

URBAN PROPERTY GROUP



Additional Groundwater Investigation



614-632 High Street, Penrith NSW

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Executive Summary

Background

Mr Robert Georges of Urban Property Group ('the Client') engaged EI Australia (EI) to conduct an Additional Groundwater Investigation for the property located at 614-632 High Street, Penrith NSW ('the site'). This assessment was conducted to assess the nature and degree of any potential onsite groundwater contamination associated with current and former users of the property. The investigation will form part of a Development Application package to Penrith City Council for site redevelopment.

This site is located approximately 49.6 km west of the Sydney Central Business District (CBD) and is located within the Local Government Area of Penrith City Council (**Figure A.1**). It is comprised of Lot 10 of DP1162271, covering a total area of 4,730 m², as depicted in **Figure A.2**. The site is currently occupied by a semi-sealed asphalt car parking area with a partially completed display-suite in the eastern portion of the site.

Based on the proposed plans (DKO Architecture, Drawing Number DA500, dated March 2019) provided by the client, EI understands that the site is to be redeveloped into two towers comprising forty-four (44) storey, high density residential / commercial building. Communal car parking and commercial tenancies are proposed for ground level with no basements proposed.

Based on the findings from this ASI it was concluded that:

- The CSM identified the following potential sources of on-site contamination:
 - Residual impacts from former underground storage tanks (USTs);
 - Contamination from off-site sources.
- One round of groundwater sampling was carried out on the two existing groundwater monitoring wells installed during the Geotechnical Investigation (EI, 2019);
- Groundwater was observed to be present at approximately 5.5m BGL and was visually observed to be of low turbidity with no odours or sheen.
- Based on local topography and the nearest water receptor, groundwater is likely flowing to the west.
- Exceedances of the ANZG (2018) Fresh Water Criteria for copper, nickel, zinc and TRH F3 were reported, however the identified concentrations were considered to be at levels presenting a low environmental and human health risk, as discussed in **Section 9**.

Based on the above findings and with due regard for the Statement of Limitations (**Section 11**), EI conclude the groundwater quality identified at the site presents a low human health and environmental risk and is suitable for the proposed mixed residential and commercial towers with above ground car parking.

1. INTRODUCTION

1.1 Background and Purpose

Mr Robert Georges of Urban Property Group ('the Client') engaged EI Australia (EI) to conduct an Additional Groundwater Investigation (AGI) for the property located at 614-632 High Street, Penrith NSW ('the site'). This assessment was conducted to assess the nature and degree of any potential onsite groundwater contamination associated with current and former users of the property. The investigation will form part of a Development Application package to Penrith City Council for site redevelopment.

This site is located approximately 49.6 km west of the Sydney Central Business District (CBD) and is located within the Local Government Area of Penrith City Council (**Figure A.1**). It is comprised of Lot 10 of DP1162271, covering a total area of 4,730 m², as depicted in **Figure A.2**. The site is currently occupied by a semi-sealed asphalt car parking area with a partially completed display-suite in the eastern portion of the site.

1.2 Proposed Development

Based on the proposed plans (DKO Architecture, Drawing Number DA500, dated March 2019) provided by the client, EI understands that the site is to be redeveloped into two towers comprising forty-four (44) storey, high density residential / commercial building. Car parking and commercial tenancies are proposed for ground level with no basements proposed.

1.3 Regulatory Framework

The following regulatory framework and guidelines were considered during the preparation of this report:

- Environmental Planning and Assessment Act (EP&A) 1979;
- Protection of the Environment Operation (POEO) Act 1997;
- Contaminated Land Management Act 1997;
- EPA (1995) Sampling Design Guidelines;
- SEPP 55 (1998) State Environment Planning Policy 55 - The Remediation of Land;
- DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites;
- Work Health and Safety Act 2011;
- Penrith Local Environmental Plan 2012;
- NEPC (2013) National Environmental Protection (Assessment of Site Contamination) Measure 1999 (Amendment 2013), in particular Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater and Schedule B(2) Guideline on Site Characterisation;
- EPA (2015) Contaminated Land Management: Guidelines on the Duty to Report Contamination;
- EPA (2017) Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme; and
- ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality;

1.4 Project Objectives

The primary objectives of this ASI are to:

- Investigate the current groundwater conditions via sampling (from the two existing groundwater wells) and laboratory analysis for the contaminants of concern; and
- Where groundwater contamination is confirmed, make recommendations for the appropriate management of any contaminated groundwater.

1.5 Scope of Works

To achieve the above objectives, the following scope of works was adopted:

1.5.1 Desktop Study

- A review of relevant topographical, geological, hydrogeological and soil landscape maps for the project area; and
- A review of previous investigation including historical aerial photographs, SafeWork NSW records, land titles and a NSW EPA Land information records regarding any statutory notices current on the site under the Contaminated Land Management Act 1997 or Protection of the Environment Operations Act 1997.

1.5.2 Field Work & Laboratory Analysis

- Preparation of a Work Health, Environment and Safety Plan (WHSEP);
- A review of existing underground services on site, with the use of 'Dial Before You Dig' (DBYD);
- A detailed site walkover inspection;
- One (1) round of groundwater sampling from the two constructed groundwater monitoring wells installed by EI during the Geotechnical Investigation (2019) assess the impacts (if any) to up-gradient and down-gradient groundwater; and
- Laboratory analysis of selected groundwater samples for relevant analytical parameters as determined from the site history survey and field observations during the investigation programme.

2. SITE CHARACTERISATION

2.1 Property Identification, Location and Physical Setting

The site identification details and associated information are presented in **Table 2-1**, while the site locality is shown in **Figure A.1**.

Table 2-1 Site Identification, Location and Zoning

Attribute	Description
Street Address	614-632 High Street, Penrith NSW
Location Description	Approx. 49.6 km west of the Sydney CBD, bound by High Street (north), Union Lane (south) and commercial / industrial lots (east and west).
Site Coordinates	North-east corner of site (GDA94-MGA56): Easting: 286032.904 Northing: 6262960.939 (Source: http://maps.six.nsw.gov.au)
Site Area	4,730 m ²
Lot and Deposited Plan (DP)	Lot 10/ - /DP1162271
Site Owner	Urban Property Group
State Survey Marks	Two (2) State Survey Marks (SSM) and three (3) Permanent Marker (PM) are situated in close proximity (<150 m) to the site: <ul style="list-style-type: none">▪ SS18074D on the corner of High Street and John Tipping Grove;▪ SS18075 on John Tipping Grove;▪ PM12650 on the corner of High Street and Worth Street;▪ PM12651 on the corner of High Street and John Tipping Grove; and▪ PM12652 on the corner of Union Road and John Tipping Grove. (Source: http://maps.six.nsw.gov.au)
Local Government Authority	Penrith City Council
Current Zoning	B4 – Mixed Use (Penrith Local Environment Plan 2012).
Current Land Uses	The site is currently occupied by a semi-sealed asphalt car parking area with a partially completed display-suite in the eastern portion of the site.

2.2 Surrounding Land Use

The site was situated within an area of mixed land uses. Uses of the immediately surrounding land are described in **Table 2-2**.

Table 2-2 Surrounding Land Uses

Direction Relative to Site	Land Use Description
North	High Street followed by commercial / industrial lot.
South	Union Lane followed by high density residential lots.
East	Commercial / industrial lot followed by Worth Street.
West	Commercial / industrial lot followed by John Tipping Grove.

2.3 Regional Setting

Regional topography, geology, soil landscape and hydrogeological information are summarised in **Table 2-3**.

Table 2-3 Regional Setting Information

Attribute	Description
Topography	The site is generally level with a slight slope (<5%) toward the Nepean River (west)
Site Drainage	Consistent with the general slope of the site, stormwater is assumed to flow to the west, towards the Nepean River (0.8 km west) via drainage systems discharging to various stormwater easements and the municipal stormwater system.
Regional Geology	With reference to the 1:100 000 scale Geological Series Sheet 9030 (Penrith) the site is likely to be underlain by Bringelly Shale, a formation of the Wianamatta Group (Rwb). Bringelly Shale typically consists of <i>Shale, carbonaceous claystone, laminite, fine to medium grained lithic sandstone</i> .
Soil Landscape	The Soil Conservation Service of NSW Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy, 1989) indicates that the site is underlain by the Richmond (ri) Alluvial Landscape, which typically includes poorly structure orange to red clay loams, clays and sands.
Acid Sulfate Soil Risk	(Benviron, 2019); The site is not included in the NSW Department of Land and Water (DLWC) <i>Acid sulfate Soil Risk Maps</i> . Therefore, there is 'No Known Occurrence' with regards to the acid sulfate risk. With reference to the Penrith LEP (2014) Acid Sulfate Soils Map (Sheet ASS_004) the site lies in an area of 'Non Standard Values', as such EI consider the ASS risk to be low.
Nearest Surface Water Feature	The Nepean River (located 0.8 km west); is classed as a freshwater water ecosystem for assessment purposes.
Inferred Groundwater Flow Direction	Based on regional topography and the nearest water receptor, groundwater was inferred to flow west.

3. PREVIOUS INVESTIGATIONS

3.1 Available documents

This AGI follows on from previous environmental assessments conducted at the site, including:

- Benviron Group (Benviron, 2019) *Detailed Site Investigation (DSI)*; 614-632 High Street, Penrith NSW, Ref: E638, dated December 2019. This report also included summary of the *Contamination Assessment* (Geotechnique, 2007) and utilised soil and groundwater results from this investigation.
- EI Australia (EI, 2019) *Geotechnical Investigation (GI)*; 614-632 High Street, Penrith NSW, Ref E24300.G03, dated 09 August 2019.

A summary of the previous investigations is presented below in **Table 3-1**.

Table 3-1 Summary of Previous Investigation Works and Findings

Assessment Details	Project Tasks and Findings
Benviron (2019) Detailed Site Investigation (DSI)	
Site Description	The site is rectangular in shape and is bound by High Street to the north, Union Lane to the south and commercial lots to the east and west. The site was unoccupied at the time of this report with more than half of the site being unsealed.
Development Controls	<p>A WorkCover NSW (SafeWork NSW) search of their Stored Chemical Information Database indicated the following:</p> <ul style="list-style-type: none"> - 1958: Gilbert & Barker confirmed despatch of 2 x 3,000 gallon tanks on sit; - 1970: 2 x UST were registered to Central Motors Nepean Pty Ltd under inflammable liquid; and - 1996: Knights Syndicate Pty Ltd stated 2 x UST were removed from site and disposed of at Rouse Hill Quarry. <p>A search was conducted of all records pertaining to Section 58 of the Contaminated Land Management Act 1997 (NSW) and revealed that the Site is not encumbered by any notices from the NSW EPA with regard to contaminated land. No sites in the vicinity of the Site were encumbered by any notices.</p> <p>A search of the NSW EPA online Protection of the Environment Operations Act 1997 (NSW) public register did not locate any records of licences, applications, notices, audits, or pollution studies/ reduction programs for the Site.</p> <p>A search of relevant documents held by Penrith City Council indicated the following:</p> <ul style="list-style-type: none"> - 2006: DA approved for demolition of building; - 2006: DA approved with conditions for carpark construction; - 2008: DA plan approved with conditions for mixed use development; - 2012: a Torrens Title Subdivision x 3 lots granted; and - 2014: DA approved with conditions for a retail premise – Vehicle Hire and Site Office.

Assessment Details	Project Tasks and Findings
Site History	<p>Aerial photographs from 1943 to 2017, available from the NSW Lands Department and Nearmap (http://maps.au.nearmap.com/) were reviewed by Benviron (2019) with relevant observations being summarised below;</p> <p>The site had been occupied by commercial type buildings from 1943 to current date. Sometime from 1956 to 1975 the site was redeveloped into a commercial property indicative of a car sales yard.</p> <p>The surrounding land had been a mixture of rural residential, commercial & agricultural in the 1943 aerial photograph. The surrounding land has remained mixed use in nature to the current date.</p> <p>A review of historical documents held at the NSW Department of Lands Offices and the title information were undertaken, summarised below;</p> <p>The land titles indicated the site had been owned by private individuals from 1900s to 1966. From 1966 to current date, the site was owned &/or leased by different commercial entities & private individuals.</p>
Bore water search	<p>A total of five (5) registered water bores were identified within the vicinity of the site including:</p> <ul style="list-style-type: none"> ▪ Three (3) monitoring bores; ▪ One (1) domestic bore; and ▪ One (1) Industrial / recreational bore.
Field Work	<p>Benviron (2019) collected samples from eight (8) borehole locations across the site on 20 November 2015. Samples were collected from an additional two (2) locations on 4 April 2017.</p> <p>All samples analysed were below the adopted human health / ecological assessment criteria.</p> <p>Geotechnique (2007) included soil sampling from five (5) borehole locations and one (1) groundwater well.</p>
Subsurface Conditions	<p>Intrusive investigation revealed that the subsurface was comprised of the following:</p> <p>Fill Gravelly SAND;</p> <p>Natural Silty SAND & Clayey SILT; Gravel; and Silty CLAY.</p> <p>Rock SHALE</p>
Results	<p>Soil:</p> <p>All samples analysed returned results below the adopted human health investigation levels (HILs) for residential development (HIL-B).</p> <p>All samples analysed returned results below the derived ecological investigation levels (EILs) with the exception of the following;</p> <ul style="list-style-type: none"> - BH5(0.5m): copper (300mg/kg), nickel (45mg/kg), zinc (1,300mg/kg); - BH1(0.3-0.5m) benzo(α)pyrene (0.91mg/kg); - BH101(0.1-0.2m) TRH F3 (300mg/kg); - SS4 TRH F3 (1,700mg/kg)

Assessment Details

Project Tasks and Findings

Groundwater

All analytes (2007) were below the respective groundwater investigation level (GILs) for the 95% protection of freshwater aquatic ecosystems, with the exception of the following;

- GW1: zinc (32µg/L), nickel (15 µg/L).

In addition detectable levels of TRH and BTEX were reported, including:

- GW1: toluene (6µg/L), ethylbenzene (6 µg/L), total xylenes (60 µg/L), TRH C6-C9 (600 µg/L), C10-C14 (20,000 µg/L), and C15- C28 (1,600 µg/L).

EI (2019) Geotechnical Investigation

Field Work

EI (2019) advanced a total of six (6) boreholes to a total depth of 18.2-19.60 mBGL with two (2) locations being converted into groundwater monitoring wells.

- Standard Penetration Testing (SPT) was conducted on all borehole locations at an approximate depth of 2.3-3.5 mBGL.

Subsurface Condition

Unit	Material ²	Depth to Top of Unit (m BEGL) ¹	Observed Thickness (m)	Comments
1	Fill	Surface	0.2 to 1.2	Silty sand Fill, usually with fine to medium gravels and rootlets.
2a	Fluvial Soil (Silty Sand / Sandy Silt)	0.2 to 1.2	1.9 to 3.0	Fine to medium grained silty sand and low plasticity silt / sandy silt. SPT values ranged from 4 to 11.
2b	Fluvial Soil (Sandy GRAVEL)	2.3 to 3.5	9.4 to 10.7	Sandy Gravels, medium to coarse, sub-angular to sub-rounded, with silt.
3	Low to Medium Strength Shale	12.9 to 13.0	2.1 to 3.2	Low to medium strength slightly weathered to fresh shale. Unit 4 was overlain by up to 350mm of distinctly weathered, very low to low strength shale.
4	High Strength Shale	15.0 to 16.2	- ³	High strength, fresh Shale

Groundwater Conditions

A total of two (2) drilled boreholes were converted into groundwater monitoring wells, summarised below;

- BH1M; installed on 22/07/19 to a total depth of 12.6 mBGL; and
- BH3M; installed on 24/07/19 to a total depth of 12.6 mBGL.

One (1) groundwater monitoring even was conducted across both of the newly installed wells. A total of two (2) soil samples and one (1) groundwater sample were selected and analysed for pH chloride, sulfate and electrical conductivity. The assessment indicated that subsurface conditions were 'mild' for buried concrete and 'non-aggressive' for buried steel structural elements.

4. CONCEPTUAL SITE MODEL

In accordance with NEPC (2013) *Schedule B2 – Guideline on Site Characterisation*, EI developed a conceptual site model (CSM) assessing plausible pollutant linkages between potential contamination sources, migration pathways and receptors. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation.

4.1 Contamination Sources

Base on the history review and inspection, the primary contaminant sources at the site in relation to groundwater are outlined in **Table 4-1**.

Table 4-1 Potential Contaminant Sources and Contaminants

Contaminant Source	Potential Impacts
Residual impacts from the two former USTs removed in 1996	Potential groundwater contamination from former USTs including heavy metals (HM), total recoverable hydrocarbons (TRH), the monocyclic aromatic hydrocarbon compounds benzene, toluene, ethyl-benzene and xylenes (BTEX), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAH).
Contamination from off-site sources	Potential groundwater contamination from off-site industrial sources, such as petrol station (<250 m of site) and main street (High Street) including heavy metals (HM), total recoverable hydrocarbons (TRH), the monocyclic aromatic hydrocarbon compounds: <i>benzene, toluene, ethyl-benzene and xylenes (BTEX)</i> , polycyclic aromatic hydrocarbons (PAH).

4.2 Other Contaminants of Concern

Per- or poly-fluoroalkyl substances (PFAS)

The EPA (2017) auditor guidelines require that PFAS is considered in assessing land contamination. EI used the following decision tree (**Table 4-2**) based on EnRisk (2016) and NEMP (2018) *PFAS National Environmental Management Plan* for prioritising the potential for PFAS to be present on site and whether PFAS sampling of soil and water was required.

Table 4-2 PFAS Decision Tree

Preliminary Screening	Decision
Did fire training occur on-site?	No
Did fire training occur, or is an airport or fire station up-gradient of or adjacent to the site? ¹	No
Have “fuel” fires ever occurred on-site? (e.g. ignition of fuel (solvent, petrol, diesel, kerosene) tanks?)	No
Have PFAS been used in manufacturing or stored on-site? ²	No
If Yes to any questions, has site analytical suite been optimised to include preliminary sampling and testing for PFAS in soil (ASLP Testing) and water?	No

Notes:

¹ Runoff from fire training areas may impact surface water, sediment and groundwater.

² PFAS is used in a wide range of industrial processes and consumer products, including in the manufacture of non-stick cookware, specialised garments and textiles, Scotchguard™ and similar products (used to protect fabric, furniture, leather and carpets from oils and stains), metal plating and in some types of fire-fighting foam (<https://www.nicnas.gov.au/chemical-information/factsheets/chemical-name/perfluorinated-chemicals-pfas>)

4.3 Potential Sources, Exposure Pathways and Receptors

Potential contamination sources, exposure pathways and human and environmental receptors that were considered relevant for this ASI are summarised in **Table 4-3**.

4.4 Data Gaps

Based on a review of previous investigations, there is uncertainty with regard to the quality groundwater beneath the site.

Table 4-3 Conceptual Site Model

Potential Sources	Impacted Media	Contaminants of Potential Concern	Transport mechanism	Exposure pathway	Potential receptor
Former USTs. Migration of contamination onto site from nearby properties and unknown contamination sources.	Groundwater	HMs, TRH, VOC (BTEXN), PAHs	Volatilisation of contamination from groundwater to indoor or outdoor air spaces.	Dermal contact; Ingestion; Inhalation of vapours	Construction and maintenance workers Basement users post-redevelopment Offsite users of constructed basements that are not water tight
			Migration of dissolved phase impacts in groundwater.	Biota uptake	Aquatic ecosystems (freshwater – Nepean River)

5. SAMPLING, ANALYTICAL AND QUALITY PLAN (SAQP)

The SAQP ensures that the data collected during the investigations, is representative and provides a robust basis for site assessment decisions. The SAQP for this DSI included the following:

- Data quality objectives, including a summary of the objectives of the ASI;
- Investigation methodology, including a description of intended sampling points, the media to be sampled and details of COPCs to be analysed;
- Sampling procedures;
- Field screening methods;
- Analysis Methods;
- Sample handling, preservation and storage; and
- Analytical QA/QC.

