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Project 71021.11
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71021.11.R.002.Rev0
KDP:mm

Tooheys Pty Ltd
29 Nyrang Street
Lidcombe NSW 2141

Attention: Mr Paul Kiely

Email: paul.kiely@lionco.com

Dear Sirs

March 2017 Groundwater Monitoring
Tooheys Brewery – 29 Nyrang Street, Lidcombe

1. Introduction

This letter report provides the laboratory results and a brief discussion of the March 2017 round of groundwater monitoring at the Tooheys Brewery site at 29 Nyrang Street, Lidcombe.

The objectives of the groundwater monitoring programme are to assess whether any groundwater contamination identified on site in 2006 is migrating off site and to address the conditions of approval for groundwater monitoring set by the NSW Department of Planning as part of the approval for the upgrade and continued operation of the site under Part 3A of the *Environmental Planning and Assessment Act 1979*.

As stated in Douglas Partners Pty Ltd's (DP) report *First Round of 2011 Groundwater Monitoring, Tooheys Brewery – 29 Nyrang Street, Lidcombe,* 7 June 2011, ref: 71021.03, a Phase 1 contamination assessment was conducted by DP in 2006. The results of the soil sampling and analysis conducted by DP in November and December 2006 indicated elevated total petroleum hydrocarbon (TPH) concentrations in samples collected from boreholes adjacent to the fuel underground storage tanks (USTs) for the former boiler (the former boiler USTs). Elevated TPH and toluene concentrations were detected in groundwater samples collected from the well adjacent to the former boiler USTs (BH6C). Elevated TPH concentrations were also detected in the groundwater samples collected from the well adjacent to the refuelling USTs (BH1).

Four additional groundwater wells were installed at the boundary of the site in order to determine whether the identified contamination was migrating off site (DP report on *Field Investigation Phase 1 Contamination Assessment, 29 Nyrang Street, Lidcombe,* March 2007, ref: 44359). Further rounds of groundwater monitoring have been undertaken by DP as follows:

- *Groundwater Monitoring Report, 29 Nyrang Street, Lidcombe*, January 2010, ref: 71021.00;
- *Groundwater Monitoring Report, 29 Nyrang Street, Lidcombe*, January 2011 ref: 71021.01;
- *First Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* June 2011 ref: 71021.03;

- *Second Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* November 2011 ref: 71021.03;
- *First Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* June 2012 ref: 71021.06;
- *Second Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* October 2012 ref: 71021.06;
- *First Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* May 2013 ref: 71021.07;
- *Second Round of Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* November 2013 ref: 71021.07;
- *2014 Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* July 2014 ref: 71021.08;
- *2015 Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* December 2015 ref: 71021.10;
- *January 2016 Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe,* February 2016 ref: 71021.10; and
- *January / February 2017 Groundwater Monitoring Tooheys Brewery – 29 Nyrang Street, Lidcombe, 6 March 2017* 2016 ref: 71021.11.R.001.Rev0.

2. Site Information

The brewery is located at 29 Nyrang Street, Lidcombe, within the Local Government Area of Cumberland and comprises a roughly rectangular area of approximately 6.2 hectares (ha). The site is contained within Lot 10 DP 1008367. It is zoned 4(a) Industrial Enterprise and is surrounded by industrial sites to the north, west and south and a residential area to the east.

Haslams Creek is located to the immediate west of the site and flows in approximately a northerly direction. To the north of the site the creek bends to the east and flows to the northeast and discharges into Homebush Bay located approximately 3.5 km downstream from the brewery. The portion of Haslams Creek adjacent to the brewery is a concrete lined stormwater channel.

The site is used for the production and storage of Tooheys beer, which is transported and distributed by trucks to various outlets. The majority of the site is occupied by large warehouse structures and large fermentation, maturation and storage tanks/silos. A site Drawing and Location Plan are presented in Drawing 1, attached.

Six decommissioned USTs were located along the northern boundary of the utility building. The USTs are reported to have been emptied 17 years ago when the boilers were converted to natural gas. It was reported by ARUP that in September 2008, Tooheys decommissioned the six former boiler USTs *in situ*, which involved removal of the residual water/fuel mix inside the tanks and foam filling.

A further three USTs were located on the north eastern boundary of the site which were formerly used for the storage of petrol or diesel for on-site vehicle refuelling. A concrete plinth and awning structure

indicated that a bowser was also located nearby. Monitoring Wells BH1 and BH2 are located to the east and west of the UST and petrol bowser respectively. It was reported that the former refuelling UST were decommissioned *in situ* by being sand filled and capped approximately 20 years ago.

DP prepared a remediation action plan (RAP) for the removal and validation of the above three USTs on the north-east boundary. The RAP was entitled *Remediation Action Plan, 29 Nyrang Street, Lidcombe,* October 2011, ref 71021.02 Revision 2. The subsequent remediation and validation for the underground petroleum storage system (UPSS) in this area was undertaken shortly after the completion of the second round of groundwater monitoring for 2011 carried out on 21 October, 2011. The procedure and results of the remediation and validation of the UPSS in the north eastern boundary area were reported separately in, *UPSS Validation Assessment, Tooheys Brewery, 29 Nyrang Street, Lidcombe*, project reference 71021.04, dated February 2012. The successful validation was subject to a Site Audit undertaken by ENVIRON Australia Pty Ltd.

3. Groundwater Investigation Levels

Groundwater Investigation Levels (GIL) have been sourced from the ANZECC *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (*2000), trigger values for toxicants in fresh waters for the protection of 95% of species.

In the absence of ANZECC (2000) criteria for total recoverable hydrocarbons (TRH) and total petroleum hydrocarbons (TPH), the laboratory limits of reporting have been adopted as the screening criteria as nominated for the auditor-approved RAP GILs. It is noted, as a result, that the GIL values for TRH/TPH are more stringent to those adopted in earlier groundwater monitoring rounds (pre November 2011).

In addition, it is noted that a hardness modified trigger value for heavy metals had been adjusted for a hardness of 500 mg/L in the previous monitoring rounds. In order to be consistent with the adopted modified values, this value has also been used for the current round of monitoring. The current adopted GILs are given in Table 1 for the contaminants of concern.

