

DUBLIN PORT TUNNEL
AIR QUALITY MONITORING
ANNUAL REPORT 2003

Introduction

One of the key challenges for the Dublin Port Tunnel project is to successfully control air pollutant emissions to avoid adverse impacts on local residents, while supporting construction milestones and ensuring that environmental commitments contained in the Project's Environmental Impact Statement are fulfilled. With pollution control measures, established policies and specifications, support from project officials, open dialog with the affected communities, the potential air quality impacts from this project can be managed successfully. This report presents the results of air quality monitoring at the Northern and Southern Portals of the Port Tunnel for the period January - December 2003. This monitoring is being carried out as a result of the public inquiry in relation to this project, which specified the following:

1. Continuous monitoring of particulates (PM₁₀) at the nearest residential receptor to the Northern Portal
2. Continuous measurement of total volatile organic compounds (VOCs) in the vicinity of the Northern Portals
3. Monitoring to be carried out prior to and during construction, and also for a period of five years following completion of the Dublin Port Tunnel

As this monitoring was required in addition to commitments in relation to air quality monitoring as specified in the Environmental Impact Statement, Dublin City Council undertook to establish monitoring sites in order to comply with the conditions specified at the formal public inquiry.

Report Summary

- Particulate levels (PM₁₀) and volatile organic compounds measured in the vicinity of the Northern Portal in 2003 complied with the relevant statutory limits for these pollutants.
- Pollutant measurements in the vicinity of the Southern Portal (sulphur dioxide, nitrogen dioxide, carbon monoxide, lead and ozone) indicate compliance with the relevant statutory limits for these pollutants.
- Particulate levels (PM₁₀) in the vicinity of the Southern Portal showed an overall increase in ambient levels since monitoring commenced. Significant construction activity, coupled with high daily traffic volumes on East Wall Road contributed to PM₁₀ levels in this area. It is anticipated that air quality in the East Wall Road area will improve significantly on completion of the Port Tunnel, as construction operations cease and traffic volumes reduce significantly.

The Legal Framework

Air quality is an issue locally, nationally and internationally. Internationally, the European Union (E.U.) sets regulations for managing air quality, which are transposed into Irish law in the Air Quality Standards Regulations 2002, presented in Table 1. The limit values established for air pollutants are based on the protection of human health. The results presented in this report are compared with the relevant limit values.

Table 1: Air Quality Standards Regulations 2002

Pollutant	Limit Value*	Permitted Exceedances	Attainment Date
Sulphur Dioxide (SO ₂)	125 µg/m ³ (24-Hour) 350 µg/m (1-Hour)	3 per year 24 per year	2005
Nitrogen Dioxide (NO ₂)	40 µg/m ³ 200 µg/m (1-Hour)	Annual Mean 18 per year	2010
Particulate Matter (PM ₁₀)	50 µg/m ³ (24-Hour) 40 µg/m ³	35 per year Annual Mean	2005
Carbon Monoxide (CO)	10 mg/m ³	Maximum daily 8-hour mean	2005
Lead (Pb)	0.5 µg/m ³	Annual Mean	2005
Benzene	5 µg/m ³	Annual Mean	2010
Ozone (O ₃)**	180µg/m ³ (1-hour)	Population Threshold	2010

* microgrammes per cubic metre/ milligrams per cubic metre

** EU Framework Directive on Air Quality

Southern Portal – East Wall

Several air pollutants are currently being measured at East Wall Road and the results presented in this report are representative of the contribution of all road and rail traffic, residential, commercial and construction activities in the local environment. Since there are multiple activities occurring at this site (including heavy traffic on East Wall Road) it is difficult to determine PM₁₀ impacts caused by project-related activities alone. Monitoring is carried out within the confines of the construction site and therefore, comparison with EU Directives and Irish Regulations is not appropriate, as the location does not represent average background conditions or siting criteria as specified in the Directives. However, given the proximity of residential property on East Wall Road, monitoring is carried out on a 24-hour basis for the pollutants detailed in Table 1 in order to assess the contribution of tunnel-related construction activities to local air quality.

