Air Quality Monitoring in Jersey 2011

Report for States of Jersey

AEA in confidence
AEAT/ENV/R/3258
ED44958001
Issue 1
Date 28/03/2012

Customer:

States of Jersey

Customer reference:

None

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AEA reference:

ID: AEAT/ENV/R/3258

Ref: ED44958001- Issue 1

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Executive summary

This report presents the results for 2011 of an ongoing programme of air quality monitoring in Jersey, carried out by AEA on behalf of the Environmental Health Department of the States of Jersey.

An automatic monitoring station for nitrogen dioxide (NO_2) has been located in the Central Market, Halkett Place, St Helier since 2008. In addition, non-automatic diffusion tube samplers were used for indicative monitoring of nitrogen dioxide (NO_2) at 12 sites, and a suite of four hydrocarbons (benzene, toluene, ethylbenzene and xylenes) at a further six sites. Monitoring sites included areas likely to be affected by specific emission sources (such as a petrol station and a paint-spraying process), as well as general background locations. The 2011 non-automatic monitoring programme continued a long-term survey that has operated in Jersey for the past 15 years.

Two hydrocarbon monitoring sites were re-located in October 2011. Beresford Street was relocated to the Central Market, Halkett Place after repeated tube thefts. The Jersey Airport site had become unsuitable and was moved to Route de L'Hermite, near the northern perimeter fence. The Clos St Andre site has been closed as it is no longer required, following the closure of the Bellozanne Valley waste incinerator.

NO_2 and hydrocarbon diffusion tubes were exposed for twelve periods approximating to calendar months. The tubes were supplied and analysed by Gradko International Ltd, and changed by Technical Officers of Jersey's Environmental Health Section.

The automatic monitoring site at Halkett Place met the EC Directive limit value (and AQS objective) for both the 1-hour mean NO_2 concentration and the annual mean NO_2 concentration.

Annual mean concentrations of NO_2 at all twelve diffusion tube monitoring sites were all within the EC Directive limit value. Annual means were generally comparable with the previous year's results, though in most cases slightly higher.

The diurnal pattern in concentrations of oxides of nitrogen at Halkett Place was similar to that observed in the past two years. It showed a clear peak in the early morning (0700 – 0800), and very little afternoon rush-hour peak. This is thought to reflect the early morning activity of market retailers arriving to set up for the day, and of daily refuse collections.

All six hydrocarbon monitoring sites met the EC Directive limit value for benzene (5 $\mu g\ m^{-3}$ as an annual mean, to be achieved by 2010). The maximum annual mean benzene concentration was 1.3 $\mu g\ m^{-3}$, measured at Faux Bie Terrace, which represents the nearest relevant public exposure to a petrol station in Springfield. Although this is the highest annual mean of all six sites, it is still well within the EC limit value.

Hydrocarbon concentrations at most sites have decreased over the duration of the survey, particularly during the early years. The exceptions are the Airport and Clos St Andre sites, but levels there were already low.

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Appendices

1 Introduction

1.1 Background

This report describes a programme of air quality monitoring undertaken by AEA, on behalf of the States of Jersey Public Health Services, on the island of Jersey in 2011. This is the fifteenth consecutive year in which an annual monitoring programme has been carried out: the first was undertaken in 1997. This ongoing monitoring programme has provided a long-term dataset of pollutant concentrations.

The pollutants measured were nitrogen dioxide (NO_2), and a range of hydrocarbon species (benzene, toluene, ethyl benzene and three xylene compounds). NO_2 was measured by an automatic monitor situated at Halkett Place, St Helier. This was supplemented by indicative monitoring of NO_2 at 12 other locations on the island, using low cost passive samplers (Palmes type diffusion tubes). The suite of hydrocarbon species was monitored using “BTEX” diffusion tubes at six sites.

This report presents the results obtained in the 2011 survey, and compares the data from Jersey with relevant air quality limit values, objectives and guidelines, data from selected UK monitoring stations and previous years' monitoring programmes.

1.2 Objectives

This survey follows on from those in the years 1997 to 2010[1-14]. The objective, as in previous surveys, was to monitor at sites where pollutant concentrations were expected to be high, and compare these with background locations. The monitoring sites consisted of a mixture of urban and rural background sites, together with some locations where higher pollutant concentrations might be expected, such as roadside and kerbside sites, and some locations close to specific emission sources (such as the airport).