Table 1: Groundwater Investigation Levels (GIL) and Rationale

Contaminant	Adopted Criteria (GIL) µg/L	Source
Metals		
Arsenic (V)	13.0	ANZECC (2000) Australian Water Quality Guidelines for the protection of 95% of freshwater species The threshold levels have been adjusted for extremely hard water in accordance with the guidelines
Cadmium	3.5	
Chromium (VI)	14.1	
Copper	21.7	
Lead	205	
Mercury	0.6	
Nickel	171.0	
Zinc	124.3	

Contaminant	Adopted Criteria (GIL) µg/L	Source
TRH/TPH		Screening GIL (at limit of reporting) – require further investigation if exceeded
$C_6 – C_9$	10	
$>C_9$	250	
$>C_{10} – C_{16}$	50	
BTEX		ANZECC (2000) Australian Water Quality Guidelines for the protection of 95% of freshwater species GIL for toluene or ethyl benzene are low reliability data.
Benzene	950	
Toluene	180	
Ethylbenzene	80	
Xylene	550	

4. Groundwater Monitoring Methodology and Field Observations

4.1 Identification of Wells

The locations of the six existing wells labelled BH1, BH2, BH7, BH8, BH9 and BH10 along the western and northern boundaries of the site are presented in the attached Drawing 1.

4.2 Frequency of Sampling

The groundwater monitoring wells BH1, BH2, BH7, BH8, BH9 and BH10 have now been sampled once in 2015, 2016 and twice in 2017 (January and March). Prior and up to 2013, monitoring was conducted twice a year on a six monthly interval during April and October and then as of 2014 has been once a year. The reduction in the monitoring frequency was due to previous results being within the GILs and an understanding that no further rounds of monitoring were required as of 2014. However, Tooheys have requested the continued monitoring until such time as their licencing conditions are changed.

4.3 Well Development

Prior to collecting groundwater samples, each well was fully developed on 22 March 2017 using a submersible 12V pump in order to remove stagnant water and to provide good hydraulic connectivity to the local groundwater system. Well development was achieved by the removal of a minimum of three well volumes of water or until the well was dry, whichever was the lesser. Monitoring wells BH7, BH9 and BH10 became dry during purging. All wells were left to equilibrate to the groundwater over a 24 hour period.

4.4 Collection of Groundwater Samples

The collection of groundwater samples from each of the six monitoring wells was carried out in accordance with the methodology as set out in the DP *Field Procedures Manual*. Groundwater sampling was undertaken on 23 March 2017 by a DP Environmental Scientist using a low flow peristaltic pump. Samples were taken from near the top of the screened section, being close to the top of the water column. The sampling programme included 10% field replicates for QA/QC purposes.

The samples were collected after stable readings were obtained for pH, conductivity, temperature and dissolved oxygen. Samples were carefully pumped into laboratory prepared sample containers including hydrochloric acid preserved BTEX vials. The groundwater samples collected for heavy metal testing were filtered in the field using a 45µm filter. Completed field sheets are attached to this report.

No phase separated hydrocarbons (PSH) were noted in the groundwater collected in all wells sampled in this monitoring round.

Sample containers were labelled and stored in the field and transported in an esky cooled with ice and later stored in a fridge at the office or laboratory. The samples were delivered to a NATA accredited laboratory, EnviroLab Services, together with chain-of-custody records.

4.5 Quality Assurance and Quality Control (QA/QC)

QA/QC sampling and analysis included the analysis of one replicate sample and one Trip Blank and Trip Spike for each groundwater monitoring event in the monitoring programme. The trip spike and blank were lost in transit and could not be analysed.

Inter-laboratory replicate analysis was conducted as a check of the reproducibility of results between the primary laboratory ELS as a measure of consistency of sampling techniques.

The comparative results of analysis between original and intra-laboratory replicate sample are summarised in Table 2.

Table 2: RPD Results – Inter-laboratory Results

Well		BH1	BD1	Difference	RPD
Heavy Metals	As	2	2	0	0
	Cd	<0.1	<0.1	0	0
	Cr	<1	<1	0	0
	Cu	1	<1	0	0
	Pb	<1	<1	0	0
	Hg	<0.05	<0.05	0	0
	Ni	10	11	1	10
	Zn	90	92	2	2
TRH	C6-C9	<10	<10	0	0
	C10-C36	<250	<250	0	0
	>C10-C16	<50	<50	0	0
Benzene		<1	<1	0	0
Toluene		<1	<1	0	0
Ethyl-Benzene		<1	<1	0	0
Total Xylene		<3	<3	0	0

The calculated RPD were all within the acceptable range of ± 30 for inorganic analytes and ± 50% for organics. Therefore the inter-laboratory replicate comparisons indicate that the sampling technique was generally consistent and repeatable and the two laboratory sampling handling and analytical methods are comparable.

A trip spike and trip blank were also analysed and the results indicated that appropriate transport and handling techniques were adopted.

4.6 Laboratory analysis

The groundwater samples (including QA/QC samples) were sent for the following analysis at a NATA accredited laboratory:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- Total recoverable hydrocarbons (TRH); and
- Benzene, toluene, ethylbenzene and xylene (BTEX).

Table 3 shows the analytical scheme for the groundwater samples.

Table 3: Analytical Scheme for Groundwater Samples

Sample ID	Heavy Metals	TRH	BTEX
BH1, 2, 7, 8, 9, 10	✓	✓	✓
BD1	✓	✓	✓
Spike / Blank			✓

BD = Blind duplicate sample of BH1

5. Results

5.1 Field Testing Results

Piezometric levels were measured prior to development and prior to sampling from the groundwater wells. The measured levels are summarised in Table 4. The attached Drawing 1A shows the groundwater flow direction and levels. The groundwater flow direction is shown to be in a north westerly direction, with the location of BH2 being hydraulically down-gradient from the former location of the UPSS near the north eastern boundary of the property.

