Limerick Gas Works Air Quality Survey Report

E&E3/AQ/PR00003

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1 Introduction

1.1 Reason for Task

A former gas works site in Limerick, County Limerick (see Figure 1 and Figure 2) is to undergo remediation in preparation for new development. In order to gather data as input to future environmental assessments, baseline monitoring of Volatile Organic Compounds (VOCs) and dust deposition has been undertaken.

1.2 Objective

The purpose of the monitoring exercise was to establish indicative baseline concentrations of VOCs and dust deposition over a three month period. This report presents the findings of the monitoring undertaken, and can be called upon as required for future environmental assessments.

The results presented from the Continuous Monitoring Unit are provisional, awaiting calibration by the manufacturer. Should the results change after calibration, an Addendum will be issued.

1.3 Project Specification

Remediation of the site will involve disturbing soil that may be contaminated with various hydrocarbon compounds. Once exposed to the atmosphere, easily volatilised compounds such as Volatile Organic Compounds (VOCs) may be released into the atmosphere. Works may also generate dust, which is not only a nuisance in itself but may contain pollutants. As such baseline conditions need to be established in order to determine whether future remediation works causes an increase in exposure to pollutants in the local environment.

1.4 The Study Area

Bord Gáis has commissioned Mouchel to undertake a three month air quality monitoring campaign for concentrations of VOCs and dust deposition levels in the local area.

VOCs were monitored using a low level benzene, toluene and xylene hydrocarbon analyser using a Photo Ionisation Detector and Gas Chromatograph. Diffusion tubes were also used at four locations off-site.

Dust was monitored using two Frisbee gauges, both on the site. Further specifications on the methods used are presented in section 2.

Monitoring locations are presented in Figure 3.

Site

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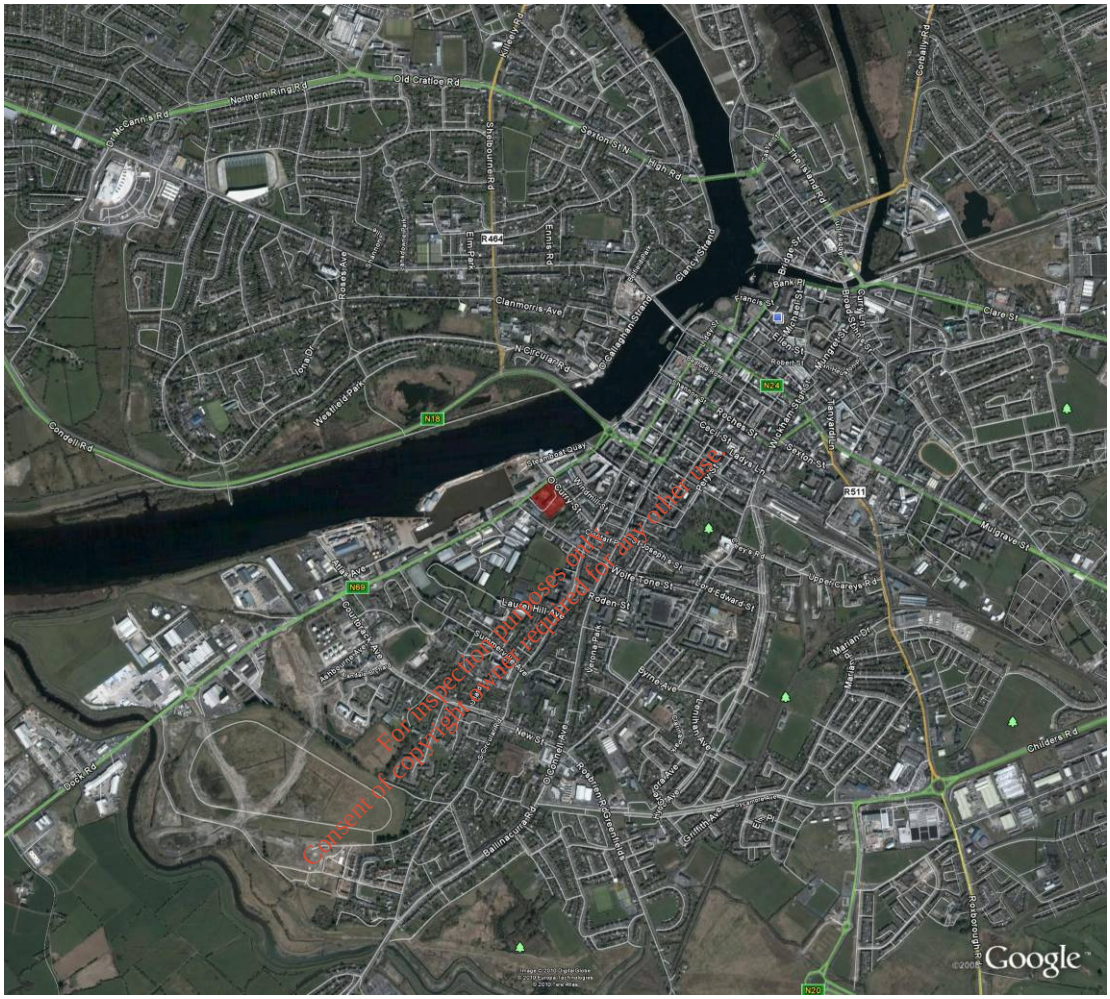

Figure 1: Overview of Site Location			Drawn	JM	28/04/10	mouchel
			Design	N/A		
			Checked	MIC	28/04/10	
Rev: A	Description: FINAL	Project: Limerick	Approved	AG	5/05/10	
			Scale	Not to Scale		