2 Details of Monitoring Programme

2.1 Pollutants Monitored

2.1.1 NO_2

A mixture of nitrogen dioxide (NO_2) and nitric oxide (NO) is emitted by combustion processes. This mixture of oxides of nitrogen is termed NO_X. NO is subsequently oxidised to NO_2 in the atmosphere. NO_2 is an irritant to the respiratory system, and can affect human health. Ambient concentrations of NO_2 are likely to be highest in the most built-up areas, especially where traffic is congested, or where buildings either side of the street create a "canyon" effect, impeding the dispersion of vehicle emissions. The units used for NO_2 concentration in this report are microgrammes per cubic metre (µg m^{-3}). The earliest reports in this series have used parts per billion (ppb): to convert from µg m^{-3} to ppb for comparison with the earlier reports if required, the following relationship should be used:

1 µg m-3 = 0.523 ppb for nitrogen dioxide at 293K (20^{o}C) and 1013mb.

2.1.2 Hydrocarbons

There are many sources of hydrocarbon emissions. Methane, for example, is a naturally occurring gas, while xylene compounds are synthetic and used in many applications, for example as a solvent in paint. A range of hydrocarbons is found in vehicle fuel, and occur in vehicle emissions. In most urban areas, vehicle emissions constitute the major source of hydrocarbons, in particular benzene. Also, there is the potential that they may be released to the air from facilities where fuels are stored or handled (such as petrol stations).

A wide range of hydrocarbons is emitted from both fuel storage and handling, and from fuel combustion in vehicles. It is not easy to measure all of these hydrocarbon species (particularly the most volatile) without expensive continuous monitoring systems. However, there are four species associated with fuels and vehicle emissions which, though not the largest constituent of such emissions, are easy to monitor using passive samplers due to their moderate volatility. These are benzene, toluene, ethyl benzene and xylene. Diffusion tubes are available for monitoring this group of organic compounds, and are known as "BTEX" tubes (BTEX being an acronym for the compounds measured).

(i) Benzene

Of the organic compounds measured in this study, benzene is the one of most concern, as it is a known human carcinogen; long-term exposure can cause leukaemia. It is found in petrol and other liquid fuels, in small concentrations. In urban areas, the major source is vehicle emissions. In the UK, annual mean benzene concentrations in ambient air are typically less than 3 µg m^{-3}. In this report, concentrations of benzene are expressed in microgrammes per cubic metre (µg m^{-3}). Some earlier reports in the series used parts per billion (ppb): to convert to ppb to if necessary, the following relationship should be used:

1 µg m^{-3} = 0.307 ppb for benzene at 293K (20^{o}C) and 1013mb.

(only applicable to benzene).

(ii) Toluene

Toluene is also found in petrol, and is also used as a solvent in paints and inks; it is also a constituent of tobacco smoke. There are no EU limit values for ambient toluene concentrations, although there are occupational limits for workplace exposure[15], and a World Health Organisation (WHO) guideline, of 260 µg m^{-3} for the weekly mean.

The best estimate for the odour threshold of toluene has been reported as 0.16ppm (613 µg m^{-3})[16]. The major concern associated with human exposure to toluene is its effect on the central nervous system: it is not believed to be carcinogenic[17]. Typical ambient concentrations are usually less than 5 µg m^{-3} in rural areas, and in the range 5-150 µg m^{-3} in urban areas[17].

In this report, concentrations are expressed in microgrammes per cubic metre (µg m^{-3}). Some earlier reports in the series used parts per billion (ppb): to convert to ppb to if necessary, the following relationship should be used:

1 µg m^{-3} = 0.261 ppb for toluene at 293K (20°C) and 1013mb.

(only applicable to toluene).

(iii) Ethyl benzene

Again, there are no limits for ambient concentration of ethyl benzene, and although there are occupational limits relating to workplace exposure[15], as discussed in previous reports in this series, they are several orders of magnitude higher than typical outdoor ambient concentrations.

(iv) Xylene

Xylene exists in ortho (o), para (p) and meta (m) isomers. Occupational limits relating to workplace exposure, are 100 ppm over 8 hours, and 150 ppm over 10 minutes. Xylene, like toluene, can cause odour nuisance near processes (such as vehicle paint spraying), which emit it. Its odour threshold varies according to the isomer, but the best estimate for the odour threshold of mixed xylenes is 0.016ppm (16 ppb or 70 µg m^{-3})[16].