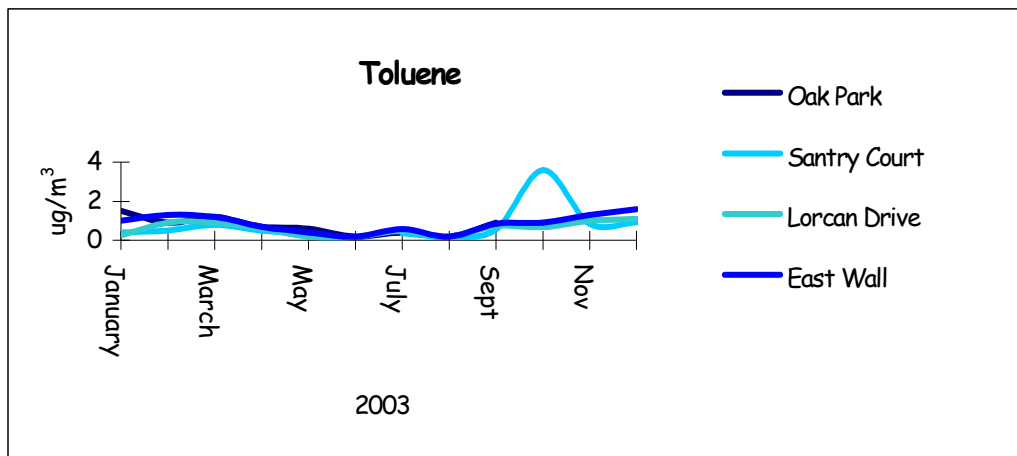
Sulphur Dioxide

This pollutant can have adverse effects on human health, vegetation and cultural heritage (protected buildings). Emissions from the combustion of fossil fuels, particularly electricity generation, account for the bulk of SO₂ emissions. Levels recorded over a six-month period in 2003 indicate compliance with the relevant statutory limits. As this pollutant is not predominantly traffic-generated, and levels are in compliance with statutory limits for the past three years, monitoring of SO₂ discontinued in the East Wall Road area in June 2003.

Maximum 1-Hour and 24-Hour SO₂ Levels

Limit Values	Jan	Feb	Mar	Apr	May	Jun
350 µg/ m ³ (1-Hour)	134.3	98.5	52.6	55.5	56.9	83.3
125 µg/m ³ (24-Hour)	47.3	35.2	23.0	30.7	33.9	51.5

Figure 1: Maximum 1-Hour and 24-Hour SO₂ Levels



Lead

The annual average lead level recorded in 2003 is in compliance with the statutory limit of 0.5µg/m³ (microgrammes per cubic metre). Lead is not a significant pollutant in the East Wall Road area.

Nitrogen Dioxide

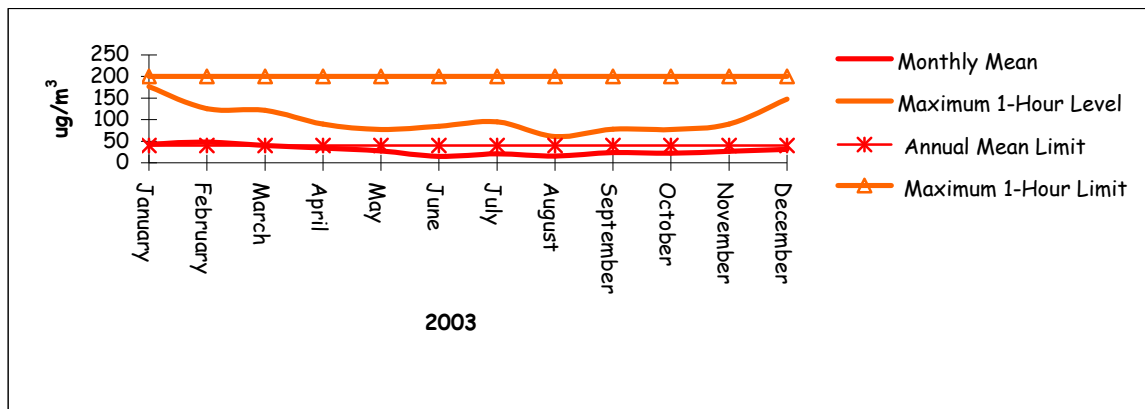
This pollutant is thought to increase the lung's vulnerability to infection. The main source of NO₂ is motor vehicles, although gas use for building heating is also a significant contributor. Statutory limits were complied with at the East Wall Road location over the monitoring period.