Figure 1: Overview of Site Location

Site

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Figure 2: Site Location			Drawn	JM	28/04/10	mouchel
			Design	N/A		
			Checked	MIC	28/04/10	
Rev: A	Description: FINAL	Project: Limerick	Approved	AG	07/05/10	
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Figure 2: Site Location

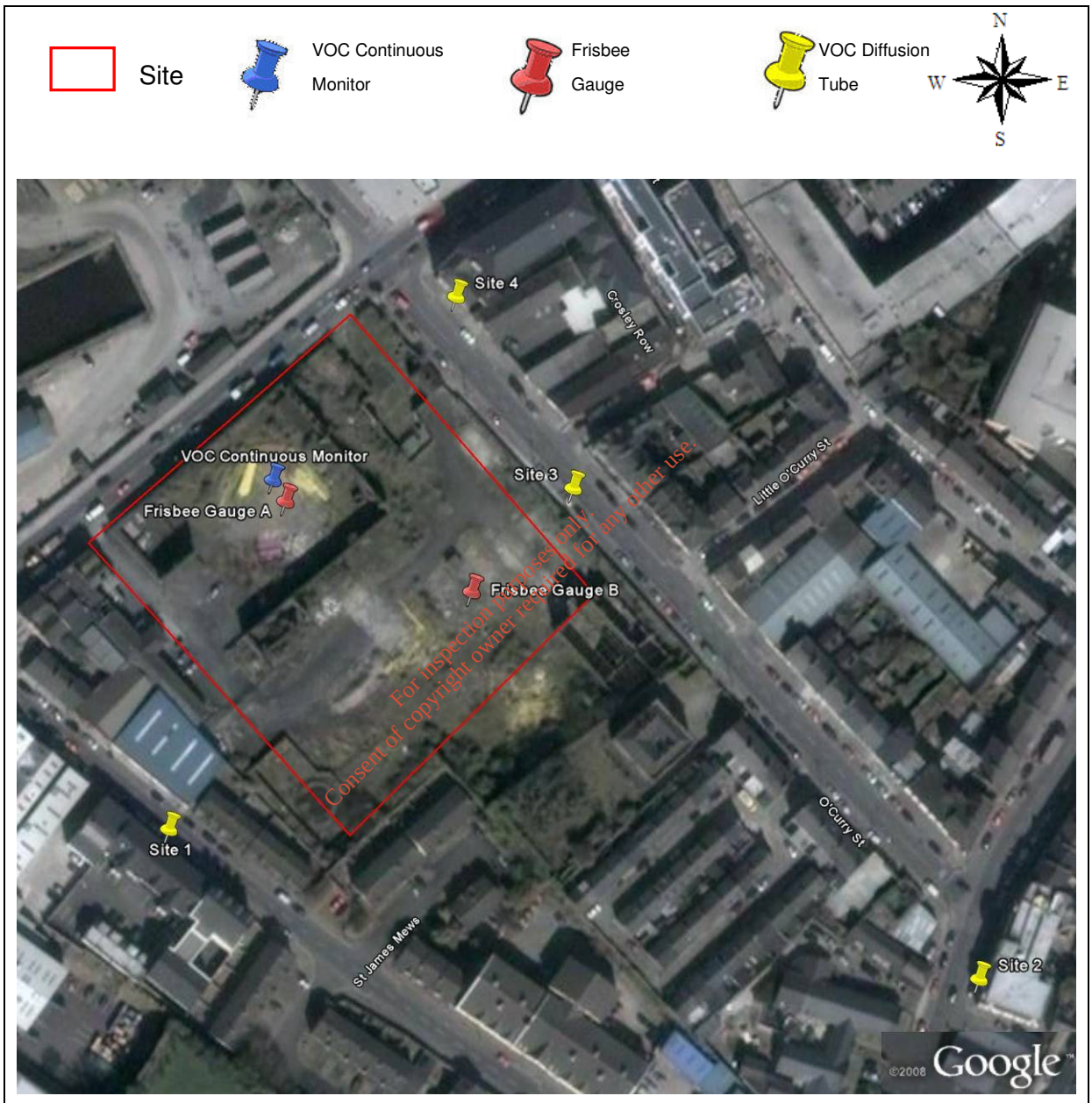

Figure 3: Monitoring Locations			Drawn	JM	29/04/10
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			Checked	MIC	29/04/10
Rev: A	Description: FINAL	Project: Limerick	Approved	AG	07/05/10
			Scale	Not to Scale	

Figure 3: Monitoring Locations

2 Methodology

2.1 Monitoring Methods Employed

The monitoring methods employed were Perkin Elmer ATD tubes, a continuous low level benzene, toluene and xylene hydrocarbon analyser using a Photo Ionisation Detector and Gas Chromatograph and Frisbee Gauges (see Table 1).

Table 1: Monitored Pollutants

Pollutant	Monitoring Category	Method	Equipment Provided and Analysed by
Top 10 VOCs	Diffusion tubes	Perkin Elmer ATD tubes analysed by thermal desorption-gas chromatography mass-spectrometry	Gradko Environmental
VOCs	Continuous monitoring unit	Low level benzene, toluene and xylene hydrocarbon analyser using a Photo Ionisation Detector and Gas Chromatograph	Enviro Technology
Dust	Frisbee Gauges	The determination of fugitive dust based on BS 2690, part 120, 1981.	Equipment from: Ian Hanby Analysis by: TES Bretby

The monitoring approach adopted was informed by monitoring work undertaken at similar gas work remediation sites owned by Bord Gáis in the Republic of Ireland. No consultation as undertaken with the Environmental Protection Agency or the Local Council.