5.1 Data Quality Objectives (DQO)

In accordance with the US EPA (2006) *Data Quality Assessment* and the EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme*, the process of developing Data Quality Objectives (DQO) was used by the EI assessment team to determine the appropriate level of data quality needed for the specific data requirements of the project. The DQO process that was applied for this DSI is documented in **Table 5-1**.

Table 5-1 Summary of Project Data Quality Objectives

DQO Steps	Details
<p>1. State the Problem</p> <p>Summarise the contamination problem that will require new environmental data, and identify the resources available to resolve the problem; develop a conceptual site model</p>	<p>Additional Characterisation of the groundwater within the site boundaries is required as part of a Development Application (DA) to Penrith City Council.</p> <p>Historical information and site inspection identified the potential for contamination to be present in site groundwater, contributed by various potential sources listed in Section 4.1. In light of the information derived from the available site history information and site observations, a conceptual site model was developed (Section 4).</p>
<p>2. Identify the Goal of the Study (Identify the decisions)</p> <p>Identify the decisions that need to be made on the contamination problem and the new environmental data required to make them</p>	<p>Based on the objectives outlined in Section 1.4, the decisions that need to be made are:</p> <ul style="list-style-type: none"> Has the nature, extent and source of any groundwater impacts onsite been defined? What impact do the site specific, geologic and hydrogeological conditions have on the fate and transport of any impacts that may be identified? Does the level of impact coupled with the fate and transport of identified COPCs represent an unacceptable risk to identified human and/or environmental receptors on or offsite? Does the collected data provide sufficient information to allow the selection and design of an appropriate remedial strategy, if necessary?
<p>3. Identify Information Inputs (Identify inputs to decision)</p> <p>Identify the information needed to support any decision and specify which inputs require new environmental measurements</p>	<p>Inputs to the decision making process include:</p> <ul style="list-style-type: none"> The proposed future land use; Available site historical information; Previous investigations; Areas of concern, identified during the site inspection prior to intrusive investigations; National and NSW EPA guidelines endorsed under the <i>Contaminated Land Management Act 1997</i>; Investigation sampling (soils and groundwater) and laboratory analysis for COPCs to verify the presence of onsite contamination and to evaluate the potential risks to sensitive receptors; and At the end of the investigation, a decision must be made regarding whether the soils and/or groundwater are suitable for the proposed development, or if additional investigation or remedial works are required to make the site suitable for the proposed use.
<p>4. Define the Boundaries of the Study</p> <p>Specify the spatial and temporal aspects of the environmental media that the data must represent to support decision</p>	<p>Lateral – The boundaries of the study are defined as the sites cadastral boundaries.</p> <p>Vertical – From the existing ground level, underlying water-bearing zones.</p> <p>Temporal – Results are valid on the day of data and sample collection and remain valid as long as no changes occur on site or contamination (if present) does not migrate on site or on to the site from off-site sources.</p>

DQO Steps	Details
<p>5. Develop the Analytic Approach (Develop a decision rule)</p> <p>To define the parameter of interest, specify the action level, and integrate previous DQO outputs into a single statement that describes a logical basis for choosing from alternative actions</p>	<p>The decision rules for the investigation were:</p> <ul style="list-style-type: none"> What are the characteristics of groundwater at the site? <i>Groundwater monitoring wells will be installed into the top of bedrock, to determine physical characteristics, chemical composition and flow direction of groundwater underlying the site.</i> Is the site contaminated by historic land use? <i>Groundwater samples will be analysed for COPCs, with the data compared to relevant screening criteria.</i> Is the site suitable for the proposed land use? <i>If the concentrations of contaminants in the soil are below the relevant human health-based and ecological criteria for the intended land use, then the site will be deemed suitable for the proposed development.</i>
<p>6. Specify Performance or Acceptance Criteria (Specify limits on decision errors)</p> <p>Specify the decision-maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data</p>	<p>Specific limits for this project are to be in accordance with NEPM, appropriate data quality indicators (DQIs) for assessing the useability of the data and EI standard procedures for field sampling and handling.</p> <p>To assess the useability of the data, pre-determined DQIs for completeness, comparability, representativeness, precision and accuracy were adopted, as presented below in Table 5-2.</p> <p>If any of the DQIs are not met, further assessment will be necessary to determine whether the non-conformance will significantly affect the useability of the data. Corrective actions may include requesting further information from samplers and/or analytical laboratories, downgrading of the quality of the data or alternatively, re-collection of samples.</p>
<p>7. Develop the Detailed Plan for Obtaining Data (Optimise the design for obtaining data)</p> <p>Identify the most resource-effective sampling and analysis design for general data that are expected to satisfy the DQOs</p>	<p>Site history indicates the potential for contamination to exist. To achieve the decision rules, the intrusive investigation included:</p> <ul style="list-style-type: none"> Sampling of locations in a grid-based pattern across accessible parts of the site. Installation and sampling of groundwater wells up gradient and down gradient of the redevelopment area, to determine flow direction. Representative groundwater samples will be collected and analysed for groundwater characterisation. Review of the results will be undertaken to determine if further intrusive investigation (i.e. additional sampling) is warranted.

5.2 Data Quality Indicators

To ensure that the investigation data were of an acceptable quality, they were assessed against the data quality indicators (DQI) outlined in **Table 5-2**, which related to both field and laboratory-based procedures. The assessment of data quality is discussed in **Section 7**.

Table 5-2 Data Quality Indicators

Data Quality Objective	Data Quality Indicator	Acceptable Range
Accuracy	Field – Trip blank (laboratory prepared) Laboratory – Laboratory control spike and matrix spike	< laboratory limit of reporting (LOR) Prescribed by the laboratories
Precision	Field – Blind replicate and spilt duplicate Laboratory – Laboratory duplicate and matrix spike duplicate	< 30% relative percentage difference (RPD [%]) Prescribed by the laboratories
Representativeness	Field – Trip blank (laboratory prepared) Laboratory – Method blank	< laboratory LOR Prescribed by the laboratories
Completeness	Completion (%)	-

6. ASSESSMENT METHODOLOGY

6.1 Sampling Rationale

With reference to the CSM described in **Section 4**, groundwater investigation works were planned in accordance with the following rationale:

- One (1) round of groundwater sampling from the two constructed groundwater monitoring wells installed by EI during the Geotechnical Investigation (2019) assess the impacts (if any) to up-gradient and down-gradient groundwater;
- Laboratory analysis of representative groundwater samples for the identified contaminants of potential concern (COPC).

6.2 Assessment Criteria

The assessment criteria proposed for this project are outlined in **Table 6-1**. These were selected from available published guidelines that are endorsed by national and/or state regulatory authorities, with due consideration of the exposure scenario that is expected for various parts of the site, the likely exposure pathways and the identified potential receptors.

Table 6-1 Adopted Investigation Levels for Soil and Groundwater

Environmental Media	Adopted Guidelines	Rationale
Groundwater	NEPC (2013) Groundwater HSLs for Vapour Intrusion	<p>Health-based Screening Levels (HSLs)</p> <p>The NEPC (2013) groundwater HSLs for vapour intrusion were used to assess potential human health impacts from residual vapours resulting from petroleum, BTEX and naphthalene impacts. The <i>HSL B</i> thresholds for low and medium-density residential sites were applied for groundwater as a conservative approach.</p> <p>EI note that the HSL-D thresholds for commercial due to proposed car park on ground floor.</p>
	ANZG (2018) Fresh Water Trigger Values	<p>Groundwater Investigation Levels (GILs) for Fresh Water</p> <p>NEPC (2013) provides GILs for typical, slightly-moderately disturbed fresh water ecosystems, which are based on the ANZG (2018) Trigger Values (TVs) for 95% level of protection of fresh water ecosystems. The fresh water criteria were considered relevant as the nearest surface water source is the Nepean River.</p>
	NHMRC (2018) Recreational Water Guidelines	<p>Groundwater Investigation Levels (GILs) for Recreational Water</p> <p>The NHMRC (2008) <i>Recreational Water Guidelines</i> (NHMRC 2008 amended in 2018) assessed for secondary recreational contact by multiplying the NHMRC drinking water guidelines by a factor of 10.</p> <p>EI consider that investigation levels for drinking water quality are not relevant for the following reasons:</p> <ul style="list-style-type: none"> ▪ There is a reticulated water system to the site and region. ▪ There is no evidence of groundwater extraction for beneficial use.

For the purposes of this investigation, the adopted soil assessment criteria are referred to as the Soil Investigation Levels (SILs) and the adopted groundwater assessment criteria are

referred to as the Groundwater Investigation Levels (GILs). SILs and GILs are presented alongside the analytical results in the corresponding summary tables, which are discussed in **Section 8**.

6.3 Groundwater Investigation

The groundwater investigation works conducted at the site are described in **Table 6-2**. Monitoring well locations are illustrated in **Figure A.2**.

Table 6-2 Summary of Groundwater Investigation Methodology

Activity/Item	Details
Fieldwork	Groundwater monitoring wells BH1.M and BH3.M (installed during the Geotechnical Investigation (EI, 2019)) were redeveloped on 13 January 2020. Water level gauging, well purging, field testing and groundwater sampling was conducted on 17 January 2020.
Well Construction	<p>Test bores BH1.M and BH3.M were converted to groundwater monitoring wells as follows:</p> <ul style="list-style-type: none"> BH1.M installed to a total depth of 13.1 mBGL (screened from 10.1-13.1 mBGL). BH1.M is considered hydraulically down-gradient; and BH3.M installed to a total depth of 13.8 mBGL (screened from 10.8-13.8 mBGL). BH3.M is considered hydraulically down-gradient. <p>Well construction was in general accordance with the standards described in NUDLC (2012) and involved the following:</p> <ul style="list-style-type: none"> 50 mm, Class 18 uPVC, threaded, machine-slotted screen and casing, with slotted intervals in shallow wells set to screen to at least 500 mm above the standing water level to allow sampling of phase-separated hydrocarbon product, if present; Base and top of each well was sealed with a uPVC cap; Annular, graded sand filter was used to approximately 300 mm above top of screen interval; Granular bentonite was applied above annular filter to seal the screened interval; Drill cuttings were used to backfill the bore annulus to just below ground level; and Surface completion comprised sufficient well stick up above ground level with concrete occurring from 0.0-0.15 MBGL).
Well Development	This involved agitation within the full length of the water column using a dedicated, HDPE, disposable bailer, followed by removal of water and accumulated sediment using a 12V, HDPE submersible bore pump (Proactive Environmental, model Super Twister). Pumping was continued until no further reduction in suspended sediment was observed (i.e. after removal of several well volumes).
Well Gauging and Groundwater Flow Direction	<p>Monitoring wells were gauged for standing water level (SWL) prior to well purging at the commencement of the GME on 17 January 2020. All measured SWLs are shown in Table 8-1.</p> <p>Phase separated hydrocarbons (PSH) and light non-aqueous phase liquid (LNAPL) were assessed at each location with a Heron Water Oil Interface Probe and checked visually with a clean dedicated bailer prior to sampling.</p>

Activity/Item	Details
Well Purging and Field Testing	<p>Well purging was performed using a low-flow, micro-purge pump.</p> <p>Measurement of water quality parameters was conducted using a water quality meter (HI98194) repeatedly during well purging and were recorded onto field data sheets (Appendix D). The field measurements included Temperature (T), Dissolved Oxygen (DO), Electrical Conductivity (EC), Reduction-Oxidation Potential (Redox) and pH. Purged water volumes removed from each well and field test results are summarised in Table 8-2.</p> <p>Once stable readings were obtained, groundwater sampling was performed.</p>
Groundwater sampling	<p>Groundwater was sampled using a micro-purge system. Water was continuously measured for T, EC, Redox, DO and pH. Once three consecutive field measurements were recorded to within $\pm 10\%$ for DO, $\pm 3\%$ for EC, ± 0.2 for pH, $\pm 0.2^\circ$ for temperature and ± 20 mV for Redox, this was considered to indicate that representative groundwater quality had been achieved and final physico-chemical measurements were recorded. Groundwater samples were then collected from the micro-purge sampling pump discharge point.</p>
Decontamination Procedure	<p>The micro-purge pump was decontaminated in a solution of potable water and Decon 90 and then rinsed with potable water between measurements/wells.</p> <p>The micro-purge system employed a disposable bladder and tubing system to further minimise potential contamination.</p> <p>All sample containers were supplied by the laboratory for the particular project and only opened once immediately prior to sampling.</p> <p>Ice packs were used to keep the samples cool when kept in an insulated chest.</p> <p>The water level probe and water quality kit probes were washed in a solution of potable water and Decon 90 and then rinsed with potable water between measurements/wells.</p>
Sample Preservation	<p>Sample containers (per well) were supplied by the laboratory with the following preservatives:</p> <ul style="list-style-type: none"> One, 1 litre amber glass, acid-washed and solvent-rinsed bottle; Two, 40ml glass vials, pre-preserved with dilute hydrochloric acid, Teflon-sealed; and One, 250mL, HDPE bottle, pre-preserved with dilute nitric acid (1 mL). <p>Samples for metals analysis were field-filtered using 0.45 μm pore-size filters. All containers were filled with sample to the brim then capped and stored in ice-filled chests, until completion of the fieldwork and during sample transit to the laboratory.</p>
Sample Transport	<p>After sampling, refrigerated sample chests were transported to SGS under strict COC conditions. COC certificates and laboratory sample receipt documentation were provided to EI for confirmation purposes (Appendix E).</p>
Quality Control and Laboratory Analysis	<p>Groundwater samples were analysed by SGS for the identified COPCs. QA/QC testing comprised a rinsate blank, trip spike / blank samples and an intra-laboratory (blind field) duplicate tested by SGS, as well as an inter-laboratory (split field) duplicate tested by Eurofins. All corresponding laboratory analytical reports are presented in Appendix F.</p>

7. DATA QUALITY ASSESSMENT

The assessment of data quality is defined as the scientific and statistical evaluation of environmental data to determine if they meet the objectives of the project (US EPA, 2006). Data quality assessment includes an evaluation of the compliance of the field sampling and laboratory analytical procedures and an assessment of the accuracy and precision of these data from the laboratory quality control measurements.

The data quality assessment for this ASI included a review of analytical procedures to confirm compliance with established laboratory protocols and an estimation of the accuracy and precision of the analytical data from a range of quality control measurements. It is summarised in **Table 8-1**.

Table 7-1 Quality Control Process

Data Quality	Control	Conformance [Yes, Part, No]	Report Sections
Preliminaries	Data Quality Objectives established	Yes	See DQO/DQI
Field work	Suitable documentation of fieldwork observations including borehole logs, sample register, field notes, calibration forms	Yes	See Appendices C / D
Sampling Plan	Use of relevant and appropriate sampling plan (density, type, and location)	Yes	See methodology
	All media sampled and duplicates collected	Yes	See methodology
	Use of approved and appropriate sampling methods	Yes	See methodology
	Preservation and storage of samples upon collection and during transport to the laboratory	Yes	See methodology
	Appropriate Rinsate, Field and Trip Blanks taken	Yes	See methodology
	Completed field and analytical laboratory sample COC procedures and documentation	Yes	See laboratory reports
Laboratory	Sample holding times within acceptable limits	Yes	See laboratory QA
	Use of appropriate analytical procedures and NATA-accredited laboratories	Yes	See laboratory report
	LOR/PQL low enough to meet adopted criteria	Yes	See laboratory appendix
	Laboratory blanks	Yes	See laboratory QA/QC
	Laboratory duplicates	Yes	See laboratory QA/QC
	Matrix spike/matrix spike duplicates (MS/MSDs)	Yes	See laboratory QA/QC

Data Quality	Control	Conformance [Yes, Part, No]	Report Sections
	Surrogates (or System Monitoring Compounds)	Yes	See laboratory QA/QC
	Analytical results for replicated samples, including field and laboratory duplicates and inter-laboratory duplicates, expressed as Relative Percentage Difference (RPD)	Yes	See QA Tables Appendix H
	Checking for the occurrence of apparently unusual or anomalous results, e.g. laboratory results that appear to be inconsistent with field observations or measurements	Yes	See Appendix F and Appendix H
Reporting	Report reviewed by senior staff to assess project meets desired quality, EPA guidelines and project outcomes.	Yes	See document control

The findings of the data quality assessment are discussed in detail in **Appendix H**. QA/QC policies and DQOs are presented in **Appendix G**.

On the basis of the analytical data validation procedure employed, the overall quality of the groundwater analytical data produced for the site were considered to be of an acceptable standard for interpretive use.

8. RESULTS

8.1 Groundwater Field Results

8.1.1 Monitoring Well Construction

Two (2) groundwater monitoring wells were installed on the site (BH1.M & BH3.M) during the Geotechnical Investigation (EI, 2019) to assess the impacts (if any) to groundwater within the site cadastral boundaries. Well construction details for the installed groundwater monitoring wells are summarised in **Table 8-1**.

Table 8-1 Monitoring Well Construction Details

Well ID	Well Depth (mBGL)	Well Stick up (m)	Screen Interval (mBGL)	Lithology Screened
BH101.M	13.1	-0.5	10.1-13.1	Sandy Gravel
BH103.M	13.8	-0.1	10.0-13.0	Sandy Gravel

Note 1 BGL - metres below ground level.

Note 2 GL - Ground Level

8.1.2 General Observations and Field Meter Results

A single GME was conducted on two (2) wells on 17 January 2020. On this date, standing water levels (SWLs) were measured within each well prior to well purging, the results of which were recorded with well purge volumes and field-based water test results. A summary of the recorded field data is presented in **Table 8-2** and copies of the completed field data sheets are included in **Appendix D**.

The field data indicated that the local groundwater was slightly acidic (pH: 5.47 to 5.54), fresh to moderately saline (EC: 2,200-3,201 $\mu\text{S}/\text{cm}$, equivalent to moderate salinity).

Table 8-2 Groundwater Field Data

Well ID	SWL (mBTOC)	Purge Volume (L)	DO (mg/L)	pH	EC (μ S/cm)	Temp ($^{\circ}$ C)	Redox (mV)	Comments
BH1.M	5.78	10	11.5	5.54	3201	20.3	302.1	Clear, low turbidity, no odour, no sheen.
BH3.M	5.5	15	13.1	5.47	2200	19.4	307.9	Clear, low turbidity, no odour, no sheen.

Notes:

SWL – Standing Water Level prior to groundwater sampling.

mBTOC – metres below top of well casing.

RL (TOC) – Reduced Level, elevation at TOC in metres relative to Australian Height Datum (mAHD).

⁺ WL – Calculated groundwater level, in m AHD (calculated as RL – SWL)

L – litres (referring to volume of water purged from the well prior to groundwater sample collection).

EE – Equipment Error

DO – Dissolved Oxygen, in units of milligrams per litre (mg/L)

EC – Electrical Conductivity, in units of micro Siemens per centimetre (μ S/cm).

ppm – Parts Per Million

PID – Photo Ionisation Detector

Redox – Reduction Oxidation Potential, adjusted to Standard Hydrogen Electrode (SHE) by adding field electrode potential (205 mV).

All groundwater parameters (pH, EC, redox and DO) were tested on site

* RL extrapolated from nearest point on survey plan (Higgins Norton Partners, 2003)

8.2 Laboratory Analytical Results

8.2.1 Groundwater Analytical Results

A summary of the laboratory analytical results for the tested groundwater samples is presented **Table B.1**, which includes the adopted GILs.

Exceedance of the ANZG (2018) Fresh Water Criteria was identified for the following concentrations of;

- BH1M: copper, nickel, zinc & TRH F3; and
- BH3M: zinc.