In this report, concentrations of ethylbenzene and xylenes are expressed in microgrammes per cubic metre (µg m^{-3}). Some earlier reports in this series used parts per billion (ppb): to convert to ppb to if required, the following relationship should be used:

1 µg m^{-3} = 0.226 ppb for ethyl benzene or xylenes at 293K (20°C) and 1013mb.

(applicable to ethylbenzene, m-, p- and o-xylene).

2.2 Air Quality Limit Values and Objectives

This report compares the results of the monitoring survey with air quality limit values and objectives applicable worldwide, in Europe and the UK. These are summarized in Appendix 1 and below.

2.2.1 World Health Organisation

In 2000, the World Health Organisation published revised air quality guidelines[17] for pollutants including NO_2. These were set using currently available scientific evidence on the effects of air pollutants on health and vegetation. The WHO guidelines are advisory only, and do not carry any mandatory status. They are summarised in Appendix 1. There are WHO guidelines for ambient NO_2 concentrations (hourly and annual means), benzene and toluene.

The WHO non-mandatory guideline[17] for NO_2 is that the annual mean should not exceed 40 µg m^{-3}. For toluene, the WHO recommends a guideline value of 0.26 mg m^{-3} (260 µg m^{-3}) for the weekly mean.

2.2.2 European Community

Throughout Europe, ambient air quality is regulated by the EC Directive on Ambient Air Quality and Cleaner Air for Europe (2008/50/EC)[18]. This Directive (referred to as the Ambient Air Quality Directive) sets limit values, which are mandatory, and other requirements for the protection of human health and ecosystems. Both NO_2 and benzene are covered by this Directive. The States of Jersey have agreed to meet the EU health limits.

The Ambient Air Quality Directive [18] contains limit values for NO_2 as follows:

- 200 µg m^{-3} as an hourly mean, not to be exceeded more than 18 times per calendar year. To have been achieved by 1st January 2010.
- 40 µg m^{-3} as an annual mean, for protection of human health. To have been achieved by 1st January 2010.
- There is also a limit for annual mean total oxides of nitrogen (NO_X), of 30 µg m^{-3}, for protection of vegetation (relevant in rural areas only).

The same Directive[18] also sets a limit of 5 µg m^{-3} for annual mean benzene, to have been achieved by 2010. Having achieved the limit values by the due dates, Member States must maintain compliance in future years.

2.2.3 UK Air Quality Strategy

The UK Air Quality Strategy (AQS) [19] contains standards and objectives for a range of pollutants including NO_2 and benzene. These are also summarised in Appendix 1. Only those objectives relating to the whole UK (as opposed to specifically England, Wales, etc.) are applicable to Jersey, and the AQS does not at present have mandatory status in the States of Jersey.

The UK Air Quality Strategy's objectives for NO_2 are very similar to the EC Directive limits above: the only difference being that they had to be achieved by 31st December 2005.

The UK Air Quality Strategy[19] sets the following objectives for benzene:

- 16.25 µg m^{-3} (for the running annual mean), to have been achieved by 31st December 2003.
- 3.25 µg m^{-3} (for the calendar year mean in Scotland and Northern Ireland), to have been achieved by 31st December 2010.
- 5 µg m^{-3} (for the calendar year mean in England and Wales), to have been achieved by 31st December 2010.

Both the 2010 benzene objectives apply to specific parts of the UK only, so strictly speaking do not apply in Jersey. However, the objective of 5 µg m^{-3} applicable to England and Wales is the same as the EC Directive limit value, which is applicable in Jersey.

2.3 Methodologies

Oxides of nitrogen were monitored using a chemiluminescent analyser, located at the Central Market, Halkett Place, St Helier. This automatic monitoring site started operation in January 2008.

The chemiluminescent NOx analyser provides a continuous output, proportional to the pollutant concentration. This output is recorded and stored every 10 seconds, and averaged to 15-minute average values by internal data loggers. The analyser is connected to a modem and interrogated by telephone to download the data to AEA. Data are downloaded daily and uploaded onto the publicly available website www.jerseymet.gov.je .