2.2 Monitoring Periods

The Continuous Monitoring Unit was in operation from the 1st December 2009 until 12th March 2010.

Diffusion tube and Frisbee monitoring was conducted from 10th December 2009 to 4th March 2010.

2.3 Monitoring Locations

2.3.1 *Continuous Monitoring Unit*

Given the power and security requirements, the VOC continuous monitoring unit was located on site at the best available location. Figure 3 presents the location of the unit. Photographs of the locations are available in Appendix 2.

2.3.2 *Diffusion Tubes*

A single VOC diffusion tube was located at each of four locations surrounding the site, as presented in Table 2 and Figure 3. Photographs of the sites are provided in Appendix 1.

Tubes were replaced every four weeks by trained staff.

Table 2: Diffusion Tube Locations

Site Number	Site Name	Approx. Height (m)	Irish Grid Coordinates	
1	St Alphonsus Street	2.8	156900	156490
2	South Circular Road	2.8	157124	156448
3	O'Curry Street	2.8	157014	156583
4	O'Curry Street	2.8	156982	156637

2.3.3 *Frisbee Gauges*

Two frisbee gauges were located on the site, as presented in Figure 3.

3 Results

3.1 Context of the Results

The purpose of the monitoring exercise was to establish indicative baseline concentrations of VOCs and dust deposition over a three month period.

Whereas the monitoring survey only covered a short period of time and no meaningful estimation of annual mean values was possible in the current exercise, this section presents the mean values observed for the VOCs monitored and compares them against UK's Environmental Assessment Levels (EALs).

3.1.1 EU Limit Values

The annual mean limit value for benzene is 5 µg/m^3 in 2010.

3.1.2 Environmental Assessment Levels (EALs)

For many substances that are released to air, environmental quality standards have not been defined. Currently some 460 substances or groups of substances are authorised by Regulators (the Environment Agency (UK)) for release into the environment and many of these may be released to air. Where the necessary criteria to establish environmental quality standards are absent, the Environment Agency have adopted interim values known as Environmental Assessment Levels.

Environment Agency guidance H1 (2010)[1] provides non-statutory benchmarks of concentrations (Environmental Assessment Levels - EALs) for substances after dispersion into the receiving environment (air), set at a level below which no harm is likely, derived by the methodology described in the document. EALs are derived for long-term and short-term exposure; however reflecting the extended duration of exposure outside of normal working hours, EALs are available for Annual Mean exposure (long term) and 1 Hour Mean exposure (short term).

In addition, EALs also take into consideration the expectation that the general population consists of individuals that are more sensitive to changes in air quality than that of the working population. Such individuals typically comprise, children, the elderly and those with upper track respiratory diseases such as asthma. Consequently, when deriving EALs conservative factors of 30 times and 100 times are typically used. The methodology for derivation of EALs is provided in Environment Agency (2010).

[1] http://www.environment-agency.gov.uk/business/topics/permitting/36414.aspx

3.1.3 *Relevant Assessment Levels*

Table 3 shows the relevant values for comparison with the Continuous Monitoring Unit. Table 4 shows additional values for comparison with the Diffusion Tube results. EALs for other substances detected are not available in the guidance documents

Table 3: Environmental Assessment Levels Relevant to Continuous Monitoring Unit Data

Substance	Long Term[(a)] (Annual Mean) EAL µg/m^3	Short Term[(b)] (1-Hour Mean) EAL µg/m^3
Benzene	5[(*)]	-
Toluene	1,910	8,000
Xylene o-, m-, p- or mixed isomers	4,410	66,200[(c).(d)]

Notes:		
	*	EU Limit Value
	a	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 8 hour reference period converted to annual mean (see notes on derivation below).
	b	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 15 minute reference period converted to hourly mean. Where marked by *, indicates that no short term OEL or MEL is provided in EH40, and the value has been derived by multiplying the long term OEL or MEL by a factor of 30.
	c	World Health Organisation WHO, Air quality guidelines 2000 [please consult the reference for the relevant averaging times]
	d	EAL derived from values for 24 hour reference period

Table 4: Additional Environmental Assessment Levels Relevant to Diffusion Tube Data

Substance	Long Term[(a)] (Annual Mean) EAL µg/m^3	Short Term[(b)] (1-Hour Mean) EAL µg/m^3
2-butanone	6,000	89,900
Ethylbenzene	4,410	55,200
Napthalene	530	8,000

Notes:		
	a	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 8 hour reference period converted to annual mean (see notes on derivation below).
	b	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 15 minute reference period converted to hourly mean. Where marked by *, indicates that no short term OEL or MEL is provided in EH40, and the value has been derived by multiplying the long term OEL or MEL by a factor of 30.