9. SITE CHARACTERISATION

9.1 Groundwater Characterisation

Groundwater was observed to be present at approximately 5.5m BGL and was visually observed to be of low turbidity with no odours or sheen. Based on local topography and the nearest water receptor, groundwater is likely flowing to the west.

Laboratory results indicated concentrations of copper, nickel, zinc and TRH F3 at levels marginally exceeding ecological criteria. The heavy metal concentrations were considered representative of, or at least consistent with, background conditions for urban (Sydney metropolitan) areas, including Penrith. Furthermore, given the protracted distance from the nearest surface water feature (>500 m) to where groundwater is likely flowing to, heavy metals and TRH concentrations will likely to attenuate prior to encountering any sensitive environmental receptors.

The heavy metal concentrations is not considered to pose a human health risk due to the lack of exposure pathways, including extraction for local use (domestic / irrigation / industrial) was not identified and groundwater will not be disturbed during redevelopment as not basement excavations are proposed.

The detected TRH concentrations identified were likely due to residual impacts from the former USTs which were removed from the site in 1996 based on known information. As the TRH concentrations were reported well below the adopted HSLs (NEPM, 2013) a negligible to low human health is considered present. In addition, TRH concentrations will likely naturally attenuate over time as primary sources (former USTs) had been removed.

9.2 Review of Conceptual Site Model

Based on investigation findings, the CSM discussed in **Section 4** was considered to appropriately identify contamination sources, migration mechanisms and exposure pathways, as well as potential onsite and offsite receptors. Based on the findings of this investigation, the identified groundwater quality of the site presents a low to negligible human health risk to the proposed development.

10. CONCLUSIONS

Mr Robert Georges of Urban Property Group ('the Client') engaged EI Australia (EI) to conduct an Additional Groundwater Investigation for the property located at 614-632 High Street, Penrith NSW ('the site'). This assessment was conducted to assess the nature and degree of any potential onsite groundwater contamination associated with current and former users of the property. The investigation will form part of a Development Application package to Penrith City Council for site redevelopment.

Based on the findings from this ASI it was concluded that:

- The CSM identified the following potential sources of on-site contamination:
 - Residual impacts from former underground storage tanks (USTs);
 - Contamination from off-site sources.
- One round of groundwater sampling was carried out on the two existing groundwater monitoring wells installed during the Geotechnical Investigation (EI, 2019);
- Groundwater was observed to be present at approximately 5.5m BGL and was visually observed to be of low turbidity with no odours or sheen.
- Based on local topography and the nearest water receptor, groundwater is likely flowing to the west.
- Exceedances of the ANZG (2018) Fresh Water Criteria for copper, nickel, zinc and TRH F3 were reported, however the identified concentrations were considered to be at levels presenting a low environmental and human health risk, as discussed in **Section 9**.

Based on the above findings and with due regard for the Statement of Limitations (**Section 11**), EI conclude the groundwater quality identified at the site presents a low human health and environmental risk and is suitable for the proposed mixed residential and commercial towers with above ground car parking.

11.STATEMENT OF LIMITATIONS

The findings presented in this report are the result of discrete and specific sampling methodologies used in accordance with best industry practices and standards. Due to the site-specific nature of soil sampling from point locations, it is considered likely that all variations in subsurface conditions across a site cannot be fully defined, no matter how comprehensive the field investigation program.

While normal assessments of data reliability have been made, EI assumes no responsibility or liability for errors in any data obtained from previous assessments conducted on site, regulatory agencies (e.g. Council, EPA), statements from sources outside of EI, or developments resulting from situations outside the scope of works of this project.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to EI's investigations and assessment.

EI's assessment is necessarily based upon the result of the site investigation and the restricted program of surface and subsurface sampling, screening and chemical testing which was set out in the proposal. Neither EI, nor any other reputable consultant, can provide unqualified warranties nor does EI assume any liability for site conditions not observed or accessible during the time of the investigations.

This report was prepared for the above named client and no responsibility is accepted for use of any part of this report in any other context or for any other purpose or by other third parties. This report does not purport to provide legal advice.

This report and associated documents remain the property of EI subject to payment of all fees due for this assessment. The report shall not be reproduced except in full and with prior written permission by EI.

12. REFERENCES

- ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia, August 2018.
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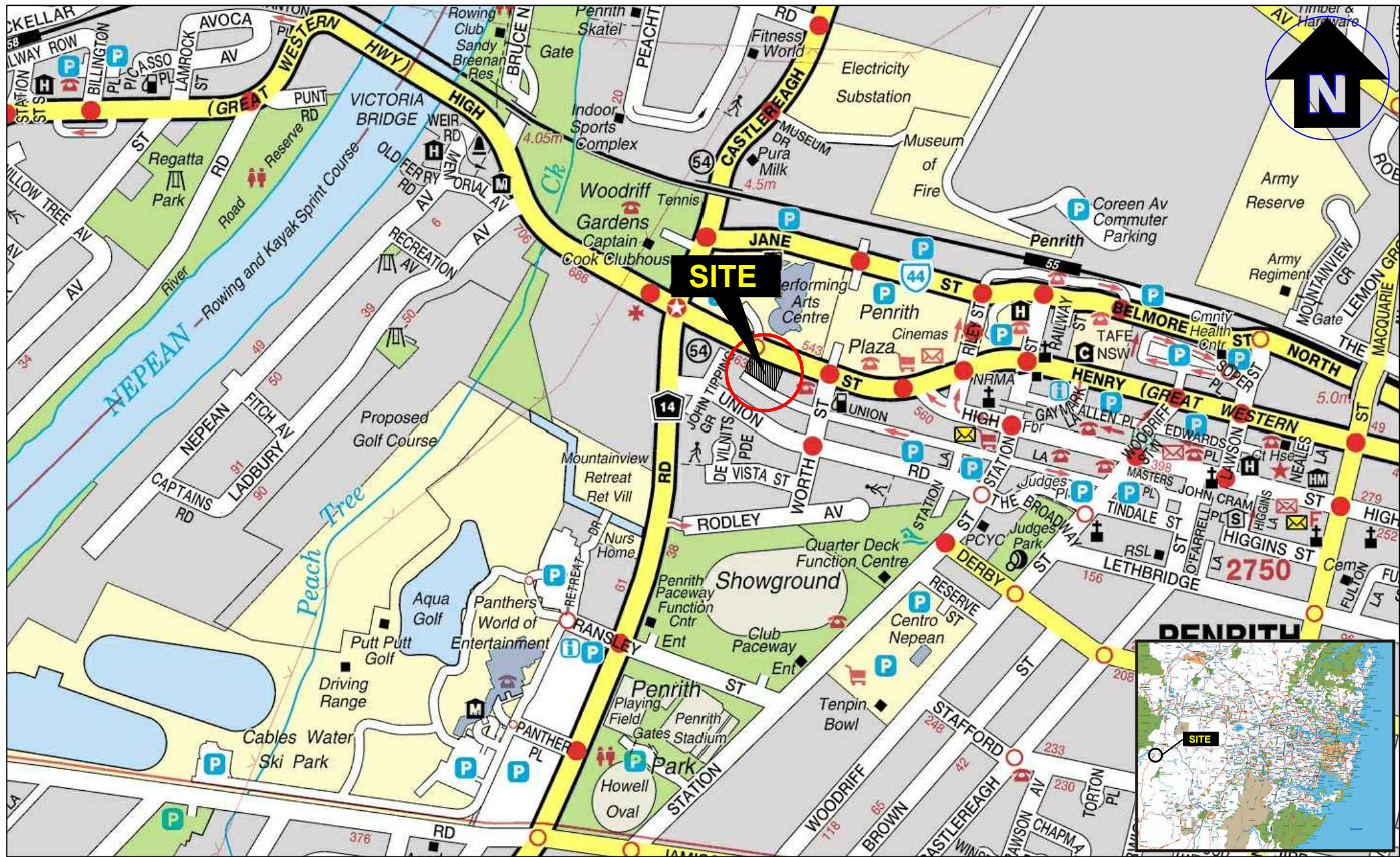
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ABBREVIATIONS

ASS	Acid sulfate soils
B(a)P	Benzo(a)Pyrene (a PAH compound), - B(a)P TEQ Toxicity Equivalent Quotient
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody
CVOCs	Chlorinated Volatile Organic Compounds (a sub-set of the VOC analysis suite)
DEC	Department of Environment and Conservation, NSW (see OEH)
DECC	Department of Environment and Climate Change, NSW (see OEH)
DECCW	Department of Environment, Climate Change and Water, NSW (see OEH)
DA	Development Application
DO	Dissolved Oxygen
DP	Deposited Plan
EC	Electrical Conductivity
EPA	Environment Protection Authority
F1	TRH C ₆ – C ₁₀ less the sum of BTEX concentrations (Ref. NEPM 2013, Schedule B1)
F2	TRH >C ₁₀ – C ₁₆ less the concentration of naphthalene (Ref. NEPM 2013, Schedule B1)
FCS	Fibre Cement Sheeting
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
HIL	Health-based Investigation Level
HSL	Health-based Screening Level
km	Kilometres
LNAPL	Light, non-aqueous phase liquid (also referred to as PSH)
DNAPL	Dense, non-aqueous phase liquid
EIL	Ecological Investigation Level
ESL	Ecological Screening Level
m	Metres
mAHD	Metres Australian Height Datum
mBGL	Metres Below Ground Level
mg/L	Milligrams per litre
µg/L	Micrograms per litre
mV	Millivolts
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
NSW	New South Wales
OEH	Office of Environment and Heritage, NSW (formerly DEC, DECC, DECCW)
PAHs	Polycyclic Aromatic Hydrocarbons
pH	Measure of the acidity or basicity of an aqueous solution
PSH	Phase-separated hydrocarbons (also referred to as LNAPL)
PQL	Practical Quantitation Limit (limit of detection for respective laboratory instruments)
QA/QC	Quality Assurance / Quality Control
SILs	Screening Investigations Levels
SRA	Sample receipt advice (document confirming laboratory receipt of samples)
SWL	Standing Water Level
TDS	Total dissolved solids (a measure of water salinity)
TPH	Total Petroleum Hydrocarbons (superseded term equivalent to TRH)
TRH	Total Recoverable Hydrocarbons (non-specific analysis of organic compounds)
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank

VOCs Volatile Organic Compounds (specific organic compounds which are volatile)

Appendix A - Figures



Drawn:	AM.H.
Approved:	E.W.
Date:	30-01-20
Scale:	Not To Scale

High 618 Pty Ltd
 Additional Site Investigation
 614-632 High Street, Penrith NSW
 Site Locality Plan

Figure:

1



LEGEND

- Approximate site boundary
- Approximate monitoring well location



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Drawn:	AM.H.
Approved:	E.W.
Date:	30/01/20

High 618 Pty Ltd
Additional Site Investigation
614-632 High Street, Penrith NSW
Sampling Location Plan

Figure:
2
Project: E24300.E03

Appendix B - Tables

Table B.1 – Summary of Analytical Results: Groundwater

Sample Identification	Date	Heavy Metals								PAHs			BTEX						TRHs					VOC		
		As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Total PAHs	Benzo(a)pyrene	Naphthalene	Benzene	Toluene	Ethylbenzene	o-xylene	m/p-xylene	Total Xylenes	F1	F2	F3	F4	Total Phenols	Methyl-tert-butyl ether	Other VOCs	
El Australia (January, 2020) - Current Investigation																										
BH1M	17/01/2020	<1	<0.1	1	2	<1	<0.1	11	47	<1	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<50	<60	670	<500	<0.01	14	14	
BH3M	17/01/2020	<1	<0.1	<1	<1	<1	<0.1	2	8	<1	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<50	<60	<500	<500	<0.01	14	14	
	HSL D - Commercial / Industrial ²	Source Depths (2 m to < 4m)										NL	5,000	NL	NL	NL			6,000	NL						
		Source Depths (4 m to <8 m)										NL	5,000	NL	NL	NL			6,000	NL						
		Source Depths (8 m +)										NL	5,000	NL	NL	NL			7,000	NL						
ANZG (2018) ³	Fresh Water	24 (AsIII) 13 (AsV)	0.2	3.3 (CrIII) 0.4 (Cr VI)	1.4	3.4	0.6	11	8		0.1	16	950	180	80	350	275		50 ⁶	60 ⁶	500 ⁶	500 ⁶	320	3200 ⁷		
NHMRC (2017) ⁴	Recreational Water	100	20	500	1,000 *	100	10	200	3 *				10	25 *	3 *	20 *										

Notes: All values are µg/L unless stated otherwise

	Highlighted indicates analyte concentration value exceeding the adopted human health criteria
	Highlighted indicates ecological criteria exceeded
	Highlighted indicates criteria exceeded

- 1
- NEPC 1999 Amendment 2013 'HSL A&B' - Groundwater Health Screening Levels for vapour intrusion at the contaminant source depths for low to high density residential.
- 2
- NEPC 1999 Amendment 2013 'HSL D' - Groundwater Health Screening Levels for vapour intrusion at the contaminant source depths for for commercial / industrial for sand.
- 3
- ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand and Australian State and Territory Governments, August 2018. ANZG (2018) Marine Water Quality is applicable for assessment purposes, where not available the ANZG (2018) Fresh Water Quality Criteria can be applied.
- 4
- NHMRC (2008) Recreational Water Guidelines are based on current Australian Drinking Water Guidelines multiplied by a factor of 10. Current Drinking Water Guidelines are the NHMRC & NRMCM (2017) Australian Drinking Water Guidelines, Version 3.4 Updated
- 5
- US EPA (November 2018) Regional Screening Levels - Tap Water with target hazard quotient of 1.0 and target cancer rick of 1e-06.
- 6
- In lack of a criteria the laboratory PQL has been used (DEC, 2007).
- 7
- Screening level obtained from CRC Care (2016) Guidance for the assessment, remediation and management of MTBE.
- F1
- C6-C10 minus BTEX.
- F2
- >C10-C16 minus Naphthalene.
- F3
- >C16-C34
- F4
- >C34-C40



Table B.2. - Summary of Groundwater RPD Data

Sample Identification	Description	TRH				BTEX				Heavy Metals							
		F1*	F2**	F3 (>C ₁₆ - C ₃₄)	F4 (>C ₃₄ - C ₄₀)	Benzene	Toluene	Ethylbenzene	Xylene (total)	Arsenic	Cadmium	Chromium (Total)	Copper	Lead	Mercury	Nickel	Zinc
Intra-laboratory Duplicate - Groundwater Investigation																	
BH1M	Groundwater	<50	<60	670	<500	<0.5	<0.5	<0.5	<1.5	<1	<0.1	1	2	<1	<0.0001	11	47
GWQD1	BFD	<50	<60	<500	<500	<0.5	<0.5	<0.5	<1.5	<1	<0.1	1	2	<1	<0.0001	12	47
RPD		0.00	0.00	29.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	0.00
Inter-laboratory Duplicate - Groundwater Investigation																	
BH1M	Groundwater	<50	<60	670	<500	<0.5	<0.5	<0.5	<1.5	<1	<0.1	1	2	<1	<0.0001	11	47
GWQT1	ILD	<10	<50	<500	<500	<1	<1	<1	<2	<1	<0.1	<1	<1	<1	<0.0001	10	32
RPD		NA	NA	29.06	0.00	NA	NA	NA	NA	0.00	0.00	0.00	66.67	0.00	0.00	9.52	37.97
Trip Blank																	
TB	De-ionised water	-	-	-	-	<0.5	<0.5	<0.5	<1.5	-	-	-	-	-	-	-	-
Trip Spikes																	
TS	water	-	-	-	-	101%	97%	96%	96%	-	-	-	-	-	-	-	-
Rinsate Blanks																	
QR1	De-ionised water	<50	<60	<500	<500	<0.5	0.8	<0.5	<1.5	<1	<0.1	<1	<1	<1	<0.1	<1	<5

NOTE: All results are reported in mg/kg (soil) or µg/L (water)

66.67	RPD calculated by halving detection limit exceeds 30-50% range referenced from AS4482.1 (2005)
66.67	RPD exceeds 30-50% range referenced from AS4482.1 (2005)

B.1 Groundwater results

B.2 QA/QC results

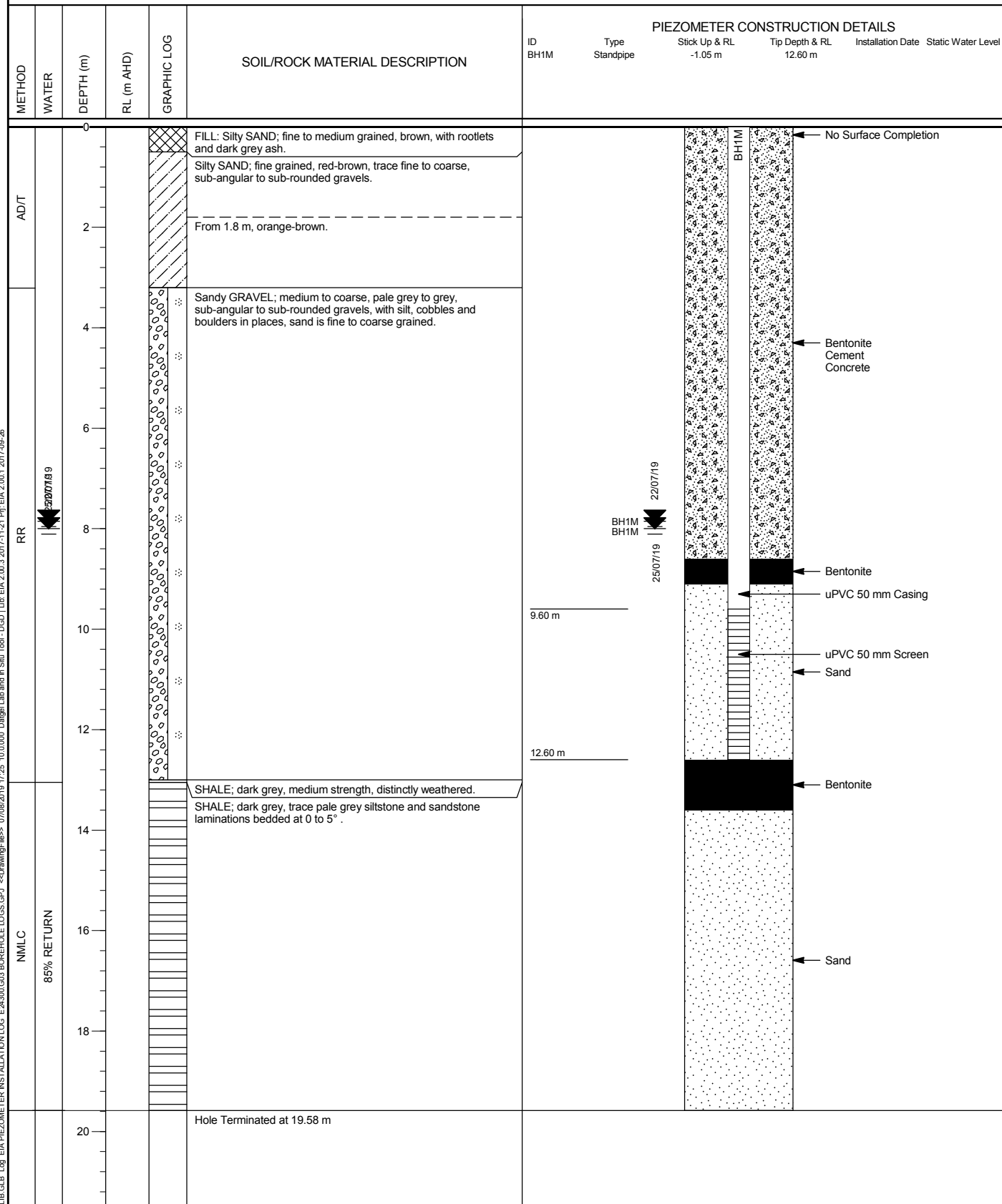
Appendix C – Borehole Logs

MONITORING WELL LOG

MW NO. BH1M

Project	Proposed Mixed Use Development	Sheet	1 of 2
Location	614-632 High Street, Penrith NSW	Date Started	22/07/2019
Position	Refer to Figure 2	Date Completed	22/07/2019
Job No.	E24300.G03	Logged By	DS
Client	High 618 Pty Ltd	Date	22/07/2019
		Reviewed By	NJ
		Date	07/08/2019