Table 4: Piezometric Levels

Monitoring Well	m AHD (surface)	Date			
		22/03/2017 (well development)		23/03/2017 (groundwater sampling)	
		m bgl	m AHD	m bgl	m AHD
1	6.46	2.2	4.26	2.24	4.22
2	6.25	2.32	3.93	2.34	3.91
7	6.38	2.03	4.35	1.75	4.63
8	6.50	4.23	2.27	4.47	2.03
9	6.00	3.84	2.16	3.84	2.16
10	5.12	1.29	3.83	0.67	4.45

m bgl: metres below ground level
m AHD: level in metres above Australian Height Datum

The water level appeared to have recovered to the equilibrium level after development in each of the wells.

Groundwater samples were noted to be clear. Samples were taken after stable readings were obtained for pH, conductivity, temperature and dissolved oxygen as presented in Table 5. A hydrocarbon odour was noted in BH10.

Table 5: Groundwater readings prior to sampling

Monitoring Well	Dissolved Oxygen (ppm)	Conductivity (µS/cm)	pH*	Redox (mV)	Temperature (ºC)
1	3.82	4052	*	-198	22.6
2	5.58	3001	*	-179	22.6
7	1.99	811	*	-254	22.9
8	8.28	2753	*	-246	23.8
9	6.82	2999	*	-106	22.7
10	2.09	641	*	-182	23.0

*probe failure

5.2 Analytical Results

Tables 6, 7, 8 and 9 provide the results of groundwater testing in July 2014, October 2015, January 2016 and January 2017 for reference purposes. The laboratory results of the current groundwater samples plus the QA/QC results are summarised in Table 10. The laboratory test results certificates and chain-of-custody information is attached.

Table 6: Results of Laboratory Analysis in July 2014 (µg/L)

Well	Hardness (mg $CaCO_3$ /L)	Heavy Metals[1]								TRH		Benzene	Toluene	Ethyl-Benzene	Total Xylene
		As	Cd	Cr[3]	Cu	Pb	Hg	Ni	Zn	C_6-C_9	C_{10}-C_{36}				
1	130	<1	<0.1	<1	1	<1	<0.05	4	82	<10	<250	<1	<1	<1	<3
[2]BD1/ 180714		<1	<0.1	<1	<1	<1	<0.05	3	74	<10	<250	<1	<1	<1	<3
2	890	<1	0.2	<1	4	<1	<0.05	9	110	<10	<250	<1	<1	<1	<3
7	100	<1	<0.1	<1	3	<1	<0.05	6	28	<10	<250	<1	<1	<1	<3
8	1900	<1	0.2	<1	3	<1	<0.05	4	18	<10	<250	<1	<1	<1	<3
9	350	<1	<0.1	<1	1	<1	<0.05	2	18	<10	<250	<1	<1	<1	<3
10	380	<1	<0.1	<1	4	<1	<0.05	6	24	<10	<250	<1	<1	<1	<3
TS	-	-	-	-	-	-	-	-	-	-	-	101%	104%	102%	105%[4]
TB	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<3
GIL		13	3.5	14.1	21.7	205	0.6	171	124.3	10	250	950	180	80	550

Notes:

1 Heavy metals thresholds adjusted for a hardness of 500 mg/L

2 Field replicate of sample listed immediately above

3 All chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.

4 (m+p)+o xylene

5 After silica gel clean-up

bold exceeds GIL

Table 7: Results of Laboratory Analysis in October 2015 (µg/L)

Well	Hardness (mg $CaCO_3$ /L)	Heavy Metals[1]								TPH		Benzene	Toluene	Ethyl-Benzene	Total Xylene
		As	Cd	Cr[3]	Cu	Pb	Hg	Ni	Zn	C_6-C_9	C_{10}-C_{36}				
1	670	2	<0.1	<1	4	<1	<0.05	7	55	<10	<250	<1	<1	<1	<3
[2]BD1/ 301015		2	<0.1	<1	<1	<1	<0.05	1	19	<10	<250	<1	<1	<1	<3
2	1000	<1	0.2	<1	2	<1	<0.05	10	50	<10	<250	<1	<1	<1	<3
7	180	3	<0.1	<1	<1	<1	<0.05	6	14	<10	<250	<1	<1	<1	<3
8	2300	<1	0.7	<1	4	<1	<0.05	4	17	<10	<250	<1	<1	<1	<3
9	420	<1	<0.1	<1	2	<1	<0.05	7	36	<10	<250	<1	<1	<1	<3
10	160	5	<0.1	<1	<1	<1	<0.05	9	8	<10	520	<1	<1	<1	<3
TS	-	-	-	-	-	-	-	-	-	-	-	81%	92%	98%	104%[4]
TB	-	-	-	-	-	-	-	-	-	<10	-	<1	<1	<1	<3
GIL		13	3.5	14.1	21.7	205	0.6	171	124.3	10	250	950	180	80	550

Notes:

1 Heavy metals thresholds adjusted for a hardness of 500 mg/L

2 Field replicate of sample listed immediately above

3 All chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.

4 (m+p)+o xylene

bold exceeds GIL

Table 8: Results of Laboratory Analysis in January 2016 (µg/L)

Well	Hardness (mg $CaCO_3$ /L)	Heavy Metals[1]								TRH			Benzene	Toluene	Ethyl-Benzene	Total Xylene
		As	Cd	Cr^3	Cu	Pb	Hg	Ni	Zn	C_6-C_9	C_{10}-C_{36}	>C_{10}-C_{16}				
1	360	3	<0.1	<1	<1	<1	<0.05	<1	12	<10	<250	66	<1	<1	<1	<3
[2]BD1/ 180714		2	<0.1	<1	<1	<1	<0.05	<1	15	<10	<250	79	<1	<1	<1	<3
2	720	<1	0.2	<1	3	<1	<0.05	14	120	<10	<250	<50	<1	<1	<1	<3
7	110	3	<0.1	<1	<1	<1	<0.05	8	13	<10	<250	<50	<1	<1	<1	<3
8	1900	<1	0.3	<1	4	<1	<0.05	4	18	<10	<250	<50	<1	<1	<1	<3
9	480	<1	<0.1	<1	2	<1	<0.05	5	43	<10	<250	<50	<1	<1	<1	<3
10	170	4	<0.1	<1	<1	<1	<0.05	2	5	<10	<250	<50	<1	<1	<1	<3
TS	-	-	-	-	-	-	-	-	-	-	-	-	94%	95%	92%	93%[4]
TB	-	-	-	-	-	-	-	-	-	<10	-	-	<1	<1	<1	<3
GIL		13	3.5	14.1	21.7	205	0.6	171	124.3	10	250	50	950	180	80	550