3.2 VOCs

3.2.1 *Continuous Monitoring*

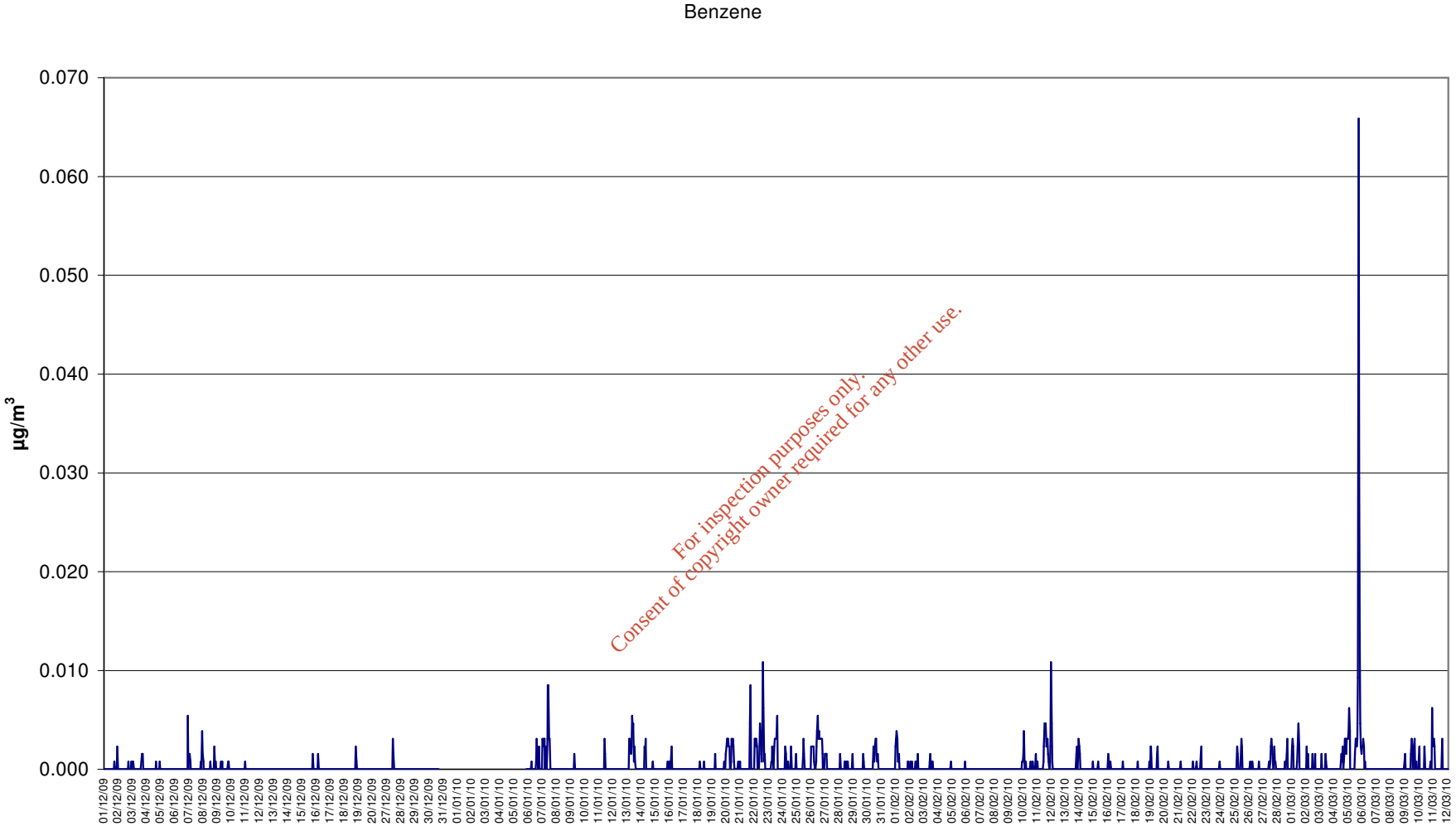
The results presented from the Continuous Monitoring Unit, presented on CD in Appendix 3, are provisional, awaiting calibration by the manufacturer. Should the results change after calibration an Addendum to this report will be issued.

Concentrations of benzene, toluene, m,p-xylene and o-xylene were measured at 15 minute intervals, with a data capture of 94.6%. These data were used to calculate hourly means. The unit was not operational between 10:00 on 31st December 2009 and 12:50 on 5th January 2010 due to the power being switched off. A summary of the results is presented in Table 5 and graphs of the results over time in Graph 1, Graph 2, Graph 3 and Graph 4.