Drilling Contactor	Geosense Drilling
Drill Rig	Hanjin D&B 8D
Inclination	-90°



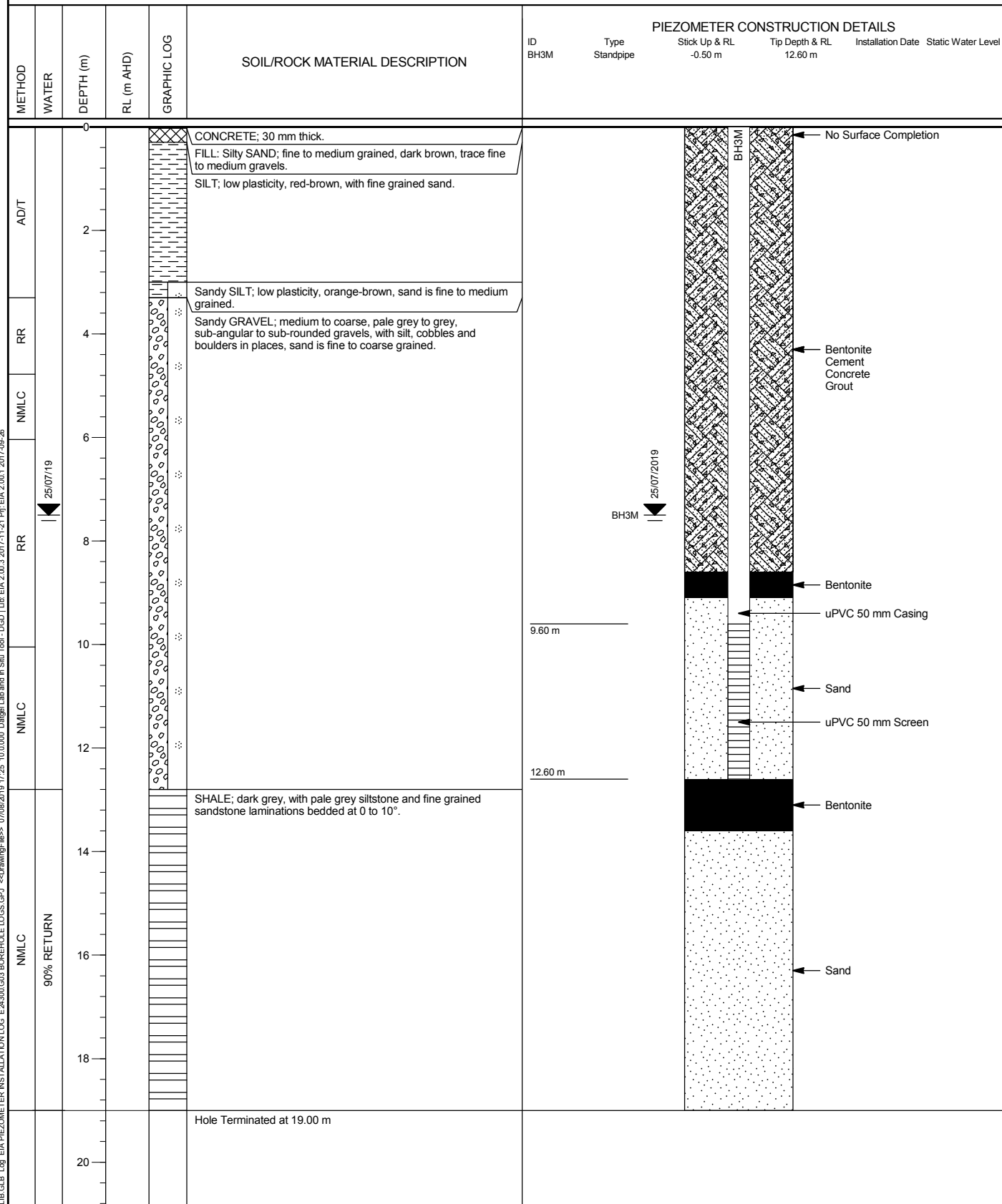
This well log should be read in conjunction with EI Australia's accompanying standard notes.

MONITORING WELL LOG

MW NO. BH3M

Project	Proposed Mixed Use Development	Sheet	1 of 2
Location	614-632 High Street, Penrith NSW	Date Started	24/07/2019
Position	Refer to Figure 2	Date Completed	24/07/2019
Job No.	E24300.G03	Logged By	DS
Client	High 618 Pty Ltd	Date	24/07/2019
		Reviewed By	NJ
		Date	07/08/2019

Drilling Contactor	Geosense Drilling
Drill Rig	Hanjin D&B 8D
Inclination	-90°



This well log should be read in conjunction with EI Australia's accompanying standard notes.

Appendix D– Field Data Sheets and Calibration Certificates



Map Source: DKO Architecture Pty Ltd, Project No: 00012012, DWG No: DA200, Rev P1, Dated on: 05/07/2019

LEGEND

- Approximate site boundary
- Approximate borehole location
- Approximate borehole/monitoring well location

eiaustralia
 Geotechnical Investigation
 Suite 6/01, 55 Miller Street, PYRMONT 2009
 Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	AM.H.
Approved:	N.J.
Date:	08-08-19

High 618 Pty Ltd
 Geotechnical Investigation
 614-632 High Street, Penrith NSW
 Sampling Location Plan

Figure:
2
 Project: E24300.G03

WATER SAMPLING FIELD SHEET



Site Address: 614-632 High St, Penrith
 Client: High 618 Pty Ltd
 Field Staff: GJ
 Well Location:
 Job Number: E24300
 Date: 17/01/20
 Sampling Location ID: BH3M1
 Round No: 1

MEDIUM ☒ Groundwater ☐ Surface Water ☐ Stormwater ☐ Other:

SAMPLING POINT INFO

Well Installation Date: 24/7/19
 Initial Well Depth (mBTC): 13.8
 Previous Sampling Date:
 Stick up / down (m): +1.2 (+ above ground - below ground)
 Screen Interval (mBTC): 10.8-13.8
 Previous SWL (mBTC):

PID READINGS

PID Headspace (ppm):
 PID Breathing Space (ppm):
 PID Background (ppm):

PRE PURGE

Total Well Depth (mBTC): 13.8
 SWL (mBTC): 5.5
 Well Head Condition: Good
 Water Column (m): 8.3

PHASE SEPARATED HYDROCARBONS (PSH)

Depth to PSH (mBTC):
 PSH Thickness (mm):
 PSH Visually Confirmed (Bailer):

PURGE AND SAMPLE

Sampling Method ☒ Bladder ☐ Peristaltic ☐ Submersible ☐ Other:
 Depth of Pump Inlet (mBTC): 11
 Pump Pressure Regulator (psi): 120
 Weather Conditions: Rain
 Pump on time: 12:40
 Fill Timer: 5
 Discharge Timer: 10
 Cycle: CPN 4
 Pump off time: 13:00

WATER QUALITY PARAMETERS

Probe Make and Model:
 Bump Test Date and Time:

Time	Volume (L)	SWL (mbtoc)	Temp (°C)	EC (µS/cm)	Redox (mV)	DO (mg/L)	pH (units)	Comments (colour, turbidity, odour, sheen etc.)
12:45	1.0	5.65	19.5	2150	101.5	11.5	5.47	clear, low, no, no.
12:46			19.3	2160	101.6	11.8	5.47	
12:47	1.5	5.95	19.3	2175	102.4	12.1	5.48	
12:48			19.4	2178	102.9	12.5	5.48	
12:49	2.0	6.01	19.4	2200	102.9	13.1	5.47	

Stabilisation range:

3 consecutive readings

±0.2°C

±3%

±20mV

±10%

±0.2

OTHER COMMENTS/OBSERVATIONS:

SIGNATURE:

Daily Inspection / Work Summary Card -

Remediation & Validation Form

OP 005a (Rev 2)



EI Australia
Suite 6.01, 55 Miller Street
PYRMONT, NSW, 2009

ABN 42 909 129 957
E service@eiaustralia.com.au
W www.eiaustralia.com.au
T 02 9516 0722

Project Number:	E243010	Engineer Name:	VJ	Page:	1 of 1
Date:	17/1/20	Time ON Site:			
Travel Time:		Time OFF Site:			

Site Address/Location: 614-632 High St, Penrith.

Climatic Conditions:

Completed Works:

GW Sampling for BH1M and DH3M.

QA/QC: GWQD1, GWQT1 = BH1M

GWQTB1, GWQTS1, GWQR1

Comments / Issues / Conclusions / Further Testing Required / Actions to be Undertaken / Timing of Actions:

Signed by:

Mr.

Appendix E – Chain of Custody and Sample Receipt Forms

Sheet _____ of _____

Site: **614-632 High St, Penrith**

Project No: **E20300**

Laboratory: **SGS Australia**

**Unit 16, 33 Maddox Street,
ALEXANDRIA NSW 2015
P: 02 8594 0400 F: 02 8594 0499**

Sample Matrix

Analysis

Comments

Sample ID	Laboratory ID	Container Type	Sampling		WATER	SOIL	OTHERS (i.e. Fibro, Paint, etc.)	HM ^A /TRH/BTEX/PAHs OCP/OP/PCB/Asbestos	HM ^A /TRH/BTEX/PAHs	HM ^A /TRH/BTEX	BTEX	VOCs	Asbestos	Asbestos Quantification	pH / CEC (cation exchange)	pH / EC (electrical conductivity)	Dewatering Suite	sPOCAS	PFAS	Phenols	TCLP HM ^B / PAH
			Date	Time																	
BH1M	1	S.Rx2, Vx2	17/1/20		X			X	X			X									
BH3M	2	↓						X				X									
BW6D1	3	↓							X												
BW6T51	4	VC									X										
BW6T31	5	VC									X										
BW6K1	6	P.Vx2	17/1/20						X												

SC 201938

- HM^A**
Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Zinc
- HM^B**
Arsenic
Cadmium
Chromium
Lead
Mercury
Nickel
- Dewatering Suite**
pH & EC
TDS / Turbidity NTU
Hardness
Total Cyanide
Metals (Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)
TRH (F1, F2, F3, F4)
BTEX
PAH
Total Phenol
- LABORATORY TURNAROUND**
- ☐ Standard
☐ 24 Hours
☐ 48 Hours
☒ 72 Hours
☐ Other _____

Container Type:

J= solvent washed, acid rinsed, Teflon sealed, glass jar
S= solvent washed, acid rinsed glass bottle
P= natural HDPE plastic bottle
VC= glass vial, Teflon Septum
ZLB = Zip-Lock Bag

Investigator: I attest that these samples were collected in accordance with standard EI field sampling procedures.

Report with EI Waste Classification Table ☐

Sampler's Name (EI):

Print

Car Ye

Signature

Date

17/1/20

Received by (SGS):

Print

Hee J

Signature

Date

17/01 15:10

Sampler's Comments:

Please filter plastic bottle for Hms



eiaustralia

Suite 6.01, 55 Miller Street,
PYRMONT NSW 2009
Ph: 9516 0722

lab@eiaustralia.com.au

CCC March 2018 FORM 1.1 - SGS

IMPORTANT:

Please e-mail laboratory results to: lab@eiaustralia.com.au



SAMPLE RECEIPT ADVICE

SE201938

CLIENT DETAILS

Contact Lan Ye
Client EIAUSTRALIA
Address SUITE 6.01
55 MILLER STREET
PYRMONT NSW 2009

Telephone 61 2 95160722
Facsimile (Not specified)
Email Lan.ye@eiaustralia.com.au

Project **E24300 614-632 High St, Penrith**
Order Number **E24300**
Samples 6

LABORATORY DETAILS

Manager Huong Crawford
Laboratory SGS Alexandria Environmental
Address Unit 16, 33 Maddox St
Alexandria NSW 2015

Telephone +61 2 8594 0400
Facsimile +61 2 8594 0499
Email au.environmental.sydney@sgs.com

Samples Received Fri 17/1/2020
Report Due Wed 22/1/2020
SGS Reference **SE201938**

SUBMISSION DETAILS

This is to confirm that 6 samples were received on Friday 17/1/2020. Results are expected to be ready by COB Wednesday 22/1/2020. Please quote SGS reference SE201938 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	6 Water
Date documentation received	17/1/2020	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	Yes
Sample temperature upon receipt	16°C	Sufficient sample for analysis	Yes
Turnaround time requested	Three Days		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

This document is issued by the Company under its General Conditions of Service accessible at www.sgs.com/en/Terms-and-Conditions.aspx. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.



SAMPLE RECEIPT ADVICE

SE201938

CLIENT DETAILS

Client **EI AUSTRALIA**

Project **E24300 614-632 High St, Penrith**

SUMMARY OF ANALYSIS

No.	Sample ID	Mercury (dissolved) in Water	PAH (Polynuclear Aromatic Hydrocarbons) in Water	Total Phenolics in Water	Trace Metals (Dissolved) in Water by ICPMS	TRH (Total Recoverable Hydrocarbons) in Water	VOCs in Water	Volatile Petroleum Hydrocarbons in Water
001	BH1M	1	22	1	7	9	78	7
002	BH3M	1	22	1	7	9	78	7
003	GWQD1	1	-	-	7	9	11	7
004	GWQTS1	-	-	-	-	-	11	-
005	GWQTB1	-	-	-	-	-	11	-
006	GWQR1	1	-	-	7	9	11	7

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

Client Details

Client	EI Australia
Attention	Lan Ye

Sample Login Details

Your reference	E24300, Penrith
Envirolab Reference	234876
Date Sample Received	20/01/2020
Date Instructions Received	20/01/2020
Date Results Expected to be Reported	23/01/2020

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	1 Water
Turnaround Time Requested	3 days
Temperature on Receipt (°C)	11.8
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie

Phone: 02 9910 6200
Fax: 02 9910 6201
Email: ahie@envirolab.com.au

Jacinta Hurst

Phone: 02 9910 6200
Fax: 02 9910 6201
Email: jhurst@envirolab.com.au

Analysis Underway, details on the following page:

**Envirolab Services Pty Ltd**

ABN 37 112 535 645

12 Ashley St Chatswood NSW 2067

ph 02 9910 6200 fax 02 9910 6201

customerservice@envirolab.com.au

www.envirolab.com.au

Sample ID	vTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	HM in water - dissolved
GWQT1	✓	✓	✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.

Requests for longer term sample storage must be received in writing.

Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.

TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

Appendix F – Laboratory Analytical Reports

CLIENT DETAILS

Contact Lan Ye
Client EI AUSTRALIA
Address SUITE 6.01
 55 MILLER STREET
 PYRMONT NSW 2009

Telephone 61 2 95160722
Facsimile (Not specified)
Email Lan.ye@eiaustralia.com.au

Project **E24300 614-632 High St, Penrith**
Order Number **E24300**
Samples 6

LABORATORY DETAILS

Manager Huong Crawford
Laboratory SGS Alexandria Environmental
Address Unit 16, 33 Maddox St
 Alexandria NSW 2015

Telephone +61 2 8594 0400
Facsimile +61 2 8594 0499
Email au.environmental.sydney@sgs.com

SGS Reference **SE201938 R0**
Date Received 17/1/2020
Date Reported 22/1/2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES



Dong LIANG
 Metals/Inorganics Team Leader



Ly Kim HA
 Organic Section Head

VOCs in Water [AN433] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQTS1	GWQTB1
			WATER - 17/1/2020 SE201938.001	WATER - 17/1/2020 SE201938.002	WATER - 17/1/2020 SE201938.003	WATER - 17/1/2020 SE201938.004	WATER - 17/1/2020 SE201938.005
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	[101%]	<0.5
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	[97%]	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	[96%]	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	[97%]	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	[96%]	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	-	<1.5
Total BTEX	µg/L	3	<3	<3	<3	-	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5
Dichlorodifluoromethane (CFC-12)	µg/L	5	<5	<5	-	-	-
Chloromethane	µg/L	5	<5	<5	-	-	-
Vinyl chloride (Chloroethene)	µg/L	0.3	<0.3	<0.3	-	-	-
Bromomethane	µg/L	10	<10	<10	-	-	-
Chloroethane	µg/L	5	<5	<5	-	-	-
Trichlorofluoromethane	µg/L	1	<1	<1	-	-	-
Acetone (2-propanone)	µg/L	10	<10	<10	-	-	-
Iodomethane	µg/L	5	<5	<5	-	-	-
1,1-dichloroethene	µg/L	0.5	<0.5	<0.5	-	-	-
Acrylonitrile	µg/L	0.5	<0.5	<0.5	-	-	-
Dichloromethane (Methylene chloride)	µg/L	5	<5	<5	-	-	-
Allyl chloride	µg/L	2	<2	<2	-	-	-
Carbon disulfide	µg/L	2	<2	<2	-	-	-
trans-1,2-dichloroethene	µg/L	0.5	<0.5	<0.5	-	-	-
MtBE (Methyl-tert-butyl ether)	µg/L	2	14	14	-	-	-
1,1-dichloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
Vinyl acetate	µg/L	10	<10	<10	-	-	-
MEK (2-butanone)	µg/L	10	<10	<10	-	-	-
cis-1,2-dichloroethene	µg/L	0.5	<0.5	<0.5	-	-	-
Bromochloromethane	µg/L	0.5	<0.5	<0.5	-	-	-
Chloroform (THM)	µg/L	0.5	<0.5	<0.5	-	-	-
2,2-dichloropropane	µg/L	0.5	<0.5	<0.5	-	-	-
1,2-dichloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
1,1,1-trichloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
1,1-dichloropropene	µg/L	0.5	<0.5	<0.5	-	-	-
Carbon tetrachloride	µg/L	0.5	<0.5	<0.5	-	-	-
Dibromomethane	µg/L	0.5	<0.5	<0.5	-	-	-
1,2-dichloropropane	µg/L	0.5	<0.5	<0.5	-	-	-
Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5	<0.5	<0.5	-	-	-
2-nitropropane	µg/L	100	<100	<100	-	-	-
Bromodichloromethane (THM)	µg/L	0.5	<0.5	<0.5	-	-	-
MIBK (4-methyl-2-pentanone)	µg/L	5	<5	<5	-	-	-
cis-1,3-dichloropropene	µg/L	0.5	<0.5	<0.5	-	-	-
trans-1,3-dichloropropene	µg/L	0.5	<0.5	<0.5	-	-	-
1,1,2-trichloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
1,3-dichloropropane	µg/L	0.5	<0.5	<0.5	-	-	-
Dibromochloromethane (THM)	µg/L	0.5	<0.5	<0.5	-	-	-
2-hexanone (MBK)	µg/L	5	<5	<5	-	-	-
1,2-dibromoethane (EDB)	µg/L	0.5	<0.5	<0.5	-	-	-
Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	<0.5	<0.5	-	-	-
1,1,1,2-tetrachloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
Chlorobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
Bromoform (THM)	µg/L	0.5	<0.5	<0.5	-	-	-
cis-1,4-dichloro-2-butene	µg/L	1	<1	<1	-	-	-
Styrene (Vinyl benzene)	µg/L	0.5	<0.5	<0.5	-	-	-
1,1,2,2-tetrachloroethane	µg/L	0.5	<0.5	<0.5	-	-	-
1,2,3-trichloropropane	µg/L	0.5	<0.5	<0.5	-	-	-
trans-1,4-dichloro-2-butene	µg/L	1	<1	<1	-	-	-