Mean Monthly and Maximum Hourly NO₂ Levels

Limit Values	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
200 µg/m ³ (1-Hour)	176.9	125.5	121.3	89.6	77.2	84.8	94.9	60.5	77.7	77.0	89.4	147.6
40 µg/m ³ Annual Mean	43.0	48.3	40.3	34.4	27.7	14.9	20.8	15.7	23.5	22.0	26.9	31.3

The annual mean of 29.0 µg/m³ recorded at East Wall Road in 2003 complies with the statutory annual mean limit value of 40 µg/m³.

Figure 2 : Mean and Maximum Monthly NO₂ Levels



Ozone

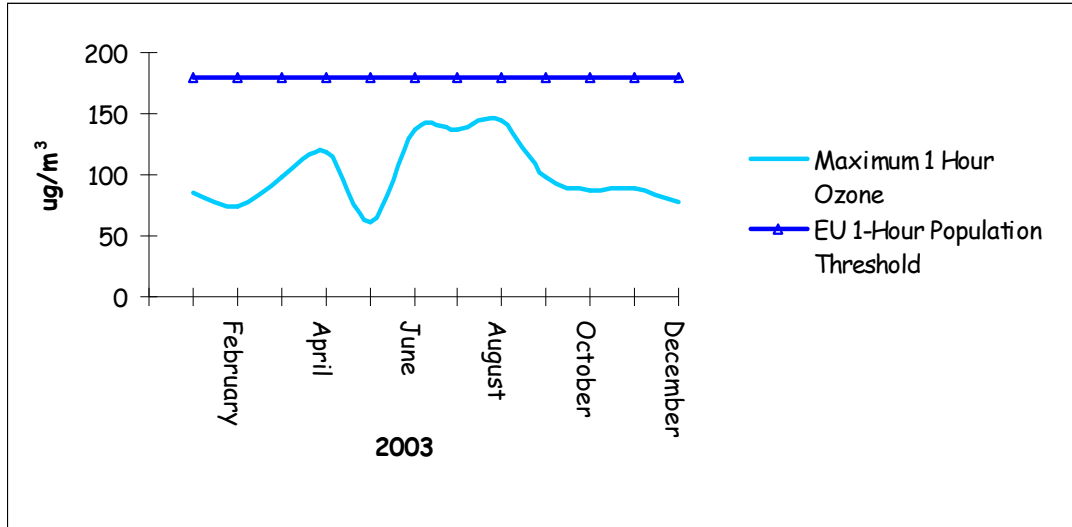
The Air Quality Standards Regulations do not set limit values for ozone, recognising that it is a secondary pollutant and has a transboundary dimension. A threshold is set, however in the EU Directive on Air Quality, above which there may be effects on human health and vegetation. Ozone is not a significant pollutant in Dublin.