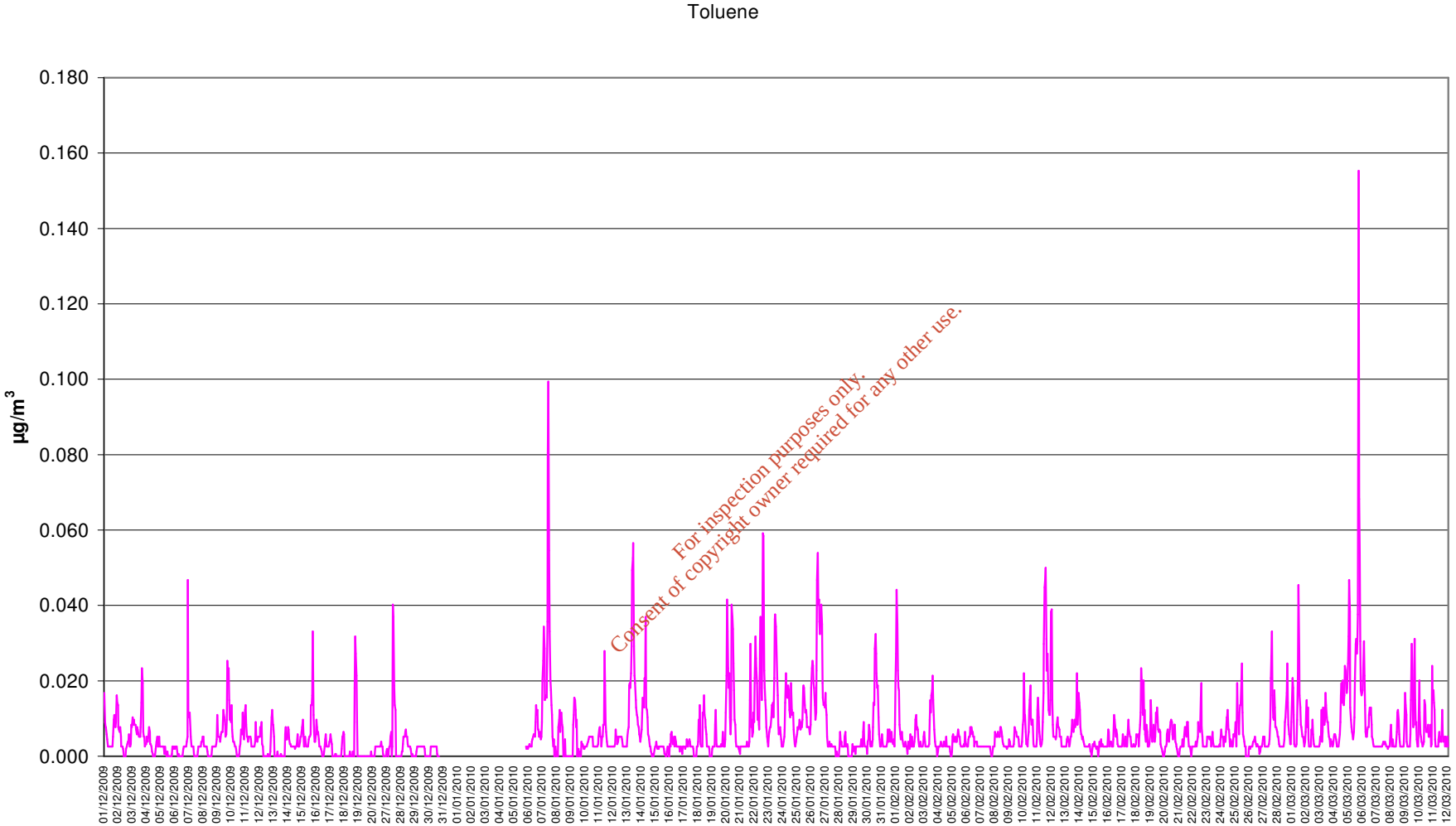
Table 5: Continuous Monitoring Unit Hourly Concentration Summary (µg/m^3)

	Benzene	Toluene	m,p-Xylene	o-Xylene
Minimum	0.000	0.000	0.000	0.000
Mean	0.000	0.007	0.001	0.000
Maximum	0.066	0.155	0.031	0.009
1-Hour EAL		8,000	66,200	

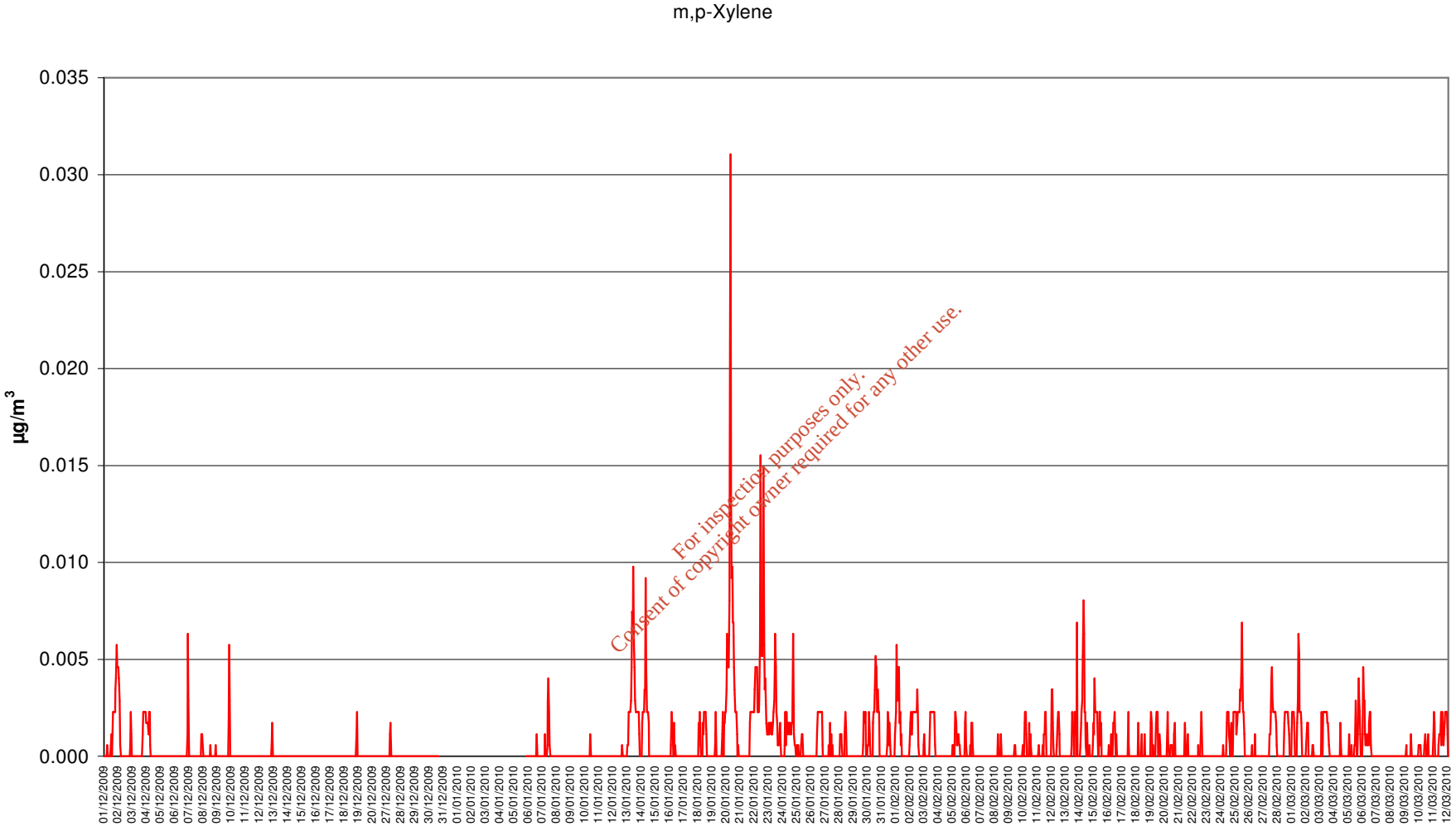
As presented in Table 5 the maximum hourly concentration of toluene is 51,613 times lower than the EAL, and the maximum hourly concentration of all forms of xylene is 1,655,000 times lower than the EAL.