VOCs in Water [AN433] Tested: 20/1/2020 (continued)

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQTS1	GWQTB1
			WATER - 17/1/2020 SE201938.001	WATER - 17/1/2020 SE201938.002	WATER - 17/1/2020 SE201938.003	WATER - 17/1/2020 SE201938.004	WATER - 17/1/2020 SE201938.005
Isopropylbenzene (Cumene)	µg/L	0.5	<0.5	<0.5	-	-	-
Bromobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
n-propylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
2-chlorotoluene	µg/L	0.5	<0.5	<0.5	-	-	-
4-chlorotoluene	µg/L	0.5	<0.5	<0.5	-	-	-
1,3,5-trimethylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
tert-butylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
1,2,4-trimethylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
sec-butylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
1,3-dichlorobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
1,4-dichlorobenzene	µg/L	0.3	<0.3	<0.3	-	-	-
p-isopropyltoluene	µg/L	0.5	<0.5	<0.5	-	-	-
1,2-dichlorobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
n-butylbenzene	µg/L	0.5	<0.5	<0.5	-	-	-
1,2-dibromo-3-chloropropane	µg/L	0.5	<0.5	<0.5	-	-	-
1,2,4-trichlorobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
Hexachlorobutadiene	µg/L	0.5	<0.5	<0.5	-	-	-
1,2,3-trichlorobenzene	µg/L	0.5	<0.5	<0.5	-	-	-
Total VOC	µg/L	10	14	14	-	-	-

VOCs in Water [AN433] Tested: 20/1/2020 (continued)

			GWQR1
			WATER
			-
			17/1/2020
PARAMETER	UOM	LOR	SE201938.006
Benzene	µg/L	0.5	<0.5
Toluene	µg/L	0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5
m/p-xylene	µg/L	1	<1
o-xylene	µg/L	0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5
Total BTEX	µg/L	3	<3
Naphthalene	µg/L	0.5	<0.5
Dichlorodifluoromethane (CFC-12)	µg/L	5	-
Chloromethane	µg/L	5	-
Vinyl chloride (Chloroethene)	µg/L	0.3	-
Bromomethane	µg/L	10	-
Chloroethane	µg/L	5	-
Trichlorofluoromethane	µg/L	1	-
Acetone (2-propanone)	µg/L	10	-
Iodomethane	µg/L	5	-
1,1-dichloroethene	µg/L	0.5	-
Acrylonitrile	µg/L	0.5	-
Dichloromethane (Methylene chloride)	µg/L	5	-
Allyl chloride	µg/L	2	-
Carbon disulfide	µg/L	2	-
trans-1,2-dichloroethene	µg/L	0.5	-
MtBE (Methyl-tert-butyl ether)	µg/L	2	-
1,1-dichloroethane	µg/L	0.5	-
Vinyl acetate	µg/L	10	-
MEK (2-butanone)	µg/L	10	-
cis-1,2-dichloroethene	µg/L	0.5	-
Bromochloromethane	µg/L	0.5	-
Chloroform (THM)	µg/L	0.5	-
2,2-dichloropropane	µg/L	0.5	-
1,2-dichloroethane	µg/L	0.5	-
1,1,1-trichloroethane	µg/L	0.5	-
1,1-dichloropropene	µg/L	0.5	-
Carbon tetrachloride	µg/L	0.5	-
Dibromomethane	µg/L	0.5	-
1,2-dichloropropane	µg/L	0.5	-
Trichloroethene (Trichloroethylene,TCE)	µg/L	0.5	-
2-nitropropane	µg/L	100	-
Bromodichloromethane (THM)	µg/L	0.5	-
MIBK (4-methyl-2-pentanone)	µg/L	5	-
cis-1,3-dichloropropene	µg/L	0.5	-
trans-1,3-dichloropropene	µg/L	0.5	-
1,1,2-trichloroethane	µg/L	0.5	-
1,3-dichloropropane	µg/L	0.5	-
Dibromochloromethane (THM)	µg/L	0.5	-
2-hexanone (MBK)	µg/L	5	-
1,2-dibromoethane (EDB)	µg/L	0.5	-
Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	-
1,1,1,2-tetrachloroethane	µg/L	0.5	-
Chlorobenzene	µg/L	0.5	-
Bromoform (THM)	µg/L	0.5	-
cis-1,4-dichloro-2-butene	µg/L	1	-
Styrene (Vinyl benzene)	µg/L	0.5	-
1,1,2,2-tetrachloroethane	µg/L	0.5	-
1,2,3-trichloropropane	µg/L	0.5	-
trans-1,4-dichloro-2-butene	µg/L	1	-

VOCs in Water [AN433] Tested: 20/1/2020 (continued)

			GWQR1
			WATER
			-
			17/1/2020
			SE201938.006
PARAMETER	UOM	LOR	
Isopropylbenzene (Cumene)	µg/L	0.5	-
Bromobenzene	µg/L	0.5	-
n-propylbenzene	µg/L	0.5	-
2-chlorotoluene	µg/L	0.5	-
4-chlorotoluene	µg/L	0.5	-
1,3,5-trimethylbenzene	µg/L	0.5	-
tert-butylbenzene	µg/L	0.5	-
1,2,4-trimethylbenzene	µg/L	0.5	-
sec-butylbenzene	µg/L	0.5	-
1,3-dichlorobenzene	µg/L	0.5	-
1,4-dichlorobenzene	µg/L	0.3	-
p-isopropyltoluene	µg/L	0.5	-
1,2-dichlorobenzene	µg/L	0.5	-
n-butylbenzene	µg/L	0.5	-
1,2-dibromo-3-chloropropane	µg/L	0.5	-
1,2,4-trichlorobenzene	µg/L	0.5	-
Hexachlorobutadiene	µg/L	0.5	-
1,2,3-trichlorobenzene	µg/L	0.5	-
Total VOC	µg/L	10	-

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQTS1	GWQTB1
			WATER	WATER	WATER	WATER	WATER
			-	-	-	-	-
			17/1/2020	17/1/2020	17/1/2020	17/1/2020	17/1/2020
			SE201938.001	SE201938.002	SE201938.003	SE201938.004	SE201938.005
TRH C6-C9	µg/L	40	<40	<40	<40	-	-
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	-	-
TRH C6-C10	µg/L	50	<50	<50	<50	-	-
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	-	-

PARAMETER	UOM	LOR	GWQR1
			WATER
			-
			17/1/2020
			SE201938.006
TRH C6-C9	µg/L	40	<40
Benzene (F0)	µg/L	0.5	<0.5
TRH C6-C10	µg/L	50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQR1
			WATER	WATER	WATER	WATER
			17/1/2020 SE201938.001	17/1/2020 SE201938.002	17/1/2020 SE201938.003	17/1/2020 SE201938.006
TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	390	<200	<200	<200
TRH C29-C36	µg/L	200	400	<200	200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	670	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	790	<320	<320	<320

PAH (Polynuclear Aromatic Hydrocarbons) in Water [AN420] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M
			WATER - 17/1/2020 SE201938.001	WATER - 17/1/2020 SE201938.002
Naphthalene	µg/L	0.1	<0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1	<0.1
Fluorene	µg/L	0.1	<0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1	<0.1
Anthracene	µg/L	0.1	<0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1	<0.1
Pyrene	µg/L	0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1	<0.1
Chrysene	µg/L	0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1	<0.1
Total PAH (18)	µg/L	1	<1	<1

Total Phenolics in Water [AN289] Tested: 21/1/2020

			BH1M	BH3M
			WATER	WATER
			-	-
			17/1/2020	17/1/2020
			SE201938.001	SE201938.002
PARAMETER	UOM	LOR		
Total Phenols	mg/L	0.01	<0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQR1
			WATER	WATER	WATER	WATER
			- 17/1/2020 SE201938.001	- 17/1/2020 SE201938.002	- 17/1/2020 SE201938.003	- 17/1/2020 SE201938.006
Arsenic, As	µg/L	1	<1	<1	<1	<1
Cadmium, Cd	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	1	<1	1	<1
Copper, Cu	µg/L	1	2	<1	2	<1
Lead, Pb	µg/L	1	<1	<1	<1	<1
Nickel, Ni	µg/L	1	11	2	12	<1
Zinc, Zn	µg/L	5	47	8	47	<5

Mercury (dissolved) in Water [AN311(Perth)/AN312] Tested: 20/1/2020

PARAMETER	UOM	LOR	BH1M	BH3M	GWQD1	GWQR1
			WATER	WATER	WATER	WATER
			-	-	-	-
			17/1/2020	17/1/2020	17/1/2020	17/1/2020
			SE201938.001	SE201938.002	SE201938.003	SE201938.006
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC's are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
		IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- 1 Bq is equivalent to 27 pCi
- 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/pv.sgsvr/en-gb/environment.

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STATEMENT OF QA/QC PERFORMANCE

SE201938 R0

CLIENT DETAILS

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Order Number **E24300**
Samples 6

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SGS Reference **SE201938 R0**
Date Received 17 Jan 2020
Date Reported 22 Jan 2020

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	6 Water
Date documentation received	17/1/2020	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	Yes
Sample temperature upon receipt	16°C	Sufficient sample for analysis	Yes
Turnaround time requested	Three Days		

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Parth)/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191418	17 Jan 2020	17 Jan 2020	14 Feb 2020	20 Jan 2020	14 Feb 2020	22 Jan 2020
BH3M	SE201938.002	LB191418	17 Jan 2020	17 Jan 2020	14 Feb 2020	20 Jan 2020	14 Feb 2020	22 Jan 2020
GWQD1	SE201938.003	LB191418	17 Jan 2020	17 Jan 2020	14 Feb 2020	20 Jan 2020	14 Feb 2020	22 Jan 2020
GWQR1	SE201938.006	LB191418	17 Jan 2020	17 Jan 2020	14 Feb 2020	20 Jan 2020	14 Feb 2020	22 Jan 2020

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
BH3M	SE201938.002	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQD1	SE201938.003	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQR1	SE201938.006	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191517	17 Jan 2020	17 Jan 2020	14 Feb 2020	21 Jan 2020	14 Feb 2020	22 Jan 2020
BH3M	SE201938.002	LB191517	17 Jan 2020	17 Jan 2020	14 Feb 2020	21 Jan 2020	14 Feb 2020	22 Jan 2020

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191408	17 Jan 2020	17 Jan 2020	15 Jul 2020	20 Jan 2020	15 Jul 2020	20 Jan 2020
BH3M	SE201938.002	LB191408	17 Jan 2020	17 Jan 2020	15 Jul 2020	20 Jan 2020	15 Jul 2020	20 Jan 2020
GWQD1	SE201938.003	LB191408	17 Jan 2020	17 Jan 2020	15 Jul 2020	20 Jan 2020	15 Jul 2020	20 Jan 2020
GWQR1	SE201938.006	LB191408	17 Jan 2020	17 Jan 2020	15 Jul 2020	20 Jan 2020	15 Jul 2020	20 Jan 2020

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
BH3M	SE201938.002	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQD1	SE201938.003	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQR1	SE201938.006	LB191437	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	22 Jan 2020
BH3M	SE201938.002	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	22 Jan 2020
GWQD1	SE201938.003	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQTS1	SE201938.004	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQTB1	SE201938.005	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQR1	SE201938.006	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1M	SE201938.001	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
BH3M	SE201938.002	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQD1	SE201938.003	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020
GWQTS1	SE201938.004	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	22 Jan 2020
GWQTB1	SE201938.005	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	22 Jan 2020
GWQR1	SE201938.006	LB191432	17 Jan 2020	17 Jan 2020	24 Jan 2020	20 Jan 2020	29 Feb 2020	21 Jan 2020

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	BH1M	SE201938.001	%	40 - 130%	58
	BH3M	SE201938.002	%	40 - 130%	54
d14-p-terphenyl (Surrogate)	BH1M	SE201938.001	%	40 - 130%	86
	BH3M	SE201938.002	%	40 - 130%	72
d5-nitrobenzene (Surrogate)	BH1M	SE201938.001	%	40 - 130%	50
	BH3M	SE201938.002	%	40 - 130%	46

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	BH1M	SE201938.001	%	40 - 130%	96
	BH3M	SE201938.002	%	40 - 130%	98
	GWQD1	SE201938.003	%	40 - 130%	97
	GWQTS1	SE201938.004	%	40 - 130%	100
	GWQTB1	SE201938.005	%	40 - 130%	98
	GWQR1	SE201938.006	%	40 - 130%	98
d4-1,2-dichloroethane (Surrogate)	BH1M	SE201938.001	%	40 - 130%	99
	BH3M	SE201938.002	%	40 - 130%	99
	GWQD1	SE201938.003	%	40 - 130%	100
	GWQTS1	SE201938.004	%	40 - 130%	101
	GWQTB1	SE201938.005	%	40 - 130%	101
	GWQR1	SE201938.006	%	40 - 130%	101
d8-toluene (Surrogate)	BH1M	SE201938.001	%	40 - 130%	97
	BH3M	SE201938.002	%	40 - 130%	97
	GWQD1	SE201938.003	%	40 - 130%	98
	GWQTS1	SE201938.004	%	40 - 130%	98
	GWQTB1	SE201938.005	%	40 - 130%	97
	GWQR1	SE201938.006	%	40 - 130%	97

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	BH1M	SE201938.001	%	40 - 130%	96
	BH3M	SE201938.002	%	40 - 130%	98
	GWQD1	SE201938.003	%	40 - 130%	97
	GWQR1	SE201938.006	%	40 - 130%	98
d4-1,2-dichloroethane (Surrogate)	BH1M	SE201938.001	%	60 - 130%	99
	BH3M	SE201938.002	%	60 - 130%	99
	GWQD1	SE201938.003	%	60 - 130%	100
	GWQR1	SE201938.006	%	60 - 130%	101
d8-toluene (Surrogate)	BH1M	SE201938.001	%	40 - 130%	97
	BH3M	SE201938.002	%	40 - 130%	97
	GWQD1	SE201938.003	%	40 - 130%	98
	GWQR1	SE201938.006	%	40 - 130%	97

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Porth)/AN312

Sample Number	Parameter	Units	LOR	Result
LB191418.001	Mercury	mg/L	0.0001	<0.0001

PAH (Polynuclear Aromatic Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN420

Sample Number	Parameter	Units	LOR	Result
LB191437.001	Naphthalene	µg/L	0.1	<0.1
	2-methylnaphthalene	µg/L	0.1	<0.1
	1-methylnaphthalene	µg/L	0.1	<0.1
	Acenaphthylene	µg/L	0.1	<0.1
	Acenaphthene	µg/L	0.1	<0.1
	Fluorene	µg/L	0.1	<0.1
	Phenanthrene	µg/L	0.1	<0.1
	Anthracene	µg/L	0.1	<0.1
	Fluoranthene	µg/L	0.1	<0.1
	Pyrene	µg/L	0.1	<0.1
	Benzo(a)anthracene	µg/L	0.1	<0.1
	Chrysene	µg/L	0.1	<0.1
	Benzo(a)pyrene	µg/L	0.1	<0.1
	Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1
	Dibenzo(ah)anthracene	µg/L	0.1	<0.1
	Benzo(ghi)perylene	µg/L	0.1	<0.1
Surrogates	d5-nitrobenzene (Surrogate)	%	-	60
	2-fluorobiphenyl (Surrogate)	%	-	68
	d14-p-terphenyl (Surrogate)	%	-	86

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result
LB191517.001	Total Phenols	mg/L	0.01	<0.01

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB191408.001	Arsenic, As	µg/L	1	<1
	Cadmium, Cd	µg/L	0.1	<0.1
	Chromium, Cr	µg/L	1	<1
	Copper, Cu	µg/L	1	<1
	Lead, Pb	µg/L	1	<1
	Nickel, Ni	µg/L	1	<1
	Zinc, Zn	µg/L	5	<5

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result
LB191437.001	TRH C10-C14	µg/L	50	<50
	TRH C15-C28	µg/L	200	<200
	TRH C29-C36	µg/L	200	<200
	TRH C37-C40	µg/L	200	<200

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB191432.001	Fumigants	2,2-dichloropropane	µg/L	0.5	<0.5
		1,2-dichloropropane	µg/L	0.5	<0.5
		cis-1,3-dichloropropene	µg/L	0.5	<0.5
		trans-1,3-dichloropropene	µg/L	0.5	<0.5
		1,2-dibromoethane (EDB)	µg/L	0.5	<0.5
	Halogenated Aliphatics	Dichlorodifluoromethane (CFC-12)	µg/L	5	<5
		Chloromethane	µg/L	5	<5
		Vinyl chloride (Chloroethene)	µg/L	0.3	<0.3
		Bromomethane	µg/L	10	<10
		Chloroethane	µg/L	5	<5
		Trichlorofluoromethane	µg/L	1	<1
		Iodomethane	µg/L	5	<5

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number	Parameter	Units	LOR	Result
LB191432.001	Halogenated Aliphatics	1,1-dichloroethene	µg/L	<0.5
		Dichloromethane (Methylene chloride)	µg/L	<5
		Allyl chloride	µg/L	<2
		trans-1,2-dichloroethene	µg/L	<0.5
		1,1-dichloroethane	µg/L	<0.5
		cis-1,2-dichloroethene	µg/L	<0.5
		Bromochloromethane	µg/L	<0.5
		1,2-dichloroethane	µg/L	<0.5
		1,1,1-trichloroethane	µg/L	<0.5
		1,1-dichloropropene	µg/L	<0.5
		Carbon tetrachloride	µg/L	<0.5
		Dibromomethane	µg/L	<0.5
		Trichloroethene (Trichloroethylene,TCE)	µg/L	<0.5
		1,1,2-trichloroethane	µg/L	<0.5
		1,3-dichloropropane	µg/L	<0.5
		Tetrachloroethene (Perchloroethylene,PCE)	µg/L	<0.5
		1,1,1,2-tetrachloroethane	µg/L	<0.5
		cis-1,4-dichloro-2-butene	µg/L	<1
		1,1,2,2-tetrachloroethane	µg/L	<0.5
		1,2,3-trichloropropane	µg/L	<0.5
	Halogenated Aromatics	trans-1,4-dichloro-2-butene	µg/L	<1
		1,2-dibromo-3-chloropropane	µg/L	<0.5
		Hexachlorobutadiene	µg/L	<0.5
		Chlorobenzene	µg/L	<0.5
		Bromobenzene	µg/L	<0.5
		2-chlorotoluene	µg/L	<0.5
		4-chlorotoluene	µg/L	<0.5
		1,3-dichlorobenzene	µg/L	<0.5
	Monocyclic Aromatic Hydrocarbons	1,4-dichlorobenzene	µg/L	<0.3
		1,2-dichlorobenzene	µg/L	<0.5
		1,2,4-trichlorobenzene	µg/L	<0.5
		1,2,3-trichlorobenzene	µg/L	<0.5
		Benzene	µg/L	<0.5
		Toluene	µg/L	<0.5
		Ethylbenzene	µg/L	<0.5
		m/p-xylene	µg/L	<1
		o-xylene	µg/L	<0.5
		Styrene (Vinyl benzene)	µg/L	<0.5
		Isopropylbenzene (Cumene)	µg/L	<0.5
		n-propylbenzene	µg/L	<0.5
		1,3,5-trimethylbenzene	µg/L	<0.5
		tert-butylbenzene	µg/L	<0.5
		1,2,4-trimethylbenzene	µg/L	<0.5
		sec-butylbenzene	µg/L	<0.5
	Nitrogenous Compounds	p-isopropyltoluene	µg/L	<0.5
		n-butylbenzene	µg/L	<0.5
	Oxygenated Compounds	Acrylonitrile	µg/L	<0.5
		Acetone (2-propanone)	µg/L	<10
		MtBE (Methyl-tert-butyl ether)	µg/L	<2
		Vinyl acetate	µg/L	<10
		MEK (2-butanone)	µg/L	<10
		MIBK (4-methyl-2-pentanone)	µg/L	<5
	Polycyclic VOCs	2-hexanone (MBK)	µg/L	<5
		Naphthalene	µg/L	<0.5
	Sulphonated	Carbon disulfide	µg/L	<2
	Surrogates	d4-1,2-dichloroethane (Surrogate)	%	98
		d8-toluene (Surrogate)	%	96
		Bromofluorobenzene (Surrogate)	%	98
	Trihalomethanes	Chloroform (THM)	µg/L	<0.5
		Bromodichloromethane (THM)	µg/L	<0.5
		Dibromochloromethane (THM)	µg/L	<0.5