Maximum 1-Hour Ozone Levels

Limit Value*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
180 $\mu\text{g}/\text{m}^3$ (1-Hour)	85.4	73.6	98	118.4	61	137.6	137.2	144.6	99	87.8	89.4	77.2

*EU population threshold

Figure 3 : Maximum Hourly O₃ Levels



Carbon Monoxide

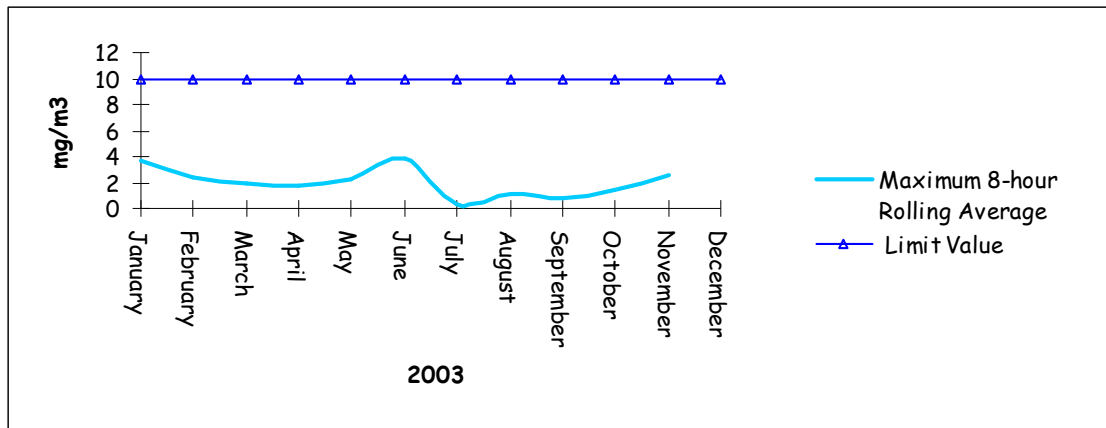
This pollutant can pose a significant threat to human health and contribute to the formation of ozone. Carbon monoxide principally originates from the incomplete combustion of fuel with the transportation sector being the largest contributor to emissions.

Maximum 8-Hour Rolling Average

Limit Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
10 mg/m^3	3.7	2.4	1.9	1.7	2.2	1.8	0.3	1.1	0.8	1.5	2.5

No data reported for December 2003 due to essential repair and maintenance, full monthly analysis not available.

Figure 4 : Maximum Monthly CO Averages



Particulate Matter (PM₁₀)

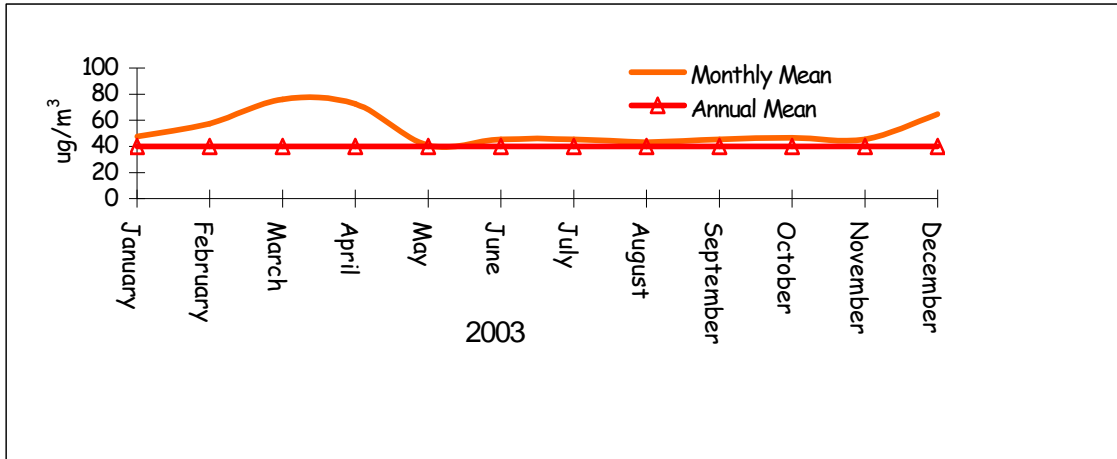
Inhalation of airborne particulate matter can increase the risk, frequency and severity of respiratory disorders. PM₁₀ in the atmosphere results from direct emissions (primary PM₁₀) or from emissions of precursors (nitrogen dioxide, sulphur dioxide and ammonia) which are transformed by chemical reaction in the atmosphere (secondary PM₁₀). The main source of this pollutant is road transport, especially diesel vehicles, although a significant proportion is transported to the Dublin region from other sources (agriculture, dust storms etc.)