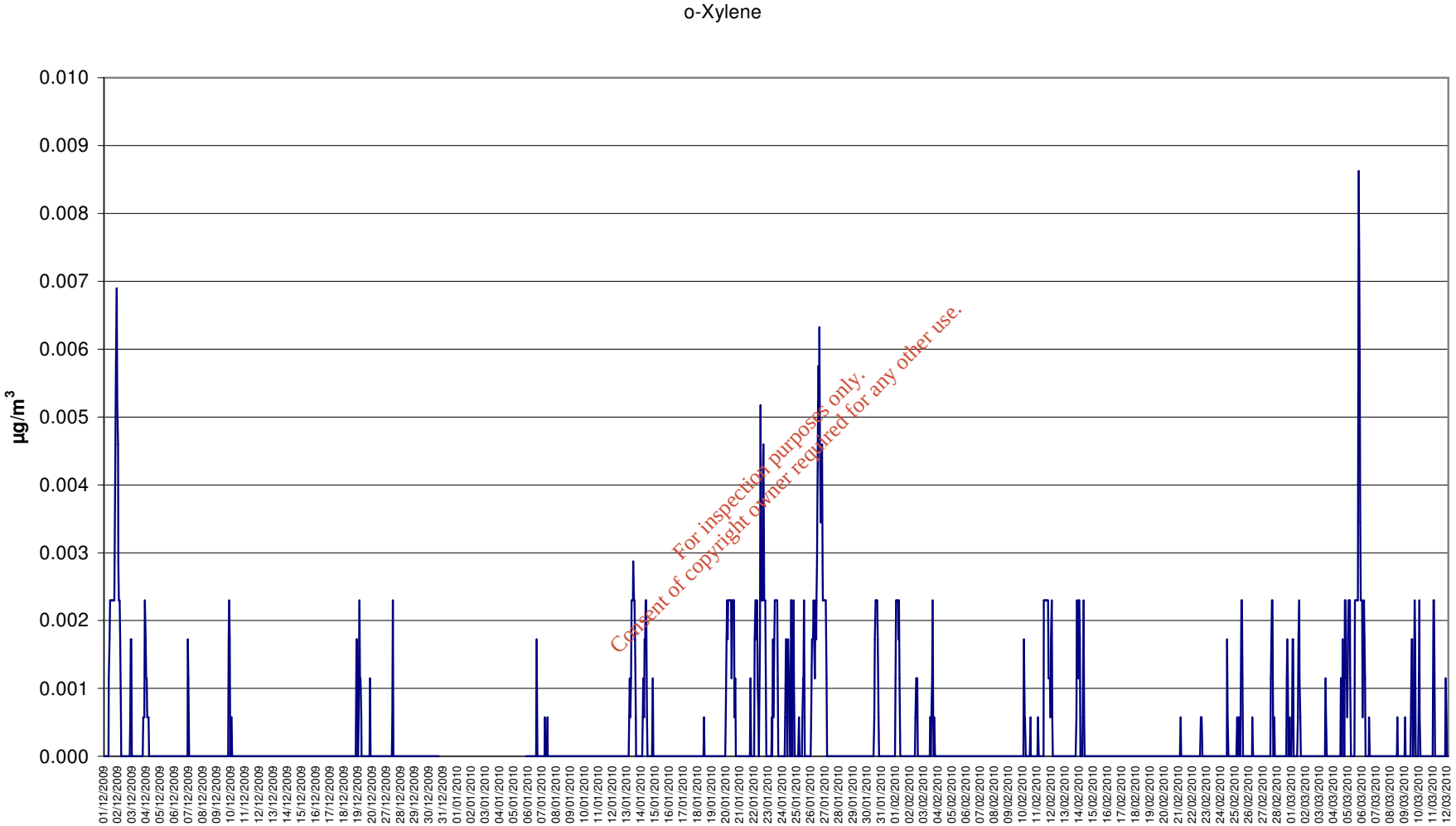
Graph 1: Hourly Mean Benzene Concentrations



Graph 2: Hourly Mean Toluene Concentrations



Graph 3: Hourly Mean m,p-Xylene Concentrations



Graph 4: Hourly Mean o-Xylene Concentrations

3.2.2 *Diffusion Tubes*

The results for the top ten compounds measured on each tube are provided in Table 6, Table 7, Table 8 and Table 9. The results presented express the variation registered each month per location.