Notes:

1 Heavy metals thresholds adjusted for a hardness of 500 mg/L

2 Field replicate of sample listed immediately above

3 All chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.

4 (m+p)+o xylene

bold exceeds GIL

Table 9: Results of Laboratory Analysis in January / February 2017 (µg/L)

Well	Heavy Metals[1]								TRH					Benzene	Toluene	Ethyl-Benzene	Total Xylene
	As	Cd	Cr[3]	Cu	Pb	Hg	Ni	Zn	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C36	>C_{10}-C_{16}				
1	1	<0.1	<1	1	<1	<0.05	4	28	<10	<50	<100	<100	<50	<1	<1	<1	<3
2	<1	0.2	<1	<1	<1	<0.05	5	20	<10	<50	<100	<100	<50	<1	<1	<1	<3
7	3	<0.1	<1	<1	<1	<0.05	6	1	<10	<50	<100	<100	<50	<1	<1	<1	<3
8	<1	0.5	<1	6	<1	<0.05	4	14	<10	<50	<100	<100	<50	<1	<1	<1	<3
9	<1	<0.1	<1	2	<1	<0.05	8	38	<10	<50	<100	<100	<50	<1	<1	<1	<3
BD1	<1	<0.1	<1	1	<1	<0.05	8	34	<10	<50	<100	<100	<50	<1	<1	<1	<3
10	3	<0.1	<1	7	<1	<0.05	50	**150**	<10	<50	**220**	<100	**98**	<1	<1	<1	<3
GIL	13	3.5	14.1	21.7	205	0.6	171	124.3	10	250			50	950	180	80	550

Notes:

1 Heavy metals thresholds adjusted for a hardness of 500 mg/L

2 Field replicate of sample listed immediately above

3 All chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.

4 (m+p)+o xylene

bold exceeds GIL

Table 9: Results of Laboratory Analysis in March 2017 (μg/L) (continued)

Well	Heavy Metals[1]								TRH					Benzene	Toluene	Ethyl-Benzene	Total Xylene
	As	Cd	Cr[3]	Cu	Pb	Hg	Ni	Zn	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C36	>C_{10}-C_{16}				
1	2	<0.1	<1	1	<1	<0.05	10	90	<10	<50	<100	<100	<50	<1	<1	<1	<3
BD1	2	<0.1	<1	<1	<1	<0.05	11	92	<10	<50	<100	<100	<50	<1	<1	<1	<3
2	<1	<0.1	<1	3	<1	<0.05	5	38	<10	<50	<100	<100	<50	<1	<1	<1	<3
7	3	<0.1	<1	<1	<1	<0.05	8	2	<10	<50	<100	<100	<50	<1	<1	<1	<3
8	<1	<0.1	<1	4	<1	<0.05	4	16	<10	<50	<100	<100	<50	<1	<1	<1	<3
9	1	<0.1	<1	3	<1	<0.05	7	42	<10	<50	<100	<100	<50	<1	<1	<1	<3
10	2	<0.1	<1	2	<1	<0.05	4	33	<10	<50	<100	<100	<50	<1	<1	<1	<3
GIL	13	3.5	14.1	21.7	205	0.6	171	124.3	10	250			50	950	180	80	550

Notes:

1 Heavy metals thresholds adjusted for a hardness of 500 mg/L

2 Field replicate of sample listed immediately above

3 All chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment.

4 (m+p)+o xylene

bold exceeds GIL

6. Discussion

Concentrations of TRH C_6-C_9, TRH C10-C36 and BTEX were reported below the laboratory limits of reporting for all tested monitoring wells sampled during this round of sampling.

Concentrations of heavy metals were reported either below their respective laboratory limits of reporting or GILs in all six samples during this monitoring round.

7. Conclusion

Based on the current round of groundwater monitoring at the site, the laboratory results indicate that the groundwater is not significantly impacted by petroleum hydrocarbon contamination.

The results are generally consistent with the previous monitoring rounds. It is noted that a slightly elevated concentration of TRH was detected in MW10 in January 2017, although it was below the detection limits in the current round.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at 29 Nyrang Street, Lidcombe in accordance with DP's proposal (SYD17071) dated 23 January 2017 and acceptance received from Mr Paul Kiely of Tooheys Pty Ltd dated 23 January 2017 (Order No. BP170767-V2). The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of (the Client) for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Please contact either of the undersigned for clarification of the above as necessary.