The annual mean recorded at East Wall Road was 62µg/m³ which is above the annual mean limit of 40µg/m³. The maximum 24-hour limit of 50 µg/m³ was also exceeded during each month in 2003. However, as discussed earlier in this report, this monitoring location is within the construction site and therefore not in compliance with EU siting criteria for pollutant measurement.

Mean and Maximum Monthly PM₁₀ Levels

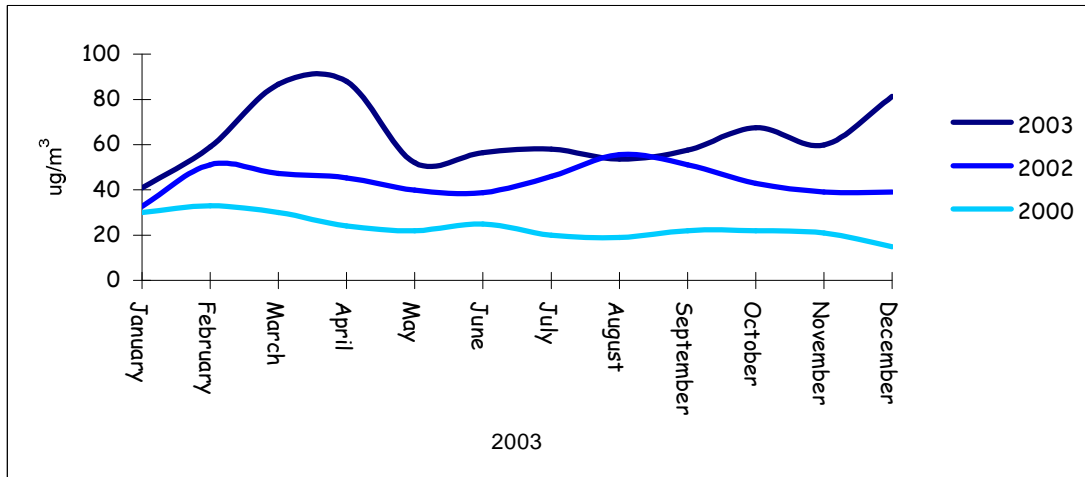
Limit Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Annual Mean 40 µg/m ³	40.8	59	86.6	87.9	52.1	56.5	58	53.6	57.6	67.6	59.8	69.5
Maximum 24-hour 50 µg/m ³	97.7	98.9	97.2	125	93.7	93.2	114	108.7	98.1	124.2	109.7	126.1

Figure 5 : Mean Monthly PM₁₀ Levels



For comparative purposes, PM₁₀ levels in 2000 and 2002 are compared with 2003 levels in Figure 6 below. Figure 6 shows an overall increase in local levels over the past three years in the East Wall Road area. It is anticipated that air quality in the East Wall Road area will improve significantly on completion of the Port Tunnel, as construction operations cease and traffic volumes reduce significantly in this area.

Figure 6 : Comparison of PM₁₀ Levels at East Wall Road



Northern Portal – Oak Park, Santry

In accordance with the requirements of the public inquiry, particulate monitoring commenced at Oak Park, Santry in November 2001. Prior to the commencement of construction of the Northern Portal, background monitoring of a number of pollutants (sulphur dioxide, nitrogen dioxide, lead, particulates, carbon monoxide) was carried out at Ellenfield Park for a two-year period and this data represents average background conditions for the locality prior to construction activities.