Table 6: Site 1 Diffusion Tube Results

Site 1	Period 1	Period 2	Period 3	Period Average ($\mu g/m^3$)	Annual Mean EAL ($\mu g/m^3$)
2-Butanone	Sample Missing[2]	*n/a*	0.64	0.64	6,000
Benzene		1.09	1.21	1.15	5
Benzene, 1,2,3-trimethyl-		*n/a*	0.28	0.28	-
Benzene, 1,2,4-trimethyl-		*n/a*	0.87	0.87	-
Benzene, 1,3,5-trimethyl-		0.83	*n/a*	0.83	-
Butane, 2,2-dimethyl-		0.28	*n/a*	0.28	-
Dodecane		0.62	*n/a*	0.62	-
Ethylbenzene		6.00	0.86	3.43	4,410
Formanide, N,N-dimethyl		*n/a*	0.72	0.72	-
Heptane		*n/a*	0.47	0.47	-
m p-Xylene		*n/a*	1.70	1.70	4,410
Naphthalene		0.40	1.88	1.14	530
Octane		0.63	*n/a*	0.63	-
o-Xylene		3.45	*n/a*	3.45	4,410
p-Xylene		7.77	*n/a*	7.77	4,410
Toluene		3.02	2.45	2.74	1,910

[2] The Diffusion tube was vandalised

Table 7: Site 2 Diffusion Tube Results

Site 2	Period 1	Period 2	Period 3	Period Average (µg/m^3)	Annual Mean EAL (µg/m^3)
2-Butanone	1.29	*n/a*	1.19	1.24	6,000
Benzene	2.02	1.29	2.35	1.89	5
Benzene, 1,2,4-trimethyl-	*n/a*	*n/a*	2.24	2.24	-
Benzene, 1,3,4-trimethyl-	1.53	*n/a*	*n/a*	1.53	-
Benzene, 1,3,5-trimethyl-	*n/a*	0.85	*n/a*	0.85	-
Benzene, 1-ethyl-3-methyl	0.61	*n/a*	*n/a*	0.61	-
Butane, 2,2-dimethyl-	0.89	0.37	*n/a*	0.63	-
Decane	*n/a*	*n/a*	1.46	1.46	-
Ethylbenzene	4.29	1.88	2.09	2.75	4,410
Formanide, N,N-dimethyl	*n/a*	0.24	0.79	0.52	-
Heptane	*n/a*	*n/a*	0.98	0.98	-
m,p-Xylene	6.23	*n/a*	3.66	4.95	4,410
Naphthalene	0.91	*n/a*	*n/a*	0.91	530
Octane	*n/a*	0.41	*n/a*	0.41	-
o-Xylene	3.02	1.70	2.47	2.40	4,410
Pentane, 2-methyl-	*n/a*	0.60	*n/a*	0.60	-
p-Xylene	*n/a*	3.61	*n/a*	3.61	4,410
Toluene	5.62	3.51	6.32	5.15	1,910

Table 8: Site 3 Diffusion Tube Results

Site 3	Period 1	Period 2	Period 3	Period Average (µg/m^3)	Annual Mean EAL (µg/m^3)
2,3-Dimethyldecane	*n/a*	*n/a*	0.35	0.35	-
2-Butanone	1.02	*n/a*	*n/a*	1.02	6,000
Benzene	1.25	1.03	0.91	1.06	5
Benzene, 1,2,3-trimethyl-	0.35	*n/a*	*n/a*	0.35	-
Benzene, 1,3,5-trimethyl-	*n/a*	0.91	*n/a*	0.91	-
Butane, 2,2-dimethyl-	0.51	*n/a*	*n/a*	0.51	-
Cyclohexane, isocyanato-	*n/a*	*n/a*	1.09	1.09	-
Cyclohexane, methyl-	*n/a*	*n/a*	1.39	1.39	-
Decane	*n/a*	*n/a*	0.45	0.45	-
Ethylbenzene	3.41	5.69	0.37	3.16	4,410
m,p-Xylene	4.78	*n/a*	0.93	2.86	4,410
Naphthalene	0.58	*n/a*	*n/a*	0.58	530
Naphthalene, 1-methyl-	*n/a*	0.37	*n/a*	0.37	-
Nonane	*n/a*	0.34	*n/a*	0.34	-
o-Xylene	2.04	3.20	*n/a*	2.62	4,410
Pentane, 2-methyl-	*n/a*	0.36	*n/a*	0.36	-
Pentane, 3-methyl-	*n/a*	0.23	*n/a*	0.23	-
p-Xylene	*n/a*	6.95	*n/a*	6.95	4,410
Tetradecane	*n/a*	*n/a*	0.49	0.49	-
Toluene	3.80	2.77	1.20	2.59	1,910
Undecane	0.48	*n/a*	0.30	0.39	-

Table 9: Site 4 Diffusion Tube Results

Site 4	Period 1	Period 2	Period 3	Period Average (µg/m^3)	Annual Mean EAL (µg/m^3)
2-Butanone	1.37	*n/a*	1.47	1.42	6,000
2-Propanl, 2-methyl-	0.38	*n/a*	*n/a*	0.38	-
Benzene	1.49	1.08	1.95	1.51	5
Benzene, 1,2,4-trimethyl-	*n/a*	*n/a*	1.73	1.73	-
Benzene, 1,3,5-trimethyl-	*n/a*	1.08	*n/a*	1.08	-
Benzene, 1-ethyl-3-methyl	0.41	*n/a*	*n/a*	0.41	-
Butane, 2,2-dimethyl-	0.66	0.33	*n/a*	0.50	-
Decane	*n/a*	*n/a*	1.03	1.03	-
Ethylbenzene	2.12	4.25	1.28	2.55	4,410
Formanide, N,N-dimethyl	*n/a*	*n/a*	0.74	0.74	-
m,p-xylene	3.58	*n/a*	2.28	2.93	4,410
Naphthalene	0.63	*n/a*	*n/a*	0.63	530
Nonane	*n/a*	0.48	*n/a*	0.48	-
o-Xylene	1.52	2.64	1.53	1.90	4,410
Pentane, 2-methyl-	*n/a*	0.50	*n/a*	0.50	-
p-Xylene	*n/a*	5.91	*n/a*	5.91	4,410
Tetradecane	*n/a*	*n/a*	0.86	0.86	-
Toluene	3.77	2.99	5.28	4.01	1,910
Undecane	*n/a*	0.51	*n/a*	0.51	-

The analysis of the results indicate that concentrations measured over the three month period are consistently lower than the annual mean EALs.