Yours faithfully
Douglas Partners Pty Ltd

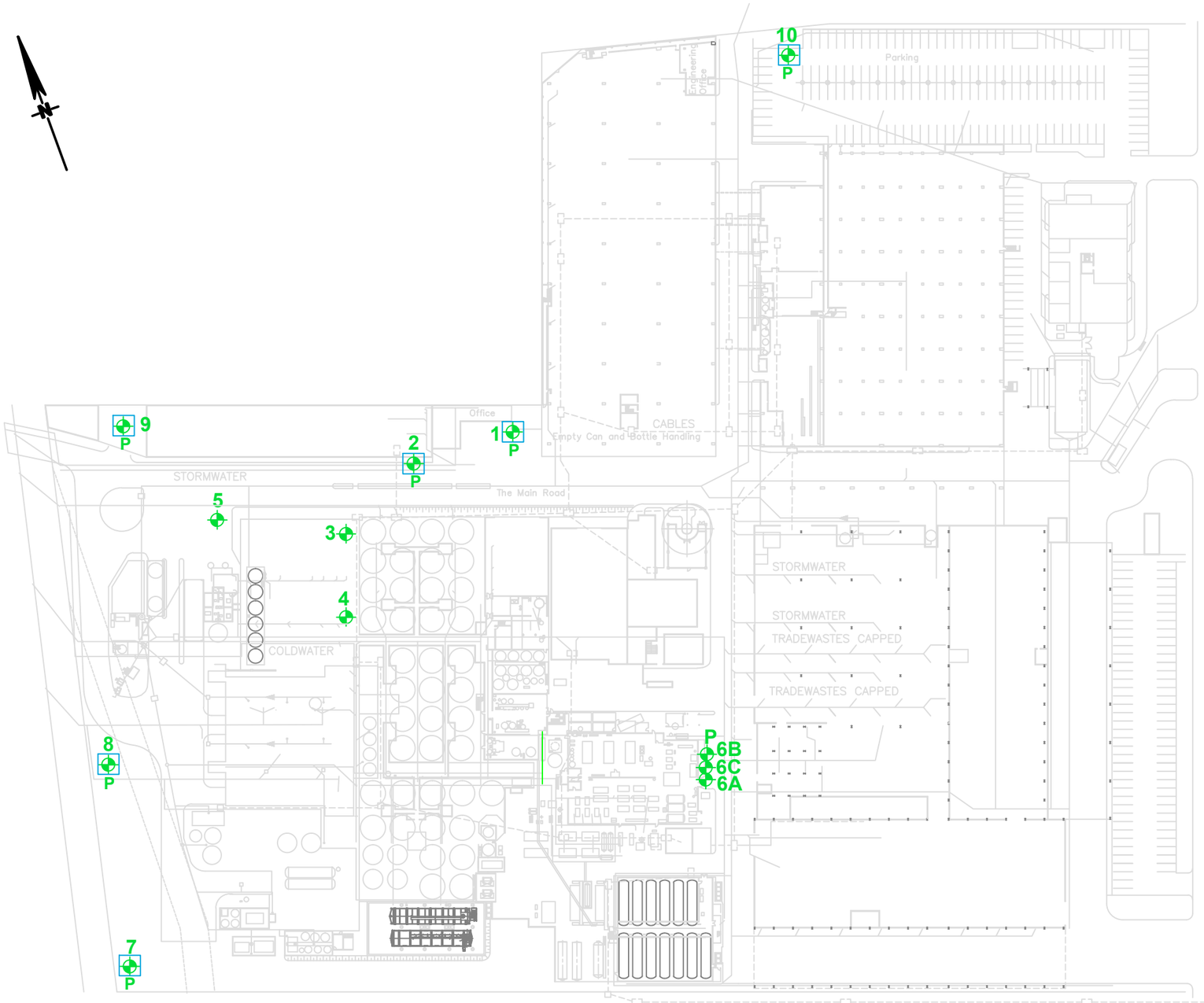
Kurt Plambeck
Senior Associate

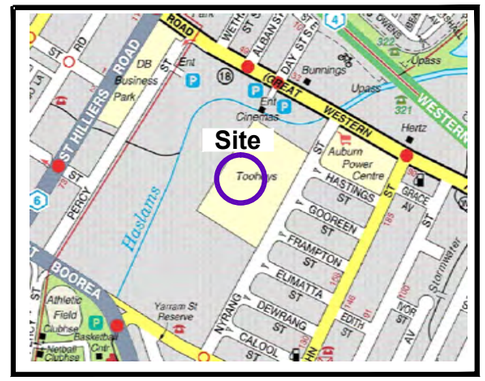
Reviewed by

PP

Paul Gorman
Principal

Attachments: Drawings
Certified Laboratory Reports
Field Notes
Notes About this Report





Locality Plan

LEGEND

- Test Bore Location
- P Piezometer
- Monitoring Well

SCALE
0 50 100m
1:1500

Douglas Partners
Geotechnics • Environment • Groundwater

CLIENT: Tooheys Pty Ltd		
DRAWN BY: PSCH	SCALE: As shown	OFFICE: Sydney
APPROVED BY:		DATE: 30.07.2014

TITLE: **Location of Monitoring Wells**
Groundwater Monitoring
29 Nyrang Street, LIDCOMBE

PROJECT No:	71021.08
DRAWING No:	1
REVISION:	0

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 164042

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kurt Plambeck

Sample log in details:

Your Reference:	**71021.11, Tooheys March 2017**		
No. of samples:	9 waters		
Date samples received / completed instructions received	23/03/17	/	23/03/17

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.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	30/03/17	/	28/03/17
Date of Preliminary Report:	NA		

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Accredited for compliance with ISO/IEC 17025 - Testing **Tests not covered by NATA are denoted with *.**

Results Approved By:

David Springer
General Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	164042-1	164042-2	164042-3	164042-4	164042-5
Your Reference	----------	BH1	BH2	BH7	BH8	BH9
Type of sample	- ----------	Water	Water	Water	Water	Water
Date extracted	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017	24/03/2017
Date analysed	-	27/03/2017	27/03/2017	27/03/2017	27/03/2017	27/03/2017
TRHC$_6$ - C$_9$	µg/L	<10	<10	<10	<10	<10
TRHC$_6$ - C$_{10}$	µg/L	<10	<10	<10	<10	<10
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	104	103	105	107	105
Surrogate toluene-d8	%	96	97	97	96	98
Surrogate 4-BFB	%	95	99	99	100	98

vTRH(C6-C10)/BTEXN in Water					
Our Reference:	UNITS	164042-6	164042-7	164042-8	164042-9
Your Reference	----------	BH10	BD1	SPIKE	BLANK
Type of sample	- ----------	Water	Water	Water	Water
Date extracted	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017
Date analysed	-	27/03/2017	27/03/2017	27/03/2017	27/03/2017
TRHC$_6$ - C$_9$	µg/L	<10	<10	[NA]	<10
TRHC$_6$ - C$_{10}$	µg/L	<10	<10	[NA]	<10
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	<10	[NA]	<10
Benzene	µg/L	<1	<1	129%	<1
Toluene	µg/L	<1	<1	121%	<1
Ethylbenzene	µg/L	<1	<1	123%	<1
m+p-xylene	µg/L	<2	<2	126%	<2
o-xylene	µg/L	<1	<1	131%	<1
Naphthalene	µg/L	<1	<1	[NA]	<1
Surrogate Dibromofluoromethane	%	106	105	103	103
Surrogate toluene-d8	%	97	97	101	95
Surrogate 4-BFB	%	99	97	112	97