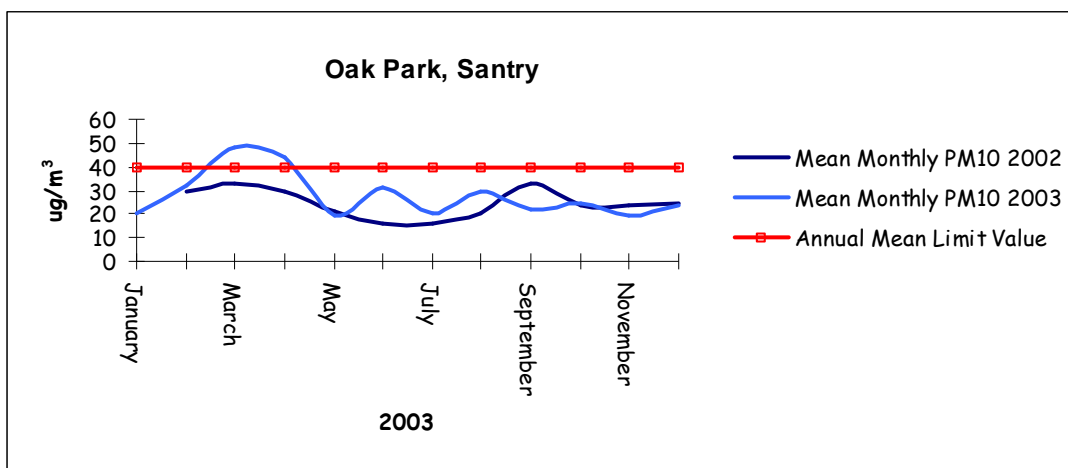
Particulates (PM₁₀) and volatile organic compounds (VOCs) were measured in 2003 in the vicinity of the Northern Portal. PM₁₀ levels recorded in 2003 are presented below and are compared with the annual mean limit of 40 µg/m³. The annual mean PM₁₀ level measured at Oak Park was 27.9µg/m³ and there were forty days during 2003 when the 24-hour limit of 50 µg/m³ was exceeded. The margin of tolerance indicates that the 24-hour limit should not be exceeded more that 35 times in a calendar year. While there is a high level of tunnel-related construction activities in this area, the transport of pollutants into the eastern region via air masses originating outside of Ireland also contributes to local particulate levels. Overall, particulate levels recorded at Oak Park are similar to average urban residential levels recorded in the Dublin area.

Mean Monthly and Maximum 24-hour PM₁₀ Levels

Limit Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Annual Mean 40 µg/m ³	20.2	32.4	48.3	43.8	19.2	31.2	20.6	29.5	22.1	24.4	19.5	23.8
Max 24-Hour 50 µg/m ³	40.5	75.5	97.7	102.6	60	82.7	69.7	57.9	49.2	47.9	42.6	86.7

Figure 7 compares PM₁₀ levels at Oak Park between 2002 and 2003 and indicates a slight increase in mean levels in the vicinity of the Northern Portal. It is anticipated that local particulate levels will reduce in 2004 as dust-generating activities will be significantly reduced in the vicinity of the monitoring location.

Figure 7: Monthly Mean Particulates (PM₁₀)



Volatile Organic Compounds (VOCs)

As previously discussed, the measurement of volatile organic compounds (VOCs) was required as a result of the public inquiry in the vicinity of the northern portal. While not legally required, monitoring of VOCs is also carried out at East Wall Road in order to determine average background levels in the vicinity of the southern portal. Thus, the results of VOCs as measured at five sites in the vicinity of the northern and southern portals of the Port Tunnel and at other local residential locations are presented in this report.

Monitoring for a number of compounds is currently being carried using diffusive samplers, which are exposed for a fixed period of time and analysed at an approved laboratory. While there is a statutory limit in relation to benzene, it is anticipated that standards will be finalised for other potentially toxic compounds shortly. Levels measured at the portals are compared with occupational standards for comparative purposes in the absence of statutory limits for toluene, xylene, and butadiene. Over the 12-month monitoring period, several diffusion tubes were reported missing or damaged due to vandalism, and loss due to construction activities in the vicinity.