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number	Parameter	Units	LOR	Result
LB191432.001	Trihalomethanes	Bromoform (THM)	µg/L	0.5
				<0.5

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Sample Number	Parameter	Units	LOR	Result
LB191432.001	TRH C6-C9	µg/L	40	<40
	d4-1,2-dichloroethane (Surrogate)	%	-	98
	d8-toluene (Surrogate)	%	-	96
	Bromofluorobenzene (Surrogate)	%	-	98

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Porth)/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE201918.006	LB191418.014	Mercury	µg/L	0.0001	-0.0334	-0.0272	180	0
SE201938.006	LB191418.024	Mercury	µg/L	0.0001	<0.0001	<0.0001	171	0

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE201938.001	LB191517.004	Total Phenols	mg/L	0.01	<0.01	<0.01	200	0

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE201938.006	LB191408.013	Arsenic, As	µg/L	1	<1	<1	200	0
		Cadmium, Cd	µg/L	0.1	<0.1	<0.1	200	0
		Chromium, Cr	µg/L	1	<1	<1	200	0
		Copper, Cu	µg/L	1	<1	<1	162	0
		Lead, Pb	µg/L	1	<1	<1	200	0
		Nickel, Ni	µg/L	1	<1	<1	200	0
		Zinc, Zn	µg/L	5	<5	<5	200	0

TRH (Total Recoverable Hydrocarbons) in Water

Method: ME-(AU)-[ENV]AN403

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE201897.002	LB191437.021	TRH C10-C14	µg/L	50	0	0	200	0
		TRH C15-C28	µg/L	200	0	0	200	0
		TRH C29-C36	µg/L	200	0	0	200	0
		TRH C37-C40	µg/L	200	0	0	200	0
		TRH C10-C40	µg/L	320	0	0	200	0
		TRH >C10-C16	µg/L	60	0	0	200	0
		TRH >C10-C16 - Naphthalene (F2)	µg/L	60	-0.0161235106	0	200	0
		TRH >C16-C34 (F3)	µg/L	500	0	0	200	0
		TRH >C34-C40 (F4)	µg/L	500	0	0	200	0
		TRH F Bands						

VOCs in Water

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE201825.005	LB191432.023	Fumigants	2,2-dichloropropane	µg/L	0.5	0	0	200	0
			1,2-dichloropropane	µg/L	0.5	0	0	200	0
			cis-1,3-dichloropropene	µg/L	0.5	0	0	200	0
			trans-1,3-dichloropropene	µg/L	0.5	0	0	200	0
			1,2-dibromoethane (EDB)	µg/L	0.5	0	0	200	0
		Halogenated	Dichlorodifluoromethane (CFC-12)	µg/L	5	0	0	200	0
			Aliphatics	Chloromethane	µg/L	5	0	0	200
		Vinyl chloride (Chloroethene)		µg/L	0.3	0	0	200	0
		Bromomethane		µg/L	10	0	0	200	0
		Chloroethane		µg/L	5	0	0	200	0
		Trichlorofluoromethane		µg/L	1	0	0	200	0
		Iodomethane		µg/L	5	0	0	200	0
		1,1-dichloroethene		µg/L	0.5	0	0	200	0
		Dichloromethane (Methylene chloride)		µg/L	5	0	0	200	0
		Allyl chloride		µg/L	2	0	0	200	0
		trans-1,2-dichloroethene		µg/L	0.5	0	0	200	0
		1,1-dichloroethane		µg/L	0.5	0	0	200	0
		cis-1,2-dichloroethene		µg/L	0.5	0	0	200	0
		Bromochloromethane		µg/L	0.5	0	0	200	0
		1,2-dichloroethane		µg/L	0.5	0	0	200	0
		1,1,1-trichloroethane		µg/L	0.5	0	0	200	0
		1,1-dichloropropene		µg/L	0.5	0	0	200	0
		Carbon tetrachloride		µg/L	0.5	0	0	200	0
		Dibromomethane		µg/L	0.5	0	0	200	0
		Trichloroethene (Trichloroethylene,TCE)		µg/L	0.5	0	0	200	0
		1,1,2-trichloroethane		µg/L	0.5	0	0	200	0
		1,3-dichloropropane		µg/L	0.5	0	0	200	0
		Tetrachloroethene (Perchloroethylene,PCE)		µg/L	0.5	0	0	200	0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %		
SE201825.005	LB191432.023	Halogenated	1,1,1,2-tetrachloroethane	µg/L	0.5	0	0	200	0		
			Aliphatics	cis-1,4-dichloro-2-butene	µg/L	1	0	0	200	0	
		1,1,2,2-tetrachloroethane		µg/L	0.5	0	0	200	0		
		1,2,3-trichloropropane	µg/L	0.5	0	0	200	0			
		trans-1,4-dichloro-2-butene	µg/L	1	0	0	200	0			
		1,2-dibromo-3-chloropropane	µg/L	0.5	0	0	200	0			
		Hexachlorobutadiene	µg/L	0.5	0	0	200	0			
		Halogenated	Chlorobenzene	µg/L	0.5	4.3354094548	5.02	41	15		
			Aromatics	Bromobenzene	µg/L	0.5	0	0	200	0	
		2-chlorotoluene		µg/L	0.5	0	0	200	0		
		4-chlorotoluene		µg/L	0.5	0	0	200	0		
		1,3-dichlorobenzene		µg/L	0.5	0	0	200	0		
		1,4-dichlorobenzene		µg/L	0.3	0	0	200	0		
		1,2-dichlorobenzene		µg/L	0.5	0	0	200	0		
		1,2,4-trichlorobenzene		µg/L	0.5	0	0	200	0		
		1,2,3-trichlorobenzene		µg/L	0.5	0	0	200	0		
		Monocyclic	Benzene	µg/L	0.5	0.3285687136	0	200	0		
			Aromatic	Toluene	µg/L	0.5	0.09411793770.1523000082	200	0		
		Ethylbenzene		µg/L	0.5	0.04752542800.1552724038	200	0			
		m/p-xylene		µg/L	1	0.14616421970.3978814403	200	0			
		o-xylene		µg/L	0.5	0.19191518440.3370508475	200	0			
		Polycyclic	Naphthalene	µg/L	0.5	0.2689629128	0	200	0		
		Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	10.04621151759.6651477206	30	4			
			d8-toluene (Surrogate)	µg/L	-	9.99495286639.9000766160	30	1			
			Bromofluorobenzene (Surrogate)	µg/L	-	10.39797191839.9393173508	30	5			
		Trihalomethanes	Chloroform (THM)	µg/L	0.5	0	0	200	0		
			Bromodichloromethane (THM)	µg/L	0.5	0	0	200	0		
			Dibromochloromethane (THM)	µg/L	0.5	0	0	200	0		
			Bromoform (THM)	µg/L	0.5	0	0	200	0		
		SE201938.001	LB191432.024	Fumigants	2,2-dichloropropane	µg/L	0.5	<0.5	0	200	0
					1,2-dichloropropane	µg/L	0.5	<0.5	0	200	0
cis-1,3-dichloropropene	µg/L				0.5	<0.5	0	200	0		
trans-1,3-dichloropropene	µg/L				0.5	<0.5	0	200	0		
1,2-dibromoethane (EDB)	µg/L				0.5	<0.5	0	200	0		
Halogenated Aliphatics	Dichlorodifluoromethane (CFC-12)			µg/L	5	<5	0	200	0		
	Chloromethane			µg/L	5	<5	0	200	0		
	Vinyl chloride (Chloroethene)			µg/L	0.3	<0.3	0	200	0		
	Bromomethane			µg/L	10	<10	0	200	0		
	Chloroethane			µg/L	5	<5	0	200	0		
	Trichlorofluoromethane			µg/L	1	<1	0	200	0		
	Iodomethane			µg/L	5	<5	0	200	0		
	1,1-dichloroethene			µg/L	0.5	<0.5	0	200	0		
	Dichloromethane (Methylene chloride)			µg/L	5	<5	0	200	0		
	Allyl chloride			µg/L	2	<2	0	200	0		
	trans-1,2-dichloroethene			µg/L	0.5	<0.5	0	200	0		
	1,1-dichloroethane			µg/L	0.5	<0.5	0	200	0		
	cis-1,2-dichloroethene			µg/L	0.5	<0.5	0	200	0		
	Bromochloromethane			µg/L	0.5	<0.5	0	200	0		
	1,2-dichloroethane			µg/L	0.5	<0.5	0	200	0		
	1,1,1-trichloroethane			µg/L	0.5	<0.5	0	200	0		
	1,1-dichloropropene			µg/L	0.5	<0.5	0	200	0		
	Carbon tetrachloride			µg/L	0.5	<0.5	0	200	0		
	Dibromomethane			µg/L	0.5	<0.5	0	200	0		
	Trichloroethene (Trichloroethylene,TCE)			µg/L	0.5	<0.5	0	200	0		
	1,1,2-trichloroethane			µg/L	0.5	<0.5	0	200	0		
	1,3-dichloropropane			µg/L	0.5	<0.5	0	200	0		
	Tetrachloroethene (Perchloroethylene,PCE)			µg/L	0.5	<0.5	0	200	0		
	1,1,1,2-tetrachloroethane			µg/L	0.5	<0.5	0	200	0		
	cis-1,4-dichloro-2-butene			µg/L	1	<1	0	200	0		
	1,1,2,2-tetrachloroethane			µg/L	0.5	<0.5	0	200	0		
	1,2,3-trichloropropane			µg/L	0.5	<0.5	0	200	0		

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = \frac{|OriginalResult - ReplicateResult|}{Mean} \times 100$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \frac{SDL}{Mean} + LR$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %	
SE201938.001	LB191432.024	Halogenated	trans-1,4-dichloro-2-butene	µg/L	1	<1	0	200	0	
		Aliphatics	1,2-dibromo-3-chloropropane	µg/L	0.5	<0.5	0	200	0	
			Hexachlorobutadiene	µg/L	0.5	<0.5	0	200	0	
		Halogenated	Chlorobenzene	µg/L	0.5	<0.5	0	200	0	
		Aromatics	Bromobenzene	µg/L	0.5	<0.5	0	200	0	
			2-chlorotoluene	µg/L	0.5	<0.5	0	200	0	
			4-chlorotoluene	µg/L	0.5	<0.5	0	200	0	
			1,3-dichlorobenzene	µg/L	0.5	<0.5	0	200	0	
			1,4-dichlorobenzene	µg/L	0.3	<0.3	0	200	0	
			1,2-dichlorobenzene	µg/L	0.5	<0.5	0	200	0	
			1,2,4-trichlorobenzene	µg/L	0.5	<0.5	0	200	0	
			1,2,3-trichlorobenzene	µg/L	0.5	<0.5	0	200	0	
			Monocyclic	Benzene	µg/L	0.5	<0.5	0.0560369820	200	0
			Aromatic	Toluene	µg/L	0.5	<0.5	0.0532397494	200	0
		Ethylbenzene		µg/L	0.5	<0.5	0.0373549739	200	0	
		m/p-xylene		µg/L	1	<1	0.1023393019	200	0	
		o-xylene		µg/L	0.5	<0.5	0.0464644590	200	0	
		Styrene (Vinyl benzene)		µg/L	0.5	<0.5	0	200	0	
		Isopropylbenzene (Cumene)		µg/L	0.5	<0.5	0	200	0	
		n-propylbenzene		µg/L	0.5	<0.5	0	200	0	
		1,3,5-trimethylbenzene		µg/L	0.5	<0.5	0	200	0	
		tert-butylbenzene		µg/L	0.5	<0.5	0	200	0	
		1,2,4-trimethylbenzene		µg/L	0.5	<0.5	0	200	0	
		sec-butylbenzene		µg/L	0.5	<0.5	0	200	0	
		p-isopropyltoluene		µg/L	0.5	<0.5	0	200	0	
		n-butylbenzene		µg/L	0.5	<0.5	0	200	0	
		Nitrogenous		Acrylonitrile	µg/L	0.5	<0.5	0	200	0
		Oxygenated		Acetone (2-propanone)	µg/L	10	<10	0	200	0
		Compounds		MtBE (Methyl-tert-butyl ether)	µg/L	2	14	14.03	34	2
				Vinyl acetate	µg/L	10	<10	0	200	0
				MEK (2-butanone)	µg/L	10	<10	0	200	0
			MIBK (4-methyl-2-pentanone)	µg/L	5	<5	0	200	0	
			2-hexanone (MBK)	µg/L	5	<5	0	200	0	
			Polycyclic	Naphthalene	µg/L	0.5	<0.5	0.1212460205	200	0
		Sulphonated	Carbon disulfide	µg/L	2	<2	0	200	0	
		Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	9.9	9.7723943929	30	1	
			d8-toluene (Surrogate)	µg/L	-	9.7	9.9763525253	30	3	
			Bromofluorobenzene (Surrogate)	µg/L	-	9.6	9.6167262392	30	0	
		Trihalomethanes	Chloroform (THM)	µg/L	0.5	<0.5	0	200	0	
			Bromodichloromethane (THM)	µg/L	0.5	<0.5	0	200	0	
			Dibromochloromethane (THM)	µg/L	0.5	<0.5	0	200	0	
			Bromoform (THM)	µg/L	0.5	<0.5	0	200	0	

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %	
SE201825.005	LB191432.023	TRH C6-C10	µg/L	50	19.063550712€	0	200	0	
		TRH C6-C9	µg/L	40	17.287755725€	0	200	0	
		Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	10.04621151759.6651477206	30	4	
			d8-toluene (Surrogate)	µg/L	-	9.99495286639.9000766160	30	1	
			Bromofluorobenzene (Surrogate)	µg/L	-	10.39797191839.9393173508	30	5	
		VPH F Bands	Benzene (F0)	µg/L	0.5	0.3285687136	0	200	0
			TRH C6-C10 minus BTEX (F1)	µg/L	50	19.063550712€	0	200	0
		SE201938.001	LB191432.024	TRH C6-C10	µg/L	50	<50	0	200
TRH C6-C9	µg/L			40	<40	0	200	0	
Surrogates	d4-1,2-dichloroethane (Surrogate)			µg/L	-	9.9	9.7723943929	30	1
	d8-toluene (Surrogate)			µg/L	-	9.7	9.9763525253	30	3
	Bromofluorobenzene (Surrogate)			µg/L	-	9.6	9.6167262392	30	0
VPH F Bands	Benzene (F0)			µg/L	0.5	<0.5	0.0560369820	200	0
	TRH C6-C10 minus BTEX (F1)			µg/L	50	<50	0	200	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Water
Method: ME-(AU)-[ENV]AN420

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191437.002	Naphthalene	µg/L	0.1	27	40	60 - 140	68
	Acenaphthylene	µg/L	0.1	37	40	60 - 140	92
	Acenaphthene	µg/L	0.1	32	40	60 - 140	81
	Phenanthrene	µg/L	0.1	34	40	60 - 140	84
	Anthracene	µg/L	0.1	32	40	60 - 140	81
	Fluoranthene	µg/L	0.1	32	40	60 - 140	81
	Pyrene	µg/L	0.1	35	40	60 - 140	87
	Benzo(a)pyrene	µg/L	0.1	33	40	60 - 140	81
	Surrogates						
	d5-nitrobenzene (Surrogate)	µg/L	-	0.3	0.5	40 - 130	54
	2-fluorobiphenyl (Surrogate)	µg/L	-	0.3	0.5	40 - 130	64
	d14-p-terphenyl (Surrogate)	µg/L	-	0.4	0.5	40 - 130	82

Total Phenolics in Water
Method: ME-(AU)-[ENV]AN289

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191517.002	Total Phenols	mg/L	0.01	0.23	0.25	80 - 120	92

Trace Metals (Dissolved) in Water by ICPMS
Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191408.002	Arsenic, As	µg/L	1	19	20	80 - 120	97
	Cadmium, Cd	µg/L	0.1	21	20	80 - 120	104
	Chromium, Cr	µg/L	1	22	20	80 - 120	109
	Copper, Cu	µg/L	1	22	20	80 - 120	110
	Lead, Pb	µg/L	1	22	20	80 - 120	109
	Nickel, Ni	µg/L	1	21	20	80 - 120	104
	Zinc, Zn	µg/L	5	22	20	80 - 120	109

TRH (Total Recoverable Hydrocarbons) in Water
Method: ME-(AU)-[ENV]AN403

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191437.002	TRH C10-C14	µg/L	50	1000	1200	60 - 140	86
	TRH C15-C28	µg/L	200	1200	1200	60 - 140	97
	TRH C29-C36	µg/L	200	1000	1200	60 - 140	86
	TRH F Bands						
	TRH >C10-C16	µg/L	60	1100	1200	60 - 140	91
	TRH >C16-C34 (F3)	µg/L	500	1200	1200	60 - 140	97
	TRH >C34-C40 (F4)	µg/L	500	510	600	60 - 140	85

VOCs in Water
Method: ME-(AU)-[ENV]AN433

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191432.002	Halogenated	1,1-dichloroethene	µg/L	54	45.45	60 - 140	120
		Aliphatics					
		1,2-dichloroethane	µg/L	52	45.45	60 - 140	114
	Aliphatics	Trichloroethene (Trichloroethylene,TCE)	µg/L	45	45.45	60 - 140	98
		Halogenated					
		Chlorobenzene	µg/L	51	45.45	60 - 140	111
	Monocyclic	Benzene	µg/L	49	45.45	60 - 140	107
		Aromatic					
		Toluene	µg/L	49	45.45	60 - 140	107
	Aromatic	Ethylbenzene	µg/L	49	45.45	60 - 140	107
		m/p-xylene	µg/L	97	90.9	60 - 140	107
		o-xylene	µg/L	48	45.45	60 - 140	106
	Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	9.9	60 - 140	99
		d8-toluene (Surrogate)	µg/L	-	10.0	70 - 130	100
		Bromofluorobenzene (Surrogate)	µg/L	-	10.0	70 - 130	100
	Trihalomethan	Chloroform (THM)	µg/L	52	45.45	60 - 140	115

Volatile Petroleum Hydrocarbons in Water
Method: ME-(AU)-[ENV]AN433

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB191432.002	TRH C6-C10	µg/L	50	1000	946.63	60 - 140	106
	TRH C6-C9	µg/L	40	850	818.71	60 - 140	104
	Surrogates						
	d4-1,2-dichloroethane (Surrogate)	µg/L	-	9.9	10	60 - 140	99
	d8-toluene (Surrogate)	µg/L	-	10.0	10	70 - 130	100
	Bromofluorobenzene (Surrogate)	µg/L	-	10.0	10	70 - 130	100
	VPH F Bands						
	TRH C6-C10 minus BTEX (F1)	µg/L	50	710	639.67	60 - 140	111

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolved) in Water

Method: ME-(AU)-[ENV]AN311(Porth)/AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE201897.001	LB191418.004	Mercury	mg/L	0.0001	0.0075	-0.0286	0.008	95