The automatic monitoring site at Halkett Place was supplemented by indicative monitoring, using diffusion tubes, for NO_2 and BTEX hydrocarbons. Diffusion tubes are "passive" samplers, i.e. they work by absorbing the pollutants direct from the surrounding air and need no power supply.

Palmes-type diffusion tubes were used for NO_2. These consist of a small plastic tube, approximately 7 cm long. During sampling, one end is open and the other closed. The closed end contains an absorbent for the gaseous species to be monitored, in this case NO_2. The tube is mounted vertically with the open end at the bottom. Ambient NO_2 diffuses up the tube during exposure, and is absorbed as nitrite. The average ambient pollutant concentration for the exposure period is calculated from the amount of pollutant absorbed.

BTEX diffusion tubes are different in appearance to NO_2 tubes. They are longer, thinner, and made of metal rather than plastic. These tubes are fitted at both ends with brass Swagelok fittings. A separate “diffusion cap” is supplied. Immediately before exposure, the Swagelok end fitting is replaced with the diffusion cap. The cap is removed after exposure, and is replaced with the Swagelok fitting. BTEX diffusion tubes are very sensitive to interference by solvents.

Diffusion tubes were prepared and analysed by Gradko International Ltd. They were supplied to local Technical Officers of Jersey's Public Health Services, who carried out the tube changing. The tubes were supplied in sealed condition prior to exposure. The tubes were exposed at the sites for a set period of time. After exposure, the tubes were again sealed and returned to Gradko for analysis. The year was divided into twelve exposure periods approximating to calendar months. The duration of the exposure periods varied between four and five weeks.

The UK Local Air Quality Management Technical Guidance LAQM.TG(09)[20] states that when using diffusion tubes for indicative NO_2 monitoring, correction should be made where applicable for any systematic bias (i.e. over-read or under-read compared to the automatic chemiluminescent technique, which is the reference method for NO_2). By co-locating diffusion tubes with the automatic monitoring site at Halkett Place, it was possible to calculate a bias adjustment factor, which could then be applied to the annual mean diffusion tube measurements in this survey. The NO_2 diffusion tube results in this report are uncorrected except where clearly specified. BTEX diffusion tubes are not affected by the same sources of bias as NO_2 diffusion tubes, therefore the BTEX results have not been bias adjusted.

Each monthly batch of diffusion tubes was accompanied by a “travel blank” NO_2 and BTEX tube. These tubes were taken with the exposure tubes to the site, but were not exposed. They were returned to the site operator’s premises, and were kept in a sealed bag in a cupboard. When the exposed tubes were collected, the “travel blank” tubes were taken by the operator to the site. The travel blanks were sent with the exposed tubes for analysis. The purpose of these tubes was to indicate if any contamination of the tubes had occurred. This was particularly relevant in the case of the BTEX tubes, which can easily be contaminated by exposure to solvents.

Gradko also retained one tube from each batch, in a sealed bag in their premises, as a “laboratory blank”.

The travel blank results for NO_2 were not used to apply any correction to the results from the exposed tubes – only to highlight possible contamination issues. BTEX results were blank corrected using the travel blank, or the laboratory blank where the analyst judged this to be appropriate.

2.4 Monitoring Sites

Automatic monitoring of oxides of nitrogen was carried out at the Central Market, Halkett Place, in St Helier (Figure 2-1). This site represents a roadside site where levels of NO_2 were expected to be high, and where members of the public are regularly exposed for periods of one hour or more.

Figure 2-1 Automatic NOx Monitoring Site, Halkett Place, St Helier

Figure 2-1 shows the location of the monitoring site. The inlet funnel (circled) is just visible as a white tube protruding from the building façade above the hanging basket just beyond the yellow shop front. It is at a height of about 4m.

Figure 2-2 shows the chemiluminescent NOx analyser itself, which is located within the building. The analyser is calibrated monthly by the States of Jersey's Environmental Health Team. Details of the calibration procedure, and an example of the calibration form used, are provided in Appendix 2.

As explained in section 2.3, diffusion tubes were also used to monitor NO_2 at twelve sites in a range of different environments around Jersey. Table 2-1 lists the NO_2 diffusion tube sites, and Figures 2-3 and 2-4 show their locations.

