C14 Fraction	----	200 µg/L	106	74	150
		EP071: C15 - C28 Fraction	----	250 µg/L	# Not Determined	77	153
		EP071: C29 - C36 Fraction	----	200 µg/L	141	67	153
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2020708)							
ES1123359-001	Anonymous	EP080: C6 - C10 Fraction	----	375 µg/L	101	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2021656)							

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: Spike Recovery (%) MS	Matrix Spike (MS) Report: Recovery Limits (%) Low	Matrix Spike (MS) Report: Recovery Limits (%) High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2021656) - continued							
ES1123445-003	BH4	EP071: >C10 - C16 Fraction	----	250 µg/L	74.4	74	150
		EP071: >C16 - C34 Fraction	----	350 µg/L	# Not Determined	77	153
		EP071: >C34 - C40 Fraction	----	150 µg/L	99.3	67	153

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1123445**	Page	: 1 of 8
Client	: C M JEWELL & ASSOC PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MS LESLEY RANDALL	Contact	: Client Services
Address	: P O BOX 10 WENTWORTH FALLS NSW, AUSTRALIA 2782	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: lesley@cm-jewell.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 4759 3251	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 4759 3257	Facsimile	: +61-2-8784 8500
Project	: J1566	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: 75 OLD PITTWATER ROAD BROOKVAL		
C-O-C number	: ----	Date Samples Received	: 27-OCT-2011
Sampler	: LR	Issue Date	: 03-NOV-2011
Order number	: ----		
		No. of samples received	: 7
Quote number	: SY/274/10	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP074A: Monocyclic Aromatic Hydrocarbons							
Amber VOC Vial - HCl BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP074B: Oxygenated Compounds							
Amber VOC Vial - HCl BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP074C: Sulfonated Compounds							
Amber VOC Vial - HCl BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP074D: Fumigants							
Amber VOC Vial - HCl BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP074E: Halogenated Aliphatic Compounds							
Amber VOC Vial - HCl BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP074F: Halogenated Aromatic Compounds							
Amber VOC Vial - HCl							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP074G: Trihalomethanes							
Amber VOC Vial - HCl							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓
EP075A: Phenolic Compounds							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075C: Phthalate Esters							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075D: Nitrosamines							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075E: Nitroaromatics and Ketones							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075F: Haloethers							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075G: Chlorinated Hydrocarbons							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075H: Anilines and Benzidines							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075I: Organochlorine Pesticides							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP075J: Organophosphorus Pesticides							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
Amber VOC Vial - HCl							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft							
Amber Glass Bottle - Unpreserved							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**28-OCT-2011**	03-NOV-2011	✓	**31-OCT-2011**	10-DEC-2011	✓
Amber VOC Vial - HCl							
BH1, BH2, BH4, BH101, BH107, BH113, DUP:1	**27-OCT-2011**	**29-OCT-2011**	10-NOV-2011	✓	**29-OCT-2011**	10-NOV-2011	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Semivolatile Organic Compounds	EP075	1	7	**14.3**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	2	13	**15.4**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	17	**11.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	2	12	**16.7**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Semivolatile Organic Compounds	EP075	1	7	**14.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Semivolatile Organic Compounds	EP075	1	7	**14.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	1	13	**7.7**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	17	**5.9**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Semivolatile Organic Compounds	EP075	1	7	**14.3**	**5.0**	✓	ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	1	13	**7.7**	**5.0**	✓	ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	17	**5.9**	**5.0**	✓	ALS QCS3 requirement
Volatile Organic Compounds	EP074	1	12	**8.3**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
TPH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Volatile Organic Compounds	EP074	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Semivolatile Organic Compounds	EP075	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP075A: Phenolic Compounds	2390828-026	----	**2-Chlorophenol**	95-57-8	61.7 %	63.1-105%	**Recovery less than lower control limit**
EP075A: Phenolic Compounds	2390828-026	----	**2-Nitrophenol**	88-75-5	114 %	55.4-110%	**Recovery greater than upper control limit**
EP075A: Phenolic Compounds	2390828-026	----	**2.4-Dimethylphenol**	105-67-9	59.0 %	61.7-110%	**Recovery less than lower control limit**
EP075E: Nitroaromatics and Ketones	2390828-026	----	**1-Naphthylamine**	134-32-7	116 %	46.8-102%	**Recovery greater than upper control limit**
EP075H: Anilines and Benzidines	2390828-026	----	**4-Chloroaniline**	106-47-8	42.9 %	44.4-106%	**Recovery less than lower control limit**
Matrix Spike (MS) Recoveries							
EP080/071: Total Petroleum Hydrocarbons	ES1123445-003	BH4	**C15 - C28 Fraction**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2	ES1123445-003	BH4	**>C16 - C34 Fraction**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**