Total Phenolics in Water

Method: ME-(AU)-[ENV]AN289

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE201928.003	LB191517.019	Total Phenols	mg/L	0.01	0.24	0.01753	0.25	88

Trace Metals (Dissolved) in Water by ICPMS

Method: ME-(AU)-[ENV]AN318

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE201933.001	LB191408.004	Arsenic, As	µg/L	1	24	0.133	20	117
		Cadmium, Cd	µg/L	0.1	21	0.132	20	107
		Chromium, Cr	µg/L	1	23	0.642	20	111
		Copper, Cu	µg/L	1	39	17.765	20	108
		Lead, Pb	µg/L	1	22	1.528	20	104
		Nickel, Ni	µg/L	1	25	4.725	20	102
		Zinc, Zn	µg/L	5	110	85.172	20	127

VOCs in Water

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number	Parameter	Units	LOR	Original	Spike	Recovery%
SE201825.001	LB191432.022	Fumigants	2,2-dichloropropane	µg/L	0.5	0	-
			1,2-dichloropropane	µg/L	0.5	0	-
			cis-1,3-dichloropropene	µg/L	0.5	0	-
			trans-1,3-dichloropropene	µg/L	0.5	0	-
			1,2-dibromoethane (EDB)	µg/L	0.5	0	-
		Halogenated	Dichlorodifluoromethane (CFC-12)	µg/L	5	0	-
			Chloromethane	µg/L	5	0	-
		Aliphatics	Vinyl chloride (Chloroethene)	µg/L	0.3	0	-
			Bromomethane	µg/L	10	0	-
			Chloroethane	µg/L	5	0	-
			Trichlorofluoromethane	µg/L	1	0	-
			Iodomethane	µg/L	5	0	-
			Dichloromethane (Methylene chloride)	µg/L	5	0	-
			Allyl chloride	µg/L	2	0	-
			trans-1,2-dichloroethene	µg/L	0.5	0	-
			1,1-dichloroethane	µg/L	0.5	0	-
			cis-1,2-dichloroethene	µg/L	0.5	0	-
			Bromochloromethane	µg/L	0.5	0	-
			1,1,1-trichloroethane	µg/L	0.5	0	-
			1,1-dichloropropene	µg/L	0.5	0	-
			Carbon tetrachloride	µg/L	0.5	0	-
			Dibromomethane	µg/L	0.5	0	-
			1,1,2-trichloroethane	µg/L	0.5	0	-
			1,3-dichloropropane	µg/L	0.5	0	-
			Tetrachloroethene (Perchloroethylene,PCE)	µg/L	0.5	0	-
			1,1,1,2-tetrachloroethane	µg/L	0.5	0	-
			cis-1,4-dichloro-2-butene	µg/L	1	0	-
			1,1,2,2-tetrachloroethane	µg/L	0.5	0	-
			1,2,3-trichloropropane	µg/L	0.5	0	-
			trans-1,4-dichloro-2-butene	µg/L	1	0	-
			1,2-dibromo-3-chloropropane	µg/L	0.5	0	-
			Hexachlorobutadiene	µg/L	0.5	0	-
		Halogenated Aromatics	Bromobenzene	µg/L	0.5	0	-
			2-chlorotoluene	µg/L	0.5	0	-
			4-chlorotoluene	µg/L	0.5	0	-
			1,3-dichlorobenzene	µg/L	0.5	0	-
			1,4-dichlorobenzene	µg/L	0.3	0	-
			1,2-dichlorobenzene	µg/L	0.5	0	-
			1,2,4-trichlorobenzene	µg/L	0.5	0	-
			1,2,3-trichlorobenzene	µg/L	0.5	0	-

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOCs in Water (continued)

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number	Parameter	Units	LOR	Original	Spike	Recovery%
SE201825.001	LB191432.022	Monocyclic	Benzene	µg/L	0.5	0.04004936973	45.45 114
		Aromatic	Toluene	µg/L	0.5	0.03255874247	45.45 111
			Ethylbenzene	µg/L	0.5	0.02397088139	45.45 103
			m/p-xylene	µg/L	1	0.06721351492	90.9 101
			o-xylene	µg/L	0.5	0.02818687289	45.45 101
		Polycyclic	Naphthalene	µg/L	0.5	0.09745407191	- -
		Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	10.24066475668	- 99
			d8-toluene (Surrogate)	µg/L	-	9.87243348036	- 101
			Bromofluorobenzene (Surrogate)	µg/L	-	9.83959977799	- 97
		Trihalomethanes	Bromodichloromethane (THM)	µg/L	0.5	0	- -
			Dibromochloromethane (THM)	µg/L	0.5	0	- -
			Bromoform (THM)	µg/L	0.5	0	- -

Volatile Petroleum Hydrocarbons in Water

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number	Parameter	Units	LOR	Original	Spike	Recovery%
SE201825.001	LB191432.022	TRH C6-C10	µg/L	50	0.92427697453	946.63	104
		TRH C6-C9	µg/L	40	1.05284913778	818.71	105
		Surrogates	d4-1,2-dichloroethane (Surrogate)	µg/L	-	10.24066475668	- 99
			d8-toluene (Surrogate)	µg/L	-	9.87243348036	- 101
			Bromofluorobenzene (Surrogate)	µg/L	-	9.83959977799	- 97
		VPH F	Benzene (F0)	µg/L	0.5	0.04004936973	- -
		Bands	TRH C6-C10 minus BTEX (F1)	µg/L	50	0.92427697453	639.67 108

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here : https://www.sgs.com.au/~media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022_QA_QC_Plan.pdf

- * NATA accreditation does not cover the performance of this service .
 - ** Indicative data, theoretical holding time exceeded.
 - Sample not analysed for this analyte.
 - IS Insufficient sample for analysis.
 - LNR Sample listed, but not received.
 - LOR Limit of reporting.
 - QFH QC result is above the upper tolerance.
 - QFL QC result is below the lower tolerance.
-
- ① At least 2 of 3 surrogates are within acceptance criteria.
 - ② RPD failed acceptance criteria due to sample heterogeneity.
 - ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
 - ④ Recovery failed acceptance criteria due to matrix interference.
 - ⑤ Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
 - ⑥ LOR was raised due to sample matrix interference.
 - ⑦ LOR was raised due to dilution of significantly high concentration of analyte in sample.
 - ⑧ Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
 - ⑨ Recovery failed acceptance criteria due to sample heterogeneity.
 - ⑩ LOR was raised due to high conductivity of the sample (required dilution).
 - † Refer to relevant report comments for further information.

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CERTIFICATE OF ANALYSIS 234876

Client Details

Client	El Australia
Attention	Lan Ye
Address	Suite 6.01, 55 Miller Street, Pyrmont, NSW, 2009

Sample Details

Your Reference	<u>E24300, Penrith</u>
Number of Samples	1 Water
Date samples received	20/01/2020
Date completed instructions received	20/01/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	23/01/2020
Date of Issue	23/01/2020
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Results Approved By

Jaimie Loa-Kum-Cheung, Metals Supervisor
Josh Williams, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water		
Our Reference		234876-1
Your Reference	UNITS	GWQT1
Date Sampled		20/01/2020
Type of sample		Water
Date extracted	-	22/01/2020
Date analysed	-	22/01/2020
TRH C ₆ - C ₉	µg/L	<10
TRH C ₆ - C ₁₀	µg/L	<10
TRH C ₆ - C ₁₀ less BTEX (F1)	µg/L	<10
Benzene	µg/L	<1
Toluene	µg/L	<1
Ethylbenzene	µg/L	<1
m+p-xylene	µg/L	<2
o-xylene	µg/L	<1
Naphthalene	µg/L	<1
Surrogate Dibromofluoromethane	%	108
Surrogate toluene-d8	%	103
Surrogate 4-BFB	%	101

svTRH (C10-C40) in Water		
Our Reference		234876-1
Your Reference	UNITS	GWQT1
Date Sampled		20/01/2020
Type of sample		Water
Date extracted	-	21/01/2020
Date analysed	-	21/01/2020
TRH C ₁₀ - C ₁₄	µg/L	<50
TRH C ₁₅ - C ₂₈	µg/L	<100
TRH C ₂₉ - C ₃₆	µg/L	<100
TRH >C ₁₀ - C ₁₆	µg/L	<50
TRH >C ₁₀ - C ₁₆ less Naphthalene (F2)	µg/L	<50
TRH >C ₁₆ - C ₃₄	µg/L	<100
TRH >C ₃₄ - C ₄₀	µg/L	<100
Surrogate o-Terphenyl	%	87

HM in water - dissolved		
Our Reference		234876-1
Your Reference	UNITS	GWQT1
Date Sampled		20/01/2020
Type of sample		Water
Date prepared	-	21/01/2020
Date analysed	-	21/01/2020
Arsenic-Dissolved	µg/L	<1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Lead-Dissolved	µg/L	<1
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	10
Zinc-Dissolved	µg/L	32

Method ID	Methodology Summary
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			22/01/2020	[NT]	[NT]	[NT]	[NT]	22/01/2020	[NT]
Date analysed	-			22/01/2020	[NT]	[NT]	[NT]	[NT]	22/01/2020	[NT]
TRH C ₆ - C ₉	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
TRH C ₆ - C ₁₀	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	111	[NT]
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	118	[NT]
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	121	[NT]
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	119	[NT]
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-016	102	[NT]	[NT]	[NT]	[NT]	105	[NT]
Surrogate toluene-d8	%		Org-016	102	[NT]	[NT]	[NT]	[NT]	103	[NT]
Surrogate 4-BFB	%		Org-016	115	[NT]	[NT]	[NT]	[NT]	121	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			21/01/2020	1	21/01/2020	21/01/2020		21/01/2020	[NT]
Date analysed	-			21/01/2020	1	21/01/2020	21/01/2020		21/01/2020	[NT]
TRH C ₁₀ - C ₁₄	µg/L	50	Org-003	<50	1	<50	<50	0	83	[NT]
TRH C ₁₅ - C ₂₈	µg/L	100	Org-003	<100	1	<100	<100	0	86	[NT]
TRH C ₂₉ - C ₃₆	µg/L	100	Org-003	<100	1	<100	<100	0	82	[NT]
TRH >C ₁₀ - C ₁₆	µg/L	50	Org-003	<50	1	<50	<50	0	83	[NT]
TRH >C ₁₆ - C ₃₄	µg/L	100	Org-003	<100	1	<100	<100	0	86	[NT]
TRH >C ₃₄ - C ₄₀	µg/L	100	Org-003	<100	1	<100	<100	0	82	[NT]
Surrogate o-Terphenyl	%		Org-003	87	1	87	82	6	109	[NT]

QUALITY CONTROL: HM in water - dissolved					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date prepared	-			21/01/2020	[NT]	[NT]	[NT]	[NT]	21/01/2020	[NT]
Date analysed	-			21/01/2020	[NT]	[NT]	[NT]	[NT]	21/01/2020	[NT]
Arsenic-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	100	[NT]
Chromium-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Copper-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Lead-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	108	[NT]
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	96	[NT]
Nickel-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	104	[NT]
Zinc-Dissolved	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Appendix G – Laboratory QA/QC Policies and DQOs

Table QC1 - Containers, Preservation Requirements and Holding Times - Soil			
Parameter	Container	Preservation	Maximum Holding Time
Acid digestible metals and metalloids - Total and TCLP (As,Cd.,Cu,Cr,Ni,Pb,Zn)	Glass with Teflon Lid	Nil	6 months
Mercury	Glass with Teflon Lid	Nil	28 days
TPH / BTEX / VOC / SVOC / CHC	Glass with Teflon Lid	4°C, zero headspace	14 days
PAHs (total and TCLP)	Glass with Teflon Lid	4°C ¹	14 days
Phenols	Glass with Teflon Lid	4°C ¹	14 days
OCPs, OPPs and total PCBs	Glass with Teflon Lid	4°C ¹	14 days
Asbestos	Sealed Plastic Bag	Nil	N/A

Table QC2 - Containers, Preservation Requirements and Holding Times - Water			
Parameter	Container Volume (mL)	Preservation	Maximum Holding Time
Heavy Metals	125mL Plastic	Field filtration 0.45µm HNO ₃ / 4°C	6 months
Cyanide	125mL Amber Glass	pH > 12 NaOH / 4°C	6 months
TPH (C6-C9) / BTEX / VOCs SVOCs / CHCs	4 x 43mL Glass	HCl / 4°C ¹	14 days
TPH (C10-C36) / PAH / Phenolics OCP / OPP / TDS / pH	3 x 1L Amber Glass	None / 4°C ¹	28 days

Notes: ¹ = Extraction within 14 days, Analysis within 40 days.

Table QC3 - Analytical Parameters, PQLs and Methods - Soil			
Parameter	Unit	PQL	Method Reference
Metals in Soil			
Arsenic - As ¹	mg / kg	1	USEPA 200.7
Cadmium - Cd ¹	mg / kg	0.5	USEPA 200.7
Chromium - Cr ¹	mg / kg	1	USEPA 200.7
Copper - Cu ¹	mg / kg	1	USEPA 200.7
Lead - Pb ¹	mg / kg	1	USEPA 200.7
Mercury - Hg ²	mg / kg	0.1	USEPA 7471A
Nickel - Ni ¹	mg / kg	1	USEPA 200.7
Zinc - Zn ¹	mg / kg	1	USEPA 200.7
Total Petroleum Hydrocarbons (TPHs) in Soil			
C ₆ -C ₉ fraction	mg / kg	25	USEPA 8260
C ₁₀ -C ₁₄ fraction	mg / kg	50	USEPA 8000
C ₁₅ -C ₂₈ fraction	mg / kg	100	USEPA 8000
C ₂₉ -C ₃₆ fraction	mg / kg	100	USEPA 8000
BTEX in Soil			
Benzene	mg / kg	1	USEPA 8260
Toluene	mg / kg	1	USEPA 8260
Ethylbenzene	mg / kg	1	USEPA 8260
m & p Xylene	mg / kg	2	USEPA 8260
o- Xylene	mg / kg	1	USEPA 8260
Other Organic Contaminants in Soil			
PAHs	mg / kg	0.05-0.2	USEPA 8270
CHCs	mg / kg	1	USEPA 8260
VOCs	mg / kg	1	USEPA 8260
SVOCs	mg / kg	1	USEPA 8260
OCPs	mg / kg	0.1	USEPA 8140, 8080
OPPs	mg / kg	0.1	USEPA 8140, 8080
PCBs	mg / kg	0.1	USEPA 8080
Phenolics	mg / kg	5	APHA 5530
Asbestos			
Asbestos	mg / kg	Presence / Absence	AS4964-2004

Notes:

1. Acid Soluble Metals by ICP-AES
2. Total Recoverable Mercury

Table QC4 - Analytical Parameters, PQLs and Methods - Groundwater

Parameter	Unit	PQL	Method	Parameter	Unit	PQL	Method
Heavy Metals				Chlorinated Hydrocarbons (CHCs)			
Antimony - Sb	µg/L	1	USEPA 200.8	1,2-dichlorobenzene	µg/L	1	USEPA 8260B
Arsenic - As	µg/L	1	USEPA 200.8	1,3-dichlorobenzene	µg/L	1	USEPA 8260B
Beryllium - Be	µg/L	0.5	USEPA 200.8	1,4-dichlorobenzene	µg/L	1	USEPA 8260B
Cadmium - Cd	µg/L	0.1	USEPA 200.8	1,2,3-trichlorobenzene	µg/L	1	USEPA 8260B
Chromium - Cr	µg/L	1	USEPA 200.8	1,2,4-trichlorobenzene	µg/L	1	USEPA 8260B
Cobalt - Co	µg/L	1	USEPA 200.8	Hexachlorobutadiene	µg/L	1	USEPA 8260B
Copper - Cu	µg/L	1	USEPA 200.8	1,1,2-trichloroethane	µg/L	1	USEPA 8260B
Lead - Pb	µg/L	1	USEPA 200.8	Hexachloroethane	µg/L	10	USEPA 8270D
Mercury - Hg	µg/L	0.5	USEPA 7471A	Other CHCs	µg/L	1	USEPA 8260B
Molybdenum - Mo	µg/L	1	USEPA 200.8	Volatile Organic Compounds (VOCs)			
Nickel - Ni	µg/L	1	USEPA 200.8	Aniline	µg/L	10	USEPA 8260B
Selenium - Se	µg/L	1	USEPA 200.8	2,4-dichloroaniline	µg/L	10	USEPA 8260B
Silver - Ag	µg/L	1	USEPA 200.8	3,4-dichloroaniline	µg/L	10	USEPA 8260B
Tin (inorg.) - Sn	µg/L	1	USEPA 200.8	Nitrobenzene	µg/L	50	USEPA 8260B
Nickel - Ni	µg/L	1	USEPA 200.8	2,4-dinitrotoluene	µg/L	50	USEPA 8260B
Zinc - Zn	µg/L	1	USEPA 200.8	2,4,6-trinitrotoluene	µg/L	50	USEPA 8260B
Total Petroleum Hydrocarbons (TPHs)				Phenolic Compounds			
C ₆ -C ₉ fraction	µg/L	10	USEPA 8220A / 8000	Phenol	µg/L	10	USEPA 8041
C ₁₀ -C ₁₄ fraction	µg/L	50	USEPA 8000	2-chlorophenol	µg/L	10	USEPA 8041
C ₁₅ -C ₂₈ fraction	µg/L	100	USEPA 8000	4-chlorophenol	µg/L	10	USEPA 8041
C ₂₉ -C ₃₆ fraction	µg/L	100	USEPA 8000	2, 4-dichlorophenol	µg/L	10	USEPA 8041
BTEX				2,4,6-trichlorophenol	µg/L	10	USEPA 8041
Benzene	µg/L	1	USEPA 8220A	2,3,4,6-tetrachlorophenol	µg/L	10	USEPA 8041
Toluene	µg/L	1	USEPA 8220A	Pentachlorophenol	µg/L	10	USEPA 8041
Ethylbenzene	µg/L	1	USEPA 8220A	2,4-dinitrophenol	µg/L	10	USEPA 8041
m- & p-Xylene	µg/L	2	USEPA 8220A	Miscellaneous Parameters			
o-Xylene	µg/L	1	USEPA 8220A	Total Cyanide	µg/L	5	APHA 4500C&E-CN
Polycyclic Aromatic Hydrocarbons (PAHs)				Fluoride	µg/L	10	APHA 4500 F-C
PAHs	µg/L	0.1	USEPA 8270	Salinity (TDS)	mg/L	1	APHA 2510
Benzo(a)pyrene	µg/L	0.01	USEPA 8270	pH	units	0.1	APHA 4500H+
OrganoChlorine Pesticides (OCPs)				OrganoPhosphate Pesticides (OPPs)			
Aldrin	µg/L	0.001	USEPA 8081	Azinphos Methyl	µg/L	0.01	USEPA 8141
Chlordane	µg/L	0.001	USEPA 8081	Chloropyrifos	µg/L	0.01	USEPA 8141
DDT	µg/L	0.001	USEPA 8081	Diazinon	µg/L	0.01	USEPA 8141
Dieldrin	µg/L	0.001	USEPA 8081	Dimethoate	µg/L	0.01	USEPA 8141
Endosulfan	µg/L	0.001	USEPA 8081	Fenitrothion	µg/L	0.01	USEPA 8141
Endrin	µg/L	0.001	USEPA 8081	Malathion	µg/L	0.01	USEPA 8141
Heptachlor	µg/L	0.001	USEPA 8081	Parathion	µg/L	0.01	USEPA 8141
Lindane	µg/L	0.001	USEPA 8081	Temephos	µg/L	0.01	USEPA 8141
Toxaphene	µg/L	0.001	USEPA 8081	Polychlorinated Biphenyls (PCBs)			
				Individual PCBs	µg/L	0.01	USEPA 8081

Table QC5 - QC Sample Data Acceptance Criteria		
QC Sample Type	Method of Assessment	Acceptable Range
Field QC		
Blind Duplicates and Split Samples	<p>The assessment of split duplicate is undertaken by calculating the Relative Percent Difference (RPD) of the duplicate concentration compared with the primary sample concentration. The RPD is defined as:</p> $RPD = 100 \times \frac{ X_1 - X_2 }{\text{mean}(X_1, X_2)}$ <p>Where: X_1 and X_2 are the concentrations of the primary and duplicate samples.</p>	<p>The acceptable range depends upon the levels detected:</p> <ul style="list-style-type: none"> - 0-150% RPD (when the average concentration is <5 times the LOR/PQL) - 0-75% RPD (when the average concentration is 5 to 10 times the LOR/PQL) - 0-50% RPD (when the average concentration is >10 times the LOR/PQL)
Rinsate & Trip Blanks	Each blank is analysed as per the original samples.	Analytical Result <LOR/PQL
Laboratory prepared Trip Spike	The Trip Spike is analysed after returning from the field and the % recovery of the known spike is calculated.	70 - 130%
Laboratory QC		
Laboratory Duplicates	Assessment of Lab Duplicate RPD as per Blind Duplicates and Split Samples.	Lab Duplicate RPD < 15% (Inorganics) Lab Duplicate RPD < 30% (Organics) for sample results > 10 LOR
Surrogates Matrix Spikes Laboratory Control Samples	<p>Assessment is undertaken by determining the percent recovery of the known surrogate spike (SS) or addition to the sample.</p> $\% \text{ Recovery} = 100 \times \frac{C - A}{B}$ <p>Where: A = Concentration of analyte determined in the original sample; B = Added Concentration; and C = Calculated Concentration.</p>	<p>at least 2 SS recoveries to be within 70-130% subject to matrix effects (Organics)</p> <p>80-120% (Inorganics / Metals) 60-140% (Organics) 10-140% (SVOC and Speciated Phenols)</p> <p>If the result is outside the above ranges, the result must be <3x Standard Deviation of the Historical Mean (calculated over the past 12 months).</p>
Sample Matrix Spike Duplicates	Recovery RPD	<30% (Inorganics & Organics)
Calibration Check Standards	Continuous Calibration Verification (CCV)	CCV must be within ±15% (inorganics) CCV must be within ±25% (inorganics)
Reagent, Method & Calibration Check Blanks	Each blank is analysed as per the original samples.	Analytical Result <LOR/PQL
Note: PQL - Laboratory Practical Quantitation Limit (PQL) or the minimum detection limit for a particular analyte. LOR = Limit of Reporting		

SGS Environmental Services is accredited by NATA for Chemical Testing (Reg.No.2562) and Quality System compliance to ISO/IEC 17025. The QC parameters contained within are designed to meet NEPM 1999 requirements.