Diffusion tubes were also co-located with the automatic monitoring site at Halkett Place, and the results of this co-located monitoring are used to assess the precision and accuracy of the diffusion tubes, relative to the automatic chemiluminescent analyser, which is defined within Europe as the reference method for NO_2. The tubes at this site are exposed in triplicate, to allow assessment of precision. All other diffusion tube sites use single tubes.

Figure 2-2 Automatic NOx Analyser at Halkett Place, St Helier

BTEX hydrocarbons were monitored at eight sites during part or all of 2011. These sites are shown in Table 2-2. The aim was to investigate sites likely to be affected by different emission sources, and compare these with background sites.

Beresford Street and Le Bas Centre were intended to monitor hydrocarbon concentrations at an urban roadside and urban background location respectively. After repeated tube thefts, the Beresford Street site was relocated in September 2011 to the Central Market, Halkett Place, where it is now co-located with the automatic monitor.

Handsford Lane was close to a paint spraying process. This is a potential source of hydrocarbon emissions, especially toluene and xylenes.

The Faux Bie site is located near a fuel filling station, a potential source of hydrocarbon emissions including benzene. The monitoring site is at a nearby house, and is intended to represent public exposure to emissions from the filling station. The fuel supplier uses a vapour recovery system to reduce emissions when filling the storage tanks, and has done so since December 2003.

The Jersey Airport site overlooked the airfield. This site was relocated in October 2011, because a customer smoking area had been set up nearby and this could affect the results. The site was moved to La Route de L'Hermite, in St Peter village, close to the northern perimeter fence of the airfield.

The Clos St Andre site was located near the former Bellozanne Valley waste incinerator (now closed). This site was closed and has not been replaced.

Table 2-1 NO_2 Monitoring Sites in Jersey

Site Name	Grid Reference	Method	Description
Central Market, Halkett Place	653 486	Automatic analyser Diffusion tubes in triplicate	Central Market, Halkett Pl., St Helier
Le Bas Centre	658 489	Diffusion tube	Urban Background
Les Quennevais	579 496	Diffusion tube	Residential Background
Rue des Raisies	689 529	Diffusion tube	Rural Background
Weighbridge	651 483	Diffusion tube	Roadside at bus station near centre of St Helier
Georgetown	661 480	Diffusion tube	Kerbside on major road
Beaumont	597 516	Diffusion tube	Kerbside
The Parade *	648 489	Diffusion tube	Roadside site at General Hospital
Broad Street	652 486	Diffusion tube	Urban background
Union Street	653 486	Diffusion tube	Kerbside in St Helier – corner of Union St. & New St.
New Street	653 485	Diffusion tube	Kerbside in St Helier
Liberation Station	652 485	Diffusion tube	Kerbside opposite entrance to new bus station

**The Parade site was moved to its current roadside location at the end of 2000.*

Kerbside: less than 1m from kerb of a busy road.