svTRH (C10-C40) in Water						
Our Reference:	UNITS	164042-1	164042-2	164042-3	164042-4	164042-5
Your Reference	----------	BH1	BH2	BH7	BH8	BH9
Type of sample	- ----------	Water	Water	Water	Water	Water
Date extracted	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017	24/03/2017
Date analysed	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017	24/03/2017
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	81	80	81	82	86

svTRH (C10-C40) in Water			
Our Reference:	UNITS	164042-6	164042-7
Your Reference	----------	BH10	BD1
Type of sample	- ----------	Water	Water
Date extracted	-	24/03/2017	24/03/2017
Date analysed	-	24/03/2017	24/03/2017
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100
Surrogate o-Terphenyl	%	85	86

HM in water - dissolved Our Reference: Your Reference Type of sample	UNITS ---------- - ----------	164042-1 BH1 Water	164042-2 BH2 Water	164042-3 BH7 Water	164042-4 BH8 Water	164042-5 BH9 Water
Date prepared	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017	24/03/2017
Date analysed	-	24/03/2017	24/03/2017	24/03/2017	24/03/2017	24/03/2017
Arsenic-Dissolved	µg/L	2	<1	3	<1	1
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	0.4	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	1	3	<1	4	3
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	10	5	8	4	7
Zinc-Dissolved	µg/L	90	38	2	16	42

HM in water - dissolved Our Reference: Your Reference Type of sample	UNITS ---------- - ----------	164042-6 BH10 Water	164042-7 BD1 Water
Date prepared	-	24/03/2017	24/03/2017
Date analysed	-	24/03/2017	24/03/2017
Arsenic-Dissolved	µg/L	2	2
Cadmium-Dissolved	µg/L	<0.1	<0.1
Chromium-Dissolved	µg/L	<1	<1
Copper-Dissolved	µg/L	2	<1
Lead-Dissolved	µg/L	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05
Nickel-Dissolved	µg/L	4	11
Zinc-Dissolved	µg/L	33	92

Method ID	Methodology Summary
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.
Org-013	Water samples are analysed directly by purge and trap GC-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.
Metals-022	Determination of various metals by ICP-MS.
Metals-021	Determination of Mercury by Cold Vapour AAS.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			24/03/2017	[NT]	[NT]	LCS-W1	24/03/2017
Date analysed	-			27/03/2017	[NT]	[NT]	LCS-W1	27/03/2017
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	117%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	117%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	116%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	117%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	115%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W1	118%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	119%
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	103	[NT]	[NT]	LCS-W1	101%
Surrogate toluene-d8	%		Org-016	96	[NT]	[NT]	LCS-W1	105%
Surrogate 4-BFB	%		Org-016	97	[NT]	[NT]	LCS-W1	106%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			24/03/2017	[NT]	[NT]	LCS-W1	24/03/2017
Date analysed	-			24/03/2017	[NT]	[NT]	LCS-W1	24/03/2017
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	111%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	118%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	115%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	111%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	118%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	115%
Surrogate o-Terphenyl	%		Org-003	79	[NT]	[NT]	LCS-W1	103%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			24/03/2017	164042-1	24/03/2017 || 24/03/2017	LCS-W2	24/03/2017
Date analysed	-			24/03/2017	164042-1	24/03/2017 || 24/03/2017	LCS-W2	24/03/2017
Arsenic-Dissolved	µg/L	1	Metals-022	<1	164042-1	2 || 2 || RPD: 0	LCS-W2	103%
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	164042-1	<0.1 || <0.1	LCS-W2	104%
Chromium-Dissolved	µg/L	1	Metals-022	<1	164042-1	<1 || <1	LCS-W2	97%
Copper-Dissolved	µg/L	1	Metals-022	<1	164042-1	1 || 1 || RPD: 0	LCS-W2	99%
Lead-Dissolved	µg/L	1	Metals-022	<1	164042-1	<1 || <1	LCS-W2	103%
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	164042-1	<0.05 || <0.05	LCS-W2	90%
Nickel-Dissolved	µg/L	1	Metals-022	<1	164042-1	10 || 11 || RPD: 10	LCS-W2	102%
Zinc-Dissolved	µg/L	1	Metals-022	<1	164042-1	90 || 94 || RPD: 4	LCS-W2	102%

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	164042-2	24/03/2017
Date analysed	-	[NT]	[NT]	164042-2	24/03/2017
Arsenic-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Cadmium-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Chromium-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Copper-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Lead-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Mercury-Dissolved	µg/L	[NT]	[NT]	164042-2	#
Nickel-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Zinc-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]

Report Comments:

8 HM in water - dissolved:
Low spike recovery was obtained for this sample. The sample was re-digested and re-spiked and the low recovery was confirmed.
This is due to matrix interferences. However, an acceptable recovery was obtained for the LCS.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

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.