3.3 Dust

Baseline dust deposition measurements are shown in Table 10.

Table 10: Dust Deposition Results

Period	Deposition (mg per m^2 per day)	
	Location A	Location B
1	13	22
2	18	25
3	59	50
Period Average	**30**	**32**

The potential for dust arising from sites is always a matter of public concern. The fear is that the nuisance created during works will affect local amenity value and quality of life for the period during operations. The level of concern, and potential for nuisance, may be directly related to the number and proximity of residential areas to the site.

The degree of nuisance experienced depends on the rate of deposition, and is discernible at two levels:

a. nuisance, experienced when the dust cover is sufficient to be visible when contrasted to an adjacent clean surface, such as when a finger is wiped across the surface. This is particularly annoying when it occurs regularly over long periods; and
b. severe nuisance, experienced when the dust cover is perceptible without a clean reference surface for comparison. This usually occurs over short periods during very dusty conditions.

Nuisance complaints are usually associated with periods of peak deposition, occurring during particular weather conditions. There is a “normal” level of dust deposition in every community and it is only when the rate of deposition is high relative to the norm that complaints tend to occur. The impact of dust on a community will therefore be determined by five main factors:

a. the short-term dustiness during periods of dry weather (climatic factors);
b. the location of the potential dust source relative to the community;
c. the effectiveness of dust control measures adopted by the site operator;
d. the frequency or regularity with which these occur; and
e. the duration of the site activities that contribute to dust.

The amount of dust that might cause complaint or nuisance in a particular circumstance is very difficult to determine and there are no statutory limits such as those applicable to suspended particulates or gaseous pollutants. However, guidance (relating specifically to mineral operations but applicable to other similar situations) suggests that complaints are likely when the rate of dust deposition is at two to three times the normal background. level of dust deposition in the area (*The Environmental Effects of Surface Mineral Workings* (HMSO 1991)).

The analysis of the dust level results indicate very low concentrations and no nuisance is anticipated from baseline conditions.

4 References

The Environmental Effects of Surface Mineral Workings (HMSO 1991)

The H1 Environmental Risk Assessment for Permits (Environment Agency 2010).

5 Appendices

Appendix 1: Diffusion Tube Location Photographs

Site 1 – St Alphonsus Street

Plate 1: Site 1, View 1 - St Alphonsus Street

Plate 2: Site 1, View 2 - St Alphonsus Street

Plate 3: Site 1, View 3 - St Alphonsus Street

Plate 4: Site 1, View 4 - St Alphonsus Street

Site 2 – South Circular Road

Plate 5: Site 2, View 1 – South Circular Road

Plate 6: Site 2, View 2 – South Circular Road

Plate 7: Site 2, View 3 – South Circular Road

Site 3 – O'Curry Street

Plate 8: Site 3, View 1 – O'Curry Street

Plate 9: Site 3, View 2 – O'Curry Street

Plate 10: Site 3, View 3 – O'Curry Street

Plate 11: Site 3, View 4 – O'Curry Street

Site 4 – O'Curry Street

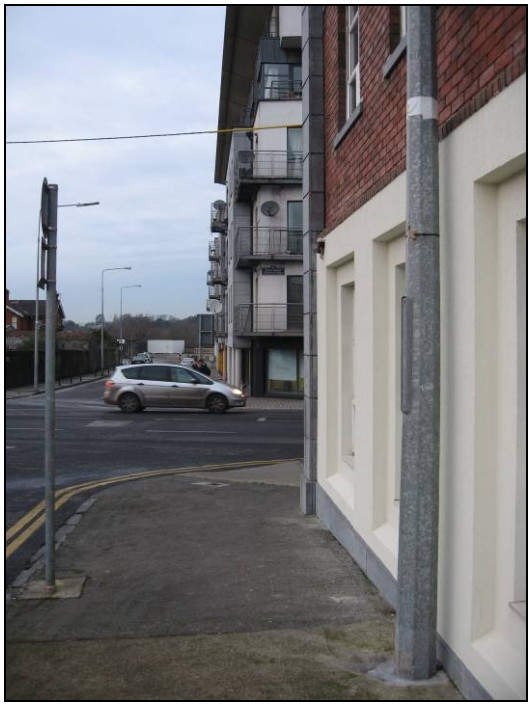


Plate 12: Site 4, View 1 – O'Curry Street

Plate 13: Site 4, View 2 – O'Curry Street

Plate 14: Site 4, View 3 – O'Curry Street

Plate 15: Site 4, View 4 – View from O'Curry Street onto Gas Works Site

Appendix 2: Continuous Monitoring Unit Location Photographs

Plate 16: Continuous Monitoring Unit, View 1

Plate 17: Continuous Monitoring Unit, View 2

Appendix 3: Laboratory Reports for Diffusion Tube and Frisbee Gauges

Raw data from the Continuous Monitoring Unit is available electronically (CD).