Quality Control samples included in any analytical run are listed below.

Reagent/Analysis Blank (BLK) Method Blank (MB)	<p>Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. A reagent blank is prepared and analysed with every batch of samples plus with each new batch of solvent prior to use.</p>
Sample Matrix Spike (MS) & Matrix Spike Duplicate (MSD)	<p>Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and <u>prior to the extraction/digestion procedure</u>. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water may be used. A duplicate spiked sample is analysed at least every 20 samples.</p>
Surrogate Spike (SS)	<p>At least one but up to three surrogate compounds are added to all samples requiring analysis for organics prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples. Where possible they are surrogate compounds recommended by the USEPA.</p>
Control Matrix Spike (CMS)	<p>To ensure spike recoveries can be determined for every batch of samples a control matrix is spiked with identical concentrations of target analyte(s) and then analysed. These results allow recoveries to be determined in the event that the matrix spikes are unusable (eg. matrix spikes performed on heavily contaminated samples). These are analysed at least every 20 samples.</p>
Internal Standard (IS)	<p>Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments. Where possible they are standard compounds recommended by the USEPA.</p>
Lab Duplicates (D)	<p>A separate portion of a sample being analysed that is treated the same as the other samples in the batch. One duplicate is processed at least every 10 samples.</p>
Lab Control Standards/Samples (LCS)	<p>Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity. Thereafter they are analysed at least every one in 20 samples plus at the end of each analytical run. This data is not reported.</p>
Continuous Calibration Verification (CCV) or Calibration Check Standard & Blank	<p>A calibration check standard or CCV and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.</p> <p>Calibration Standards are checked old versus new with a criteria of $\pm 10\%$</p>



Quality Assurance Programs are listed below:

Statistical analysis of Quality Control data (SQC)	Quality control data is plotted on control charts using the APHA procedure with warning and control limits at 2 and 3 standard deviations respectively. See also QMS Procedure "Statistical Quality Control".
Certified Reference Materials (CRM/SRM)	Certified Reference Materials and Standards are regularly analysed. These materials/standards have certified reference values for various parameters.
Proficiency Testing	Regular proficiency test samples are analysed by our laboratories. SGS Environmental participates in a number of programs. Results and proficiency status are compiled and sent to participating laboratory post data interpretation. Failure to comply with acceptable values result in further investigations.
Inter-laboratory & Intra-laboratory Testing	SGS Environmental Services has schedules in the Quality Systems to participate in Inter/Intra laboratory testing conducted internally and by other parties.
Data Acceptance Criteria Unless otherwise specified in the method or method manual the following general criteria apply to all inorganic tests. All recoveries are to be reported to 3 significant figures.	Failure to meet the internal acceptance criteria will result in sample batch repeats dependent upon investigation outcomes. For data to be accepted: <u>Inorganics (water samples)</u> <ul style="list-style-type: none"> For all inorganic analytes the Reagent & Method Blanks must be less than the LOR. The Calibration Check Standards or Continuous Calibration Verification (CCV) must be within $\pm 15\%$. Control Standards must be 80-120% of the accepted value. The Calibration Check Blanks must be less than the LOR. Lab Duplicates RPD to be $<15\%$. Note: If client field duplicates do not meet this criteria it may indicate heterogeneity and shall be noted on the data reports for QC samples. Sample (and if applicable Control) Matrix Spike² Duplicate recovery RPD to be $<30\%$. Where CRMs are used, results to be within ± 2 standard deviations of the expected value. <u>Inorganics (soil samples)</u> <ul style="list-style-type: none"> For all inorganic analytes the Reagent & Method Blanks must be less than the LOR. The Calibration Check Standards or Continuous Calibration Verification (CCV) must be within $\pm 15\%$. Control Standards must be 80-120% of the accepted value. The Calibration Check Blanks must be less than the LOR. Lab duplicate RPD to be $<30\%$* for sample results greater than 10 times LOR. Sample Matrix Spike Duplicate (MS²/MSD) recovery RPD to be $<30\%$. In the event that the matrix spike has been applied to samples whose matrix or contamination is problematic to the method then these acceptance criteria apply to the Control Matrix Spike (CMS/D). Where CRMs are used, results to be within ± 2 standard deviations of the expected value.

<p>Data Acceptance Criteria</p> <p>Unless otherwise specified in the method or method manual the following general criteria apply to all organic tests.</p> <p>All recoveries are to be reported to 3 significant figures.</p>	<p><u>Organics</u></p> <ul style="list-style-type: none"> • Volatile & extractable Reagent & Method Blanks must contain levels less than or equal to LOR. • The Calibration Check Standards or Continuous Calibration Verification (CCV) must be within $\pm 25\%$. Some analytes may have specific criteria. • Control Standards (LCS/CMS) and Certified Reference Materials (CRM) recoveries are to be within established control limits or as a default 60-140% unless compound specific limits apply. • Retention times are to vary by no more than 0.2 min. • At least two of three routine level soil sample Surrogate Spike (SS) recoveries are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as acceptance criterion. Any recoveries outside these limits will have comment. • Water sample Surrogates Spike (SS) recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion. Any recoveries outside these limits will have comment. • Lab Duplicates (D) must have a RPD $< 30\%^*$. • Sample Matrix Spike Duplicate (MS^d/MSD) recovery RPD to be $< 30\%$. In the event that the matrix spike has been applied to samples whose matrix or contamination is problematic to the method then these acceptance criteria apply to the Control Matrix Spike (CMS/D).
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*Only if results are at least 10 times the LOR otherwise no acceptance criteria for RPD's apply.

Application of more stringent criteria shall be applied for clean water sample from water boards and any other nominated client contracts. Nominal 10xLOR criteria are dropped to 5xLOR where specified.

^dMatrix do not readily equate to definitive recovery due to inherent matrix interferences and thus do not have recovery compliance values set. As a guide inorganic recoveries should be between 70-130% and for organics 60-130%

Batch Structure Summary

An analytical batch is nominally considered as 20 samples or smaller. As a standard template the following should be **used as a guide** according to the above Quality Control Types:

1	MB	16	UNK_DUP
2	STD1	17	MS
3	STD2	18	MS_DUP
4	STD3	19	UNK 11
5	LCS	20	UNK 12
6	BLK	21	UNK 13
7	UNK 1	22	UNK 14
8	UNK 2	23	UNK 15
9	UNK 3	24	UNK 16
10	UNK 4	25	UNK 17
11	UNK 5	26	UNK 18
12	UNK 6	27	UNK 19
13	UNK 7	28	UNK 20 (SS if applicable)
14	UNK 8	29	UNK_DUP
15	UNK 9	30	CCV
16	UNK 10 (SS if applicable)	31	CRM / SRM / CMS / LCS

Appendix H - QA/QC Assessment

H1 QUALITY CONTROL PROGRAM

H1.1 PROJECT QA/QC PROTOCOLS

The overall quality assurance comprises an assessment of the reliability of the field procedures and the laboratory results against standard industry practices, documented sampling and analysis plans or remediation action plans. A summary of the project QA/QC protocols to be followed during the investigation works is presented in **Table H-1**.

Table H-1 QA/QC Protocols

Task	Description	Project
Field QA/QC		
General	Work was undertaken following standard field procedures which are based on industry accepted standard practice.	Groundwater samples collected with low flow pump, samples placed in dedicated, single-use sample vessels with no headspace.
	All fieldwork was supervised by a suitably qualified and experienced scientist or engineer.	Yes
Rinsate Samples	One rinsate blank would be collected per sampling event and analysed for the primary contaminants. All results should be non-detect.	The results for rinsate samples were reported below laboratory LOR.
Transport	Samples were stored in ice-brick cooled cooler box and transported to the primary and secondary laboratories. To ensure the integrity of the samples from collection to receipt by the analytical laboratory, samples were sent by courier to the laboratories under 'chain of custody' describing sample preservation, and transport duration.	Yes
Trip Blanks	Trip blank samples were prepared and analysed by the primary laboratory for BTEX and naphthalene. Analytical results for trip blank samples below the laboratory PQLs, indicate that ideal sample transport and handling conditions are achieved.	Yes
Trip Spikes	Trip spike samples were prepared and analysed by the primary laboratory for BTEX. Acceptance criteria of BTEX spike recoveries are between 70% - 130%.	Yes

Task	Description	Project
QA samples	Field and laboratory QA samples will be analysed as follows: Intra-laboratory and inter-laboratory duplicate samples will be collected at a rate of 1 pair per 20 primary samples	Yes See Table H-2 <u>Groundwater - Blind Field Triplicate (BFT):</u> - Copper: 66.67% Analytical results for both the Primary and BFD were less than ten times the laboratory PQL, therefore the RPD exceedance is deemed acceptable.
Laboratory QA/QC		
Laboratory analysis	The laboratories selected are NATA accredited for the analytes selected and perform their own internal QA/QC programs	Yes SGS - primary laboratory Eurofins - secondary laboratory The laboratory QA/QC reports are included in Appendix G.
	Appropriate detection limits were used for the analyses to be undertaken.	Practical Quantitation Limits for all tested parameters during the assessment of soils and groundwater are presented in summary tables Table B.1 – B.2
	Methods followed are generally in accordance with the requirements of NEPM (2013).	Yes
Holding Times	Holding times are the maximum permissible elapsed time in days from the collection of the sample to its extraction and/or analysis. All extraction and analyses should be completed within standard guidelines.	Yes
Laboratory Duplicates	Laboratory duplicates are field samples that are split in the laboratory and subsequently analysed a number of times in the same batch. These sub-samples are selected by the laboratory to assess the accuracy and precision of the analytical method. The selected laboratories should undertake QA/QC procedures such as calibration standards, laboratory control samples, surrogates, reference materials, sample duplicates and matrix spikes. Intra-laboratory duplicates should be performed at a frequency of 1 per 10 samples.	The Laboratory duplicate samples for the analysis batches showed calculated RPDs were within acceptable ranges

Task	Description	Project
Laboratory Control Standard	A laboratory control standard is a standard reference material used in preparing primary standards. The concentration should be equivalent to a mid-range standard to confirm the primary calibration. Laboratory control samples should be performed on a frequency of 1 per 20 samples or at least one per analytical run.	The Laboratory Control Samples for the analysis batches were within acceptable ranges.
Matrix Spikes / Matrix Spike Duplicates (MS/MSD)	MS/MSDs are field samples to which a predetermined stock solution of known concentration has been added. The samples are then analysed for recovery of the known addition. Recoveries should be within the stated laboratory control limits of 70 to 130% and duplicates should have RPDs of less than 50%.	Most MS / MSD for the analysis batches were within acceptable ranges.
Surrogate Spikes	Surrogate spikes provide a means of checking, for every analysis that no gross errors have occurred at any stage of the procedure leading to significant analyte loss. Recoveries should be within the stated laboratory control limits of 70 to 130%.	Surrogate spikes for the analysis batches were within acceptable ranges.
QA/QC Conclusion	The QA/QC indicators should either all comply with the required standards or showed no variations that would have no significant effect on the quality of the data.	EI considers that the data confirms that the analytical results for the various phases of laboratory testing were valid and useable for interpretation purposes.

H1.2 CALCULATION OF RELATIVE PERCENTAGE DIFFERENCE (RPD)

The RPD values were calculated using the following equation:

$$RPD = \frac{|C_O - C_R|}{[(C_O + C_R)/2]} \times 100$$

Where:

C_O = Concentration obtained for the primary sample; and

C_R = Concentration obtained for the blind replicate or split duplicate sample.

Data precision would be deemed acceptable if RPDs are found to be less than 30%. RPDs that exceed this range may be considered acceptable where:

- Results are less than 10 times the limits of reporting (LOR);
- Results are less than 20 times the LOR and the RPD is less than 50%; or
- Heterogeneous materials or volatile compounds are encountered.

In cases where RPD value was considered unacceptable, the analytical results of primary and duplicate samples were both reviewed against the adopted assessment criteria. If the review indicates the variations in data between the primary and duplicate samples would result in a different conclusion (e.g. the higher concentration is failing the assessment criteria), the need for re-sampling / validation would be considered.

H2 FIELD QA/QC DATA PROGRAM

H2.1 FIELD QA SAMPLING PROGRAM

The field quality assurance/quality control (QA/QC) samples collected during the investigation works are summarised on **Table H-2**. Inter-lab duplicates were analysed by the secondary laboratory, Eurofins. Analytical results of the Field QA samples are tabulated in **Table H-3**, alongside calculated RPDs between the primary and field duplicate samples.

Table H-2 Field QA Sampling Program

Activity	Matrix	No. Primary Samples	Primary Sample ID	Intra-Lab Duplicate ID	Inter-Lab Duplicate ID	No. of Duplicates	Duplicate Ratio
Field QA Samples - Duplicates							
GME	Water	2	BH1.M-1	GWQD1	GWQT1	2	1:1
Other Field QA Samples							
GME	Water	GWQR1 – rinsate QTB1 – trip blank QTS1 – trip spike					

H2.2 FIELD DATA QUALITY INDICATORS

A discussion of the field data quality indicators is presented below.

Table H-4 Field Data Quality Indicators

QA/QC Measures	Field Data Quality Indicators	Conformance / Comments
Precision – A quantitative measure of the variability (or reproducibility) of data	Standard operation procedures appropriate and complied with	Yes
Completeness – A measure of the amount of useable data from a data collection activity	Each critical location sampled	Yes
	Samples collected at targeted locations and depth	Yes
	SAQP appropriate and complied with	Yes
	Experienced sampler	Yes
	Field documentation correct	Yes

QA/QC Measures	Field Data Quality Indicators	Conformance / Comments
Comparability – The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event	Same sampling method used on each occasion/location	Yes
	Experienced sampler	Yes
	Climatic conditions (temperature, rainfall, wind)	Climate conditions were recorded to be light rain. These climatic conditions unlikely had significant influence on the results of the investigation.
	Same type of samples collected (filtered, size, fractions)	Yes
Representativeness – The confidence (expressed qualitatively) that data are representative of each medium present onsite	Appropriate media sampled according to SAQP	Yes
	Each media identified in SAQP sampled	Yes
	Appropriate sample collection methodologies, handling, storage and preservation techniques used	Yes
	Consistency between field observations and laboratory results.	Yes
Accuracy – A quantitative measure of the closeness of reported data to the “true” value	Standard operation procedures appropriate and complied with	Yes
	Calibration of instruments against known standards	Yes

H2.3 CONCLUSION FOR THE FIELD QA/QC

Based on the above review of the field QA/QC data EI considered the field QA/QC programme carried out during the investigations to be appropriate and the results to be acceptable.

H3 LABORATORY QA/QC

H3.1 LABORATORY ACCREDITATION

Primary and intra-laboratory duplicate samples were analysed by SGS Alexandria Environmental, NSW; inter-laboratory triplicate samples were analysed by Eurofins, Lane Cove NSW; all laboratories are accredited by NATA for the analyses undertaken.

A discussion of the laboratory DQIs is presented below.

Table H-5 Lab Data Quality Indicators

QA/QC Measures	Laboratory Data Quality Indicators	Conformance/Comments
Completeness – A measure of the amount of useable data from a data collection activity	All critical samples analysed according to SAQP and proposal	Yes
	All analytes analysed according to SAQP in proposal	Yes
	Appropriate methods and PQLs	Yes
	Sample documentation complete	Yes
	Sample holding times complied with	Yes
Comparability – The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event	Same sample analytical methods used (including clean-up)	Yes
	Same Sample PQLs	Yes
	Same laboratories (NATA-accredited)	Yes
	Same units	Yes
Representativeness – The confidence (expressed qualitatively) that data are representative of each medium present onsite	All key samples analysed according to SAQP in the proposal.	Yes
	Analysis of laboratory-prepared volatile trip spikes and trip blanks	Yes
Precision – A quantitative measure of the variability (or reproducibility) of data	Analysis of laboratory and inter-laboratory duplicates	Yes
	Analysis of field duplicates	Yes
Accuracy – A quantitative measure of the closeness of reported data to the “true” value	Analysis of rinsate blanks	Yes
	Analysis of reagent blanks	Not applicable
	Analysis of method blanks	Yes
	Analysis of matrix spikes (MS)	Yes
	Analysis of matrix spike duplicates (MSD)	Yes

QA/QC Measures	Laboratory Data Quality Indicators	Conformance/Comments
	Analysis of surrogate spikes	Yes
	Analysis of reference materials	Not performed / applicable
	Analysis of laboratory control samples	Yes
	Analysis of laboratory-prepared spikes	Yes

Overall, it is considered that the laboratory data quality objectives for this project have been attained.

H3.2 CONCLUSIONS ON LAB QA/QC

Based on the laboratory QA/QC results EI considers that the data generally confirms that the analytical results for the various phases of laboratory testing were valid and useable for interpretation purposes.

H4 SUMMARY OF PROJECT QA/QC

The sampling methods (including sample preservation, transport and decontamination procedures) and laboratory methods followed during this investigation works were mostly consistent with EI protocols and meeting the DQOs for this project. Some discrepancies from the DQOs were reported however they were considered to not be detrimental to the validity of collected data. It is therefore considered that the data is sufficiently precise and accurate.