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-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.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Douglas Partners Pty Ltd
Attention	Kurt Plambeck

Sample Login Details	
Your Reference	71021.11, Tooheys March 2017
Envirolab Reference	**164042**
Date Sample Received	23/03/2017
Date Instructions Received	23/03/2017
Date Results Expected to be Reported	**30/03/2017**

Sample Condition	
Samples received in appropriate condition for analysis	YES
No. of Samples Provided	9 waters
Turnaround Time Requested	Standard
Temperature on receipt (°C)	18.6
Cooling Method	Ice
Sampling Date Provided	YES

Comments
Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	Phone: 02 9910 6200
Fax: 02 9910 6201	Fax: 02 9910 6201
Email: ahie@envirolabservices.com.au	Email: jhurst@envirolabservices.com.au

Sample and Testing Details on 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
enquiries@envirolabservices.com.au
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Sample Id	*vTRH(C6-C10)/BTEXN in Water*	*svTRH (C10-C40) in Water*	*HM in water - dissolved*
BH1	✓	✓	✓
BH2	✓	✓	✓
BH7	✓	✓	✓
BH8	✓	✓	✓
BH9	✓	✓	✓
BH10	✓	✓	✓
BD1	✓	✓	✓
SPIKE	✓		
BLANK	✓		

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

Douglas Partners
Geotechnics / Environment / Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	71021.11	**Suburb:**	Lidcombe	**To:**	Envirolab Services
Project Name:	Tooheys March 2017	**Order Number**			12 Ashley Street, Chatswood
Project Manager:	Kurt Plambeck	**Sampler:**	Matthew Hyde	**Attn:**	Aileen
Emails:	kurt.plambeck@douglaspartners.com.au			**Phone:**	612 9910 6200
Date Required:	Standard			**Email:**	ahie@envirolab.com.au

Prior Storage: ☒ Esky ☐ Fridge ☐ Shelved — Do samples contain 'potential' HBM? Yes ☐ No ☒ (If YES, then handle, transport and store in accordance with FPM HAZID)

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: 8 Metals	TRH	BTEX							Notes/preservation
BH1	1				X	X	X							
BH2	2				X	X	X							
BH7	3				X	X	X							
BH8	4				X	X	X							
BH9	5				X	X	X							
BH10	6				X	X	X							
BD1	7				X	X	X							
Spike	8						X							
Blank	9						X							
PQL (S) mg/kg													**ANZECC PQLs req'd for all water analytes** ☐	

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container: 30 **Relinquished by:** TG **Transported to laboratory by:**

Send Results to: Douglas Partners Pty Ltd **Address** 96 Hermitage Road, West Ryde **Phone:** **Fax:**

Signed: **Received by:** James ELS **Date & Time:** 23/03 17.00

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 164042
Date Received: 23/03
Time Received: 17:00
Received by: JAG
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: ~~Intact/Broken/None~~

Douglas Partners
Geotechnics / Environment / Groundwater

Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH1**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	6.5 m AHD		
Bore Easting:		Northing:	
Installation Date:	24-Oct-16		
GW Level (during drilling):	m bgl		
Well Depth:	14.2 m bgl		
Screened Interval:	2.0-14.2 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	2.20 m bgl		
GW Level (post-purge):	2.57 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	14.35 m bgl		
Estimated Bore Volume:	85 L		
Total Volume Purged:	280 L		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy. Dry		
GW Level (pre-purge):	2.24 m bgl		
GW Level (post sample):	2.25 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	14.35 m bgl		
Estimated Bore Volume:	85 L		
Total Volume Purged:	11 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
11:38 / 1	23.3	3.52	3856	10.45		-166
11:40 / 2	23.0	2.49	3880	10.34		-172
11:42 / 3	23.0	2.71	3884	10.36		-175
11:44 / 4	22.9	3.18	3883	10.34		-176
11:46 / 5	22.8	3.61	3904	10.34		-175
11:48 / 6	22.7	3.79	3959	10.36		-175
11:50 / 7	22.7	3.80	3993	10.32		-197
11:52 / 8	22.6	3.82	4096	10.37		-190
11:54 / 9	22.6	3.81	4050	10.35		-192
11:56 / 10	22.6	3.82	4052	10.40		-198
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			
	44.7	4270	2905			

Sample Details

Sampling Depth (rationale):	7 m bgl, Middle of Bore
Sample Appearance (e.g. colour, siltiness, odour):	clear. Slight musty odour
Sample ID:	BH1
QA/QC Samples:	BD1 ~~BD2~~
Sampling Containers and filtration:	1x amber, 2x vial, 1x preserved plastic. 45µm filter
Comments / Observations:	

Douglas Partners
Geotechnics / Environment / Groundwater

Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH2**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	6.2 m AHD		
Bore Easting:		Northing:	
Installation Date:	20-Oct-16		
GW Level (during drilling):	m bgl		
Well Depth:	14.5 m bgl		
Screened Interval:	2.0-14.5 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	2.32 m bgl		
GW Level (post-purge):	5.69 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	13.34 m bgl		
Estimated Bore Volume:	80 L		
Total Volume Purged:	240 L		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy, dry.		
GW Level (pre-purge):	3.34 m bgl		
GW Level (post sample):	2.47 m bgl		
PSH observed:	Yes / ~~No~~ (interface/visual). ? mm thick		
Observed Well Depth:	13.34 m bgl		
Estimated Bore Volume:	80 L		
Total Volume Purged:	11 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1058 / 1	23.5	6.36	3068	10.00		-129
1100 / 2	23.4	6.19	3193	9.97		-137
1102 / 3	23.2	5.81	3288	9.97		-141
1104 / 4	23.1	5.31	3261	10.07		-146
1106 / 5	22.9	4.95	3103	10.09		-100
1108 / 6	22.8	5.04	3048	10.08		-163
1110 / 7	22.7	5.20	3022	10.06		-168
1112 / 8	22.6	5.52	3005	10.03		-174
1114 / 9	22.6	5.63	3021	9.97		-175
1116 / 10	22.6	5.58	3001	9.95		-179
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			

Sample Details

Sampling Depth (rationale):	7 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	Light brown, slightly silty - No odour
Sample ID:	BH2
QA/QC Samples:	/
Sampling Containers and filtration:	1x amber, 2x vials, 1x preserved plastic. 45 µm filter
Comments / Observations:	

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Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH7**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	6.4 m AHD		
Bore Easting:		Northing:	
Installation Date:	7-Dec-16		
GW Level (during drilling):	m bgl		
Well Depth:	6.5 m bgl		
Screened Interval:	1.5-6.5 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	2.03 m bgl		
GW Level (post-purge):	m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	5.50 m bgl		
Estimated Bore Volume:	25 L		
Total Volume Purged:	— L No Purge		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy, dry		
GW Level (pre-purge):	1.75 m bgl		
GW Level (post sample):	4.36 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	5.50 m bgl		
Estimated Bore Volume:	25 L		
Total Volume Purged:	19 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1258 / 5	22.9	0.76	700	11.33		-253
1303 / 10	23.2	0.84	520	11.03		-278
1308 / 15	23.1	1.14	572	10.94		-274
1309 / 16	23.0	1.81	762	11.03		-253
1310 / 17	22.9	1.88	783	11.05		-252
1311 / 18	22.9	1.94	800	11.08		-255
1312 / 19	22.9	1.99	811	11.05		-254
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			
	23.5	855	559			