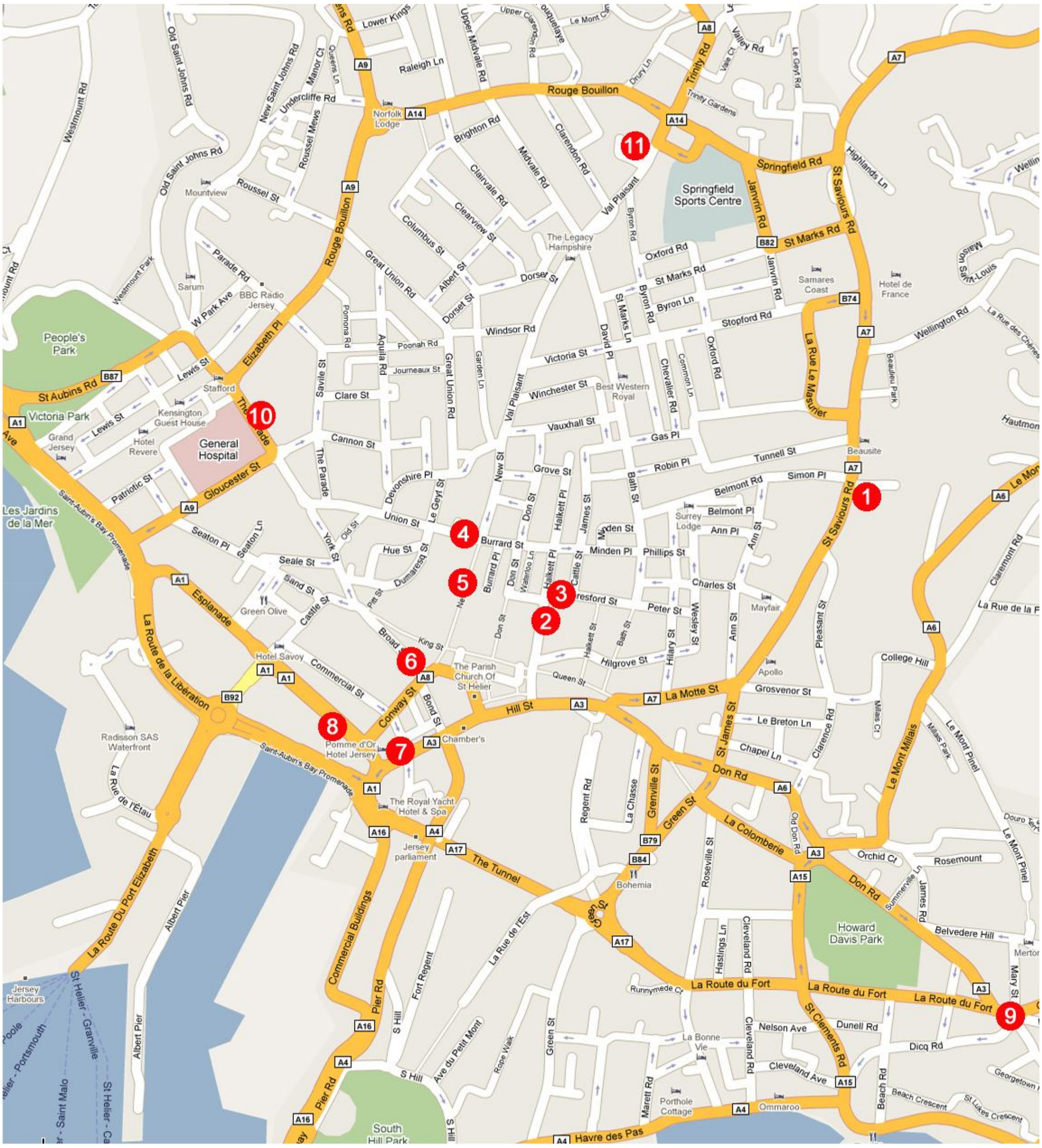
Roadside: 1-5m from kerb of a busy road.

Background: > 50m from the kerb of any major road.

Note: all grid references are from OS 1:25000 Leisure Map of Jersey and are given to the nearest 100m.

Figure 2-3 Site Locations Outside St Helier

Figure 2-4 Sites in St Helier town



Key:

1	Le Bas Centre	NO_2, BTEX	10	The Parade	NO_2
2	Central Market	NO_2 (diffusion tube and automatic), BTEX	11	Faux Bie	BTEX
3	Beresford Street	NO_2, BTEX	12	Airport	BTEX
4	Union Street	NO_2	13	Les Quennevais	NO_2
5	New Street	NO_2	14	Beaumont	NO_2
6	Broad Street	NO_2	15	Clos St Andre	BTEX
7	Weighbridge	NO_2	16	Rue Des Raisies	NO_2
8	Liberation Station	NO_2	17	Handsford Lane	BTEX
9	Georgetown	NO_2	18	La Route de L'Hermite	BTEX

Table 2-2 BTEX Diffusion Tube Monitoring sites

Site Name	Grid Reference	Description
Beresford Street	653 486	Urban Roadside
Le Bas Centre	658 489	Urban Background
Faux Bie	658 495	Urban background near fuel filling station
Clos St Andre	638 499	Residential area near site of former Bellozanne Valley refuse incinerator (now closed).
Airport	587 509	Jersey Airport, on arrivals hall building overlooking car park.
Handsford Lane	633 499	Urban background near a paint spraying process.
Halkett Place	653 486	Urban Roadside (replaced Beresford Street in September 2011).
Route de L'Hermite	592 512	Airport. Replaced the original Jersey Airport site in October 2011.

2.5 Calendar of Diffusion Tube Exposure Periods

The calendar of exposure periods used for the NO_2 and BTEX diffusion tubes is shown in Table 2-3. They were intended to approximate to calendar months, while allowing for the tubes to be changed on a consistent day of the week.