The current VOC monitoring locations include:

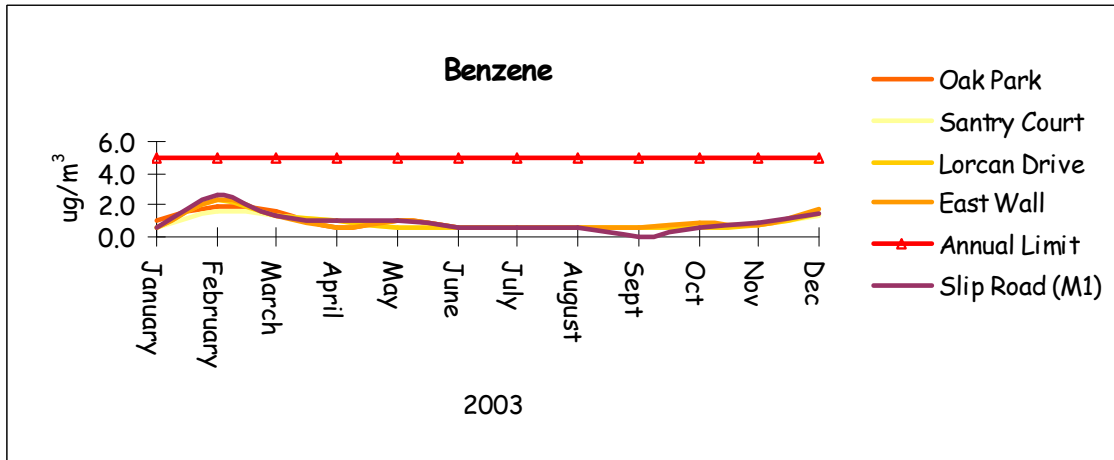
- Oak Park
- Santry Court
- Lorcan Drive
- East Wall Road
- M1 Sliproad at Santry

BENZENE

Benzene is an organic chemical which is a constituent of crude oil and is present in unleaded petrol. The main source of exposure for the general population is from vehicle exhaust emissions, where benzene is produced by chemical reactions occurring during the combustion of petrol. A further source of exposure, which contributes a significant proportion of an individual's total intake of benzene is cigarette smoking. Passive smoking may also contribute to benzene intake.

The annual average benzene levels measured at the five sites ranged from 0.6 – 2.3 $\mu\text{g}/\text{m}^3$ which are within the relevant statutory limit of 5 $\mu\text{g}/\text{m}^3$.

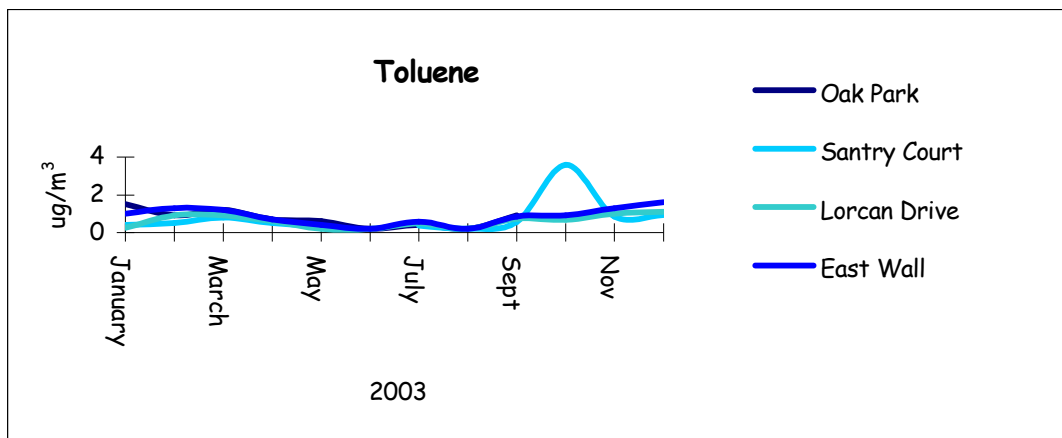
Figure 8 : Average Benzene Levels



TOLUENE

Vehicle emissions are the principal source of emissions of toluene to the atmosphere. Other forms of environmental exposure to toluene usually occurs from exposure to paints, adhesives, cigarette smoke. Health effects of exposure through inhalation to toluene include decreased resistance to respiratory infections and cardiac problems. Toluene is not however a human carcinogen. Average background levels are compared with a World Health Organization 24-hour average value of 7.5 milligrams per cubic metre. Figure 9 shows that toluene levels were not significant at the five monitored locations in 2003.