Sample Details

Sampling Depth (rationale):	5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	Light brown, slightly silty.
Sample ID:	BH7
QA/QC Samples:	—
Sampling Containers and filtration:	1x amber, 2x vials, 1x preserved plastic, 45µm filter
Comments / Observations:	Bore bent, no development possible

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Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH8**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	6.5 m AHD		
Bore Easting:		Northing:	
Installation Date:	7-Dec-06		
GW Level (during drilling):	m bgl		
Well Depth:	8.25 m bgl		
Screened Interval:	2.0-8.25 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	4.23 m bgl		
GW Level (post-purge):	5.83 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	8.29 m bgl		
Estimated Bore Volume:	30 L		
Total Volume Purged:	200 L		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy, dry		
GW Level (pre-purge):	4.47 m bgl		
GW Level (post sample):	4.53 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	8.29 m bgl		
Estimated Bore Volume:	30 L		
Total Volume Purged:	9 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
0940 / 1	24.2	6.56	2897	8.40		-205
0942 / 2	24.1	7.06	2749	8.28		-214
0944 / 3	24.0	7.63	2730	8.22		-221
0946 / 4	23.9	7.99	2738	8.15		-226
0948 / 5	23.9	8.26	2753	8.15		-233
0950 / 6	23.8	8.30	2741	8.15		-238
0952 / 7	23.8	8.36	2725	8.21		-243
0954 / 8	23.8	8.28	2753	8.22		-246
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			
	99.1	2919				

Sample Details

Sampling Depth (rationale):	6.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	clear, No odour
Sample ID:	BH8
QA/QC Samples:	—
Sampling Containers and filtration:	1x amber, 2x vials, 1x preserved plastic. 45µm filter
Comments / Observations:	

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Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH9**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	6.0 m AHD		
Bore Easting:		Northing:	
Installation Date:	7-Dec-06		
GW Level (during drilling):	m bgl		
Well Depth:	6.5 m bgl		
Screened Interval:	1.5-6.5 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	3.84 m bgl		
GW Level (post-purge):	5.73 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	6.64 m bgl		
Estimated Bore Volume:	20 L		
Total Volume Purged:	15 L Pumped dry		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy, drizzly		
GW Level (pre-purge):	3.84 m bgl		
GW Level (post sample):	4.34 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	6.64 m bgl		
Estimated Bore Volume:	20 L		
Total Volume Purged:	8 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	***0.1° C***	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1017 / 1	22.7	7.20	2701	9.31		-113
1019 / 2	22.8	7.81	2817	9.26		-107
1021 / 3	22.8	7.46	2886	9.21		-111
1023 / 4	22.8	7.02	2970	9.15		-112
1025 / 5	22.7	6.85	2997	9.08		-113
1027 / 6	22.7	6.81	2957	9.05		-109
1029 / 7	22.7	6.82	2999	9.01		-106

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS
	77.4	3191	2080

Sample Details

Sampling Depth (rationale):	5.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	brown, turbid, slight sulfur odour
Sample ID:	BH9
QA/QC Samples:	—
Sampling Containers and filtration:	1x amber, 2x vials, 1x preserved plastic - 0.45µm filter
Comments / Observations:	

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Groundwater Field Sheet

Project and Bore Installation Details			
Bore / Standpipe ID:	**BH10**		
Project Name:	Tooheys March 2017 Monitoring		
Project Number:	71021.11		
Site Location:	29 Nyrnag Street, Lidcombe		
Bore RL	5.1 m AHD		
Bore Easting:		Northing:	
Installation Date:	7-Dec-06		
GW Level (during drilling):	m bgl		
Well Depth:	5 m bgl		
Screened Interval:	1.5-5.0 m bgl		
Contaminants/Comments:			
Bore Development Details			
Date/Time:	Wednesday 22 March		
Purged By:	Tom Graham		
GW Level (pre-purge):	1.29 m bgl		
GW Level (post-purge):	4.07 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	5.41 m bgl		
Estimated Bore Volume:	30 L		
Total Volume Purged:	20 L Pumped dry		
Equipment:	12 Volt pump		
Micropurge and Sampling Details			
Date/Time:	Thursday 23 March		
Sampled By:	Tom Graham		
Weather Conditions:	Cloudy, dry		
GW Level (pre-purge):	0.67 m bgl		
GW Level (post sample):	2.78 m bgl		
PSH observed:	Yes / (No) (interface/visual). ? mm thick		
Observed Well Depth:	~~30~~ 5.41 m bgl		
Estimated Bore Volume:	30 L		
Total Volume Purged:	11 L		
Equipment:	peristaltic pump and TPS multimeter		

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Turbidity	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10%**	**+/- 10 mV**
1216 / 1	22.7	2.84	1106	11.87		-149
1218 / 2	22.7	2.43	800	11.59		-148
1220 / 3	22.8	2.42	717	11.46		-144
1222 / 4	22.8	2.33	667	11.39		-144
1224 / 5	22.9	2.16	635	11.41		-155
1226 / 6	22.9	2.10	585	11.48		-156
1228 / 7	23.0	2.19	579	11.51		-169
1230 / 8	23.0	2.23	637	11.51		-175
1232 / 9	23.0	2.11	652	11.48		-178
1234 / 10	23.0	2.09	641	11.49		-182
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS			
	25.2	612	572			

Sample Details

Sampling Depth (rationale):	3.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	Brown, Silty. No odour
Sample ID:	BH10
QA/QC Samples:	
Sampling Containers and filtration:	1x amber, 2x vials, 1x preserved plastic. 45µm filter.
Comments / Observations:	

About this Report

Douglas Partners

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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