Table 2-3 Diffusion Tube Exposure Periods

Month	Start Date	End Date
January	05/01/2011	02/02/2011
February	02/02/2011	02/03/2011
March	02/03/2011	30/03/2011
April	30/03/2011	27/04/2011
May	27/04/2011	01/06/2011
June	01/06/2011	29/06/2011
July	29/06/2011	03/08/2011
August	03/08/2011	31/08/2011
September	31/08/2011	28/09/2011
October	28/09/2011	02/11/2011
November	02/11/2011	30/11/2011
December	30/11/2011	04/01/2012

3 Quality Assurance and Data Capture

3.1 Quality Assurance And Quality Control

A full intercalibration audit of the Jersey Halkett Place air quality monitoring site takes place annually. In addition to instrument and calibration standard checking, the air intake sampling system is cleaned and all other aspects of site infrastructure are checked.

Following the instrument and calibration gas checking, and the subsequent scaling and ratification of the data, the overall accuracy and precision figures for the pollutants monitored at Jersey can be summarised as in Table 3-1. These are given in ppb, the “native” unit of the automatic data.

Table 3-1 Estimated Accuracy and Precision of the Data Presented

Pollutant	Precision	Accuracy %
NO	±5 ppb	±15%
NO_2	±5 ppb	±15%

3.2 Data Capture

Overall data capture statistics for the monitoring site are given in Table 3-2. A data capture rate of 90% or greater for ratified data is recommended in the Defra Technical Guidance LAQM.TG(09)[20]. The Halkett Place site achieved the data capture target of 90%: there were no major gaps in the data set. Data capture was lower than expected because for the first eight months of 2011, two hours data per day were lost due to programmed power resets. This was corrected at audit.

Table 3-2 Jersey Halkett Place - Data Capture Statistics 2011

Site	NO	NO_2	NO_X
Jersey Halkett Place	90.4 %	90.4 %	90.4 %

3.3 Diffusion Tube Uncertainty and Detection Limits

Diffusion tubes are an indicative technique, with greater uncertainty than more sophisticated automatic methods. The reported margins of uncertainty on the analysis only were typically ± 7.3% for NO_2 and ± 10.3% for BTEX hydrocarbons. However, uncertainties arising from the exposure phase also contribute to the overall uncertainty: it is usually estimated that the overall uncertainty on diffusion tube measurements is approximately ± 25% for NO_2 and ± 25% for BTEX hydrocarbons.

The limits of detection in ambient air depend partly on the exposure time, and therefore vary to some extent from month to month. Typically the detection limit for NO_2 in 2011 was equivalent to an ambient concentration of 0.23 $\mu g\ m^{-3}$ or 0.29 $\mu g\ m^{-3}$ for five or four week exposure periods, and for hydrocarbons was equivalent to 0.02 - 0.04 $\mu g\ m^{-3}$ depending on species and exposure period. Diffusion tube results less than 10 x the limit of detection will have a higher level of uncertainty. In the case of the NO_2 sites, ambient concentrations are well above this threshold at all but the most rural locations. However, ambient concentrations of BTEX hydrocarbons are closer to the lower limit of detection: the non-urban sites have in the past regularly measured concentrations of 0.5 $\mu g\ m^{-3}$ and less.

4 Results and Discussion

4.1 Presentation of Results

4.1.1 Automatic NO_2 Monitoring Results

Table 4-1 shows the key statistics for oxides of nitrogen measured by the automatic analyser at Halkett Place. Figure 4-1 shows time series plots of hourly mean NO, NO_2 and NOx concentrations. The purpose of these plots is to illustrate how concentrations of these pollutant species varied on a short-term timescale, and throughout the year. It also illustrates that there were no major gaps in the dataset.