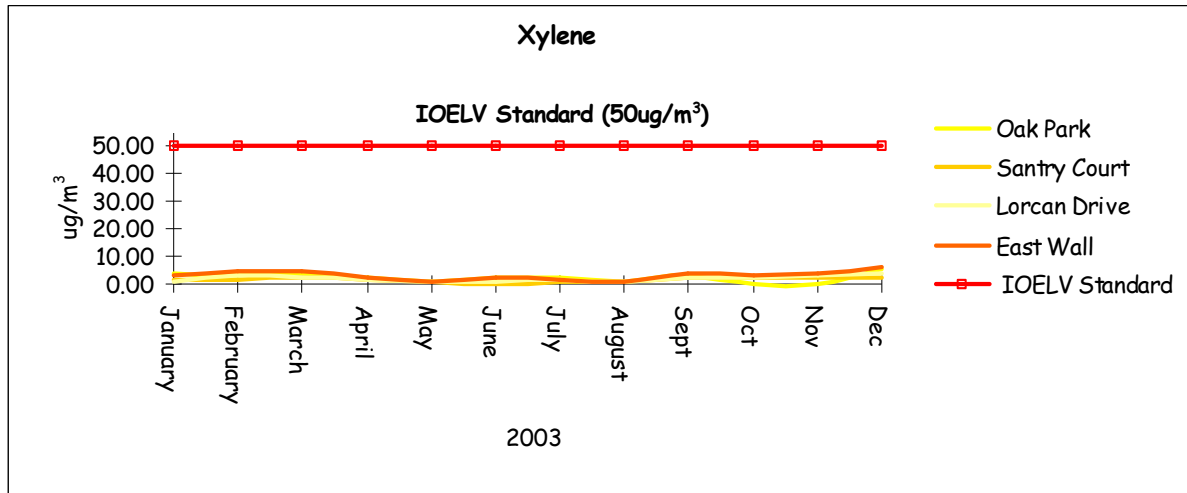
Figure 9 : Average Toluene Levels



XYLENES

Environmental exposure to xylenes occurs through inhalation from paints, solvents and petrol. Similar to toluene, xylenes have not been associated with an increased risk of cancer in humans. Xylenes are also distributed throughout the environment – they have been detected in air, rainwater, and soils. Average background levels of xylenes are compared with an EU Indicative Occupational Exposure Limit Value (IOELV) adopted under Council Directive 98/24/EC. This limit value of $50\mu\text{g}/\text{m}^3$ relates to indoor exposure and is used for comparative purposes only. Figure 10 indicates that xylene levels were not significant at the five monitored locations in 2003.

Figure 10 : Average Xylene Levels



1,3 BUTADIENE

Motor vehicle exhaust is a constant source of 1,3 butadiene. Although it breaks down quickly in the atmosphere, 1,3 butadiene is usually found in ambient air at low levels in urban and suburban areas. Butadiene levels have fallen rapidly with the introduction of catalytic converters on vehicles. Epidemiological studies have reported a possible association between this compound and cardiovascular disease. Other sources include manufacturing and processing facilities, cigarette smoke and fires. This pollutant has been classified as a probable human carcinogen.

Average 1,3 butadiene levels at the five monitored locations range from 0.1-0.5 ppb. These levels compare favourably with a standard of 1.0ppb (annual mean) as established by the U.K. Expert Panel on Air Quality Standards.