Table 4-1 Oxides of Nitrogen: Air Quality Statistics for 2011

POLLUTANT	NO µg m^{-3}	NO_2 µg m^{-3}	NO_X µg m^{-3}
Maximum 15-minute mean	834	567	1362
Maximum hourly mean	318	185	569
Maximum running 8-hour mean	115	93	245
Maximum running 24-hour mean	68	69	154
Maximum daily mean	68	68	154
Average	18	28	55
Data capture	90.4 %	90.4 %	90.4 %

4.1.2 NO_2 Diffusion Tube Results

NO_2 diffusion tube results are presented in Figure 4-1 Time series plots of hourly mean pollutant concentrations at Halkett Place, 2011

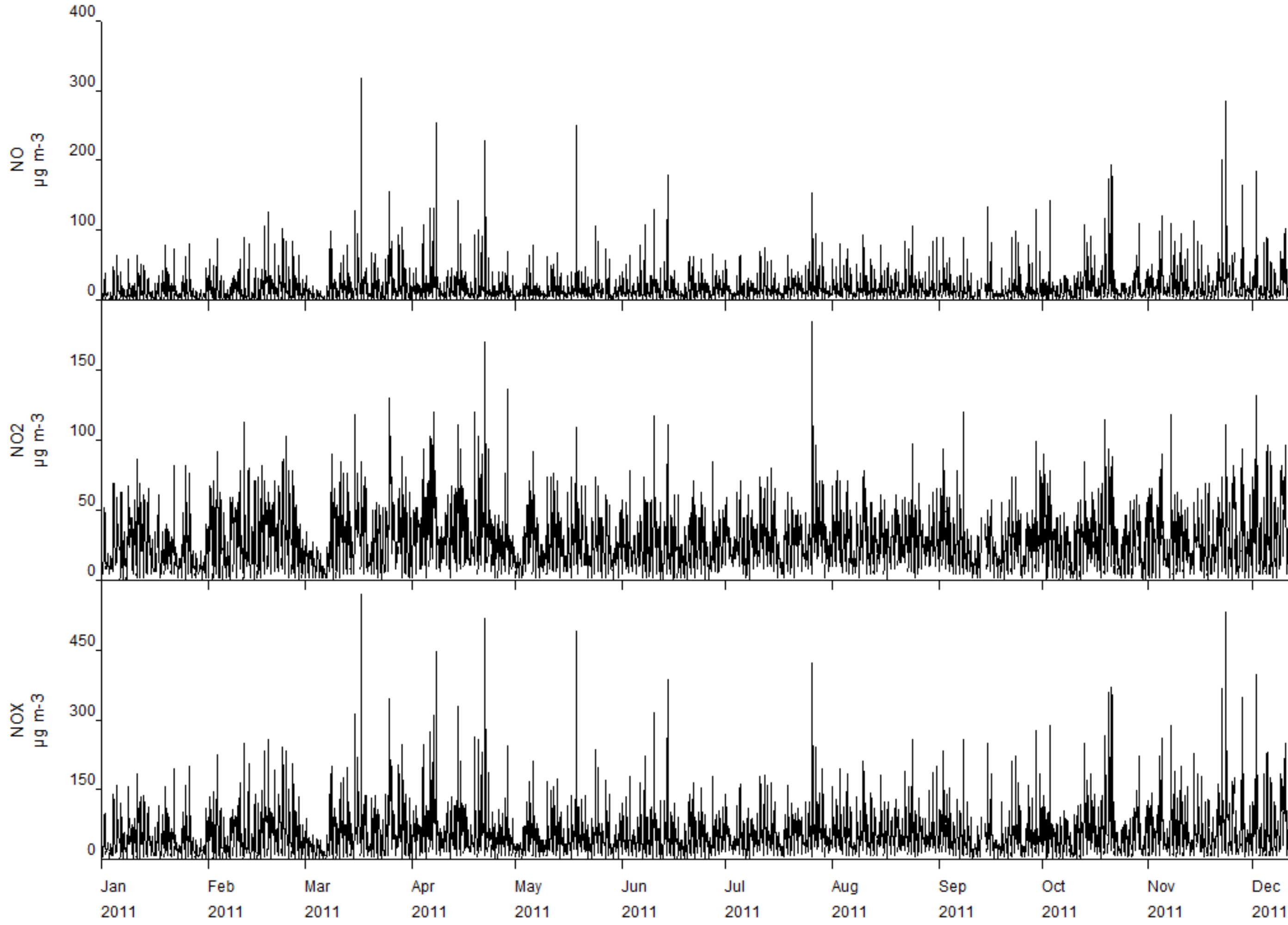


Table 4-2 and Figure 4-2. Site type is indicated as follows in Figure 4-1 Time series plots of hourly mean pollutant concentrations at Halkett Place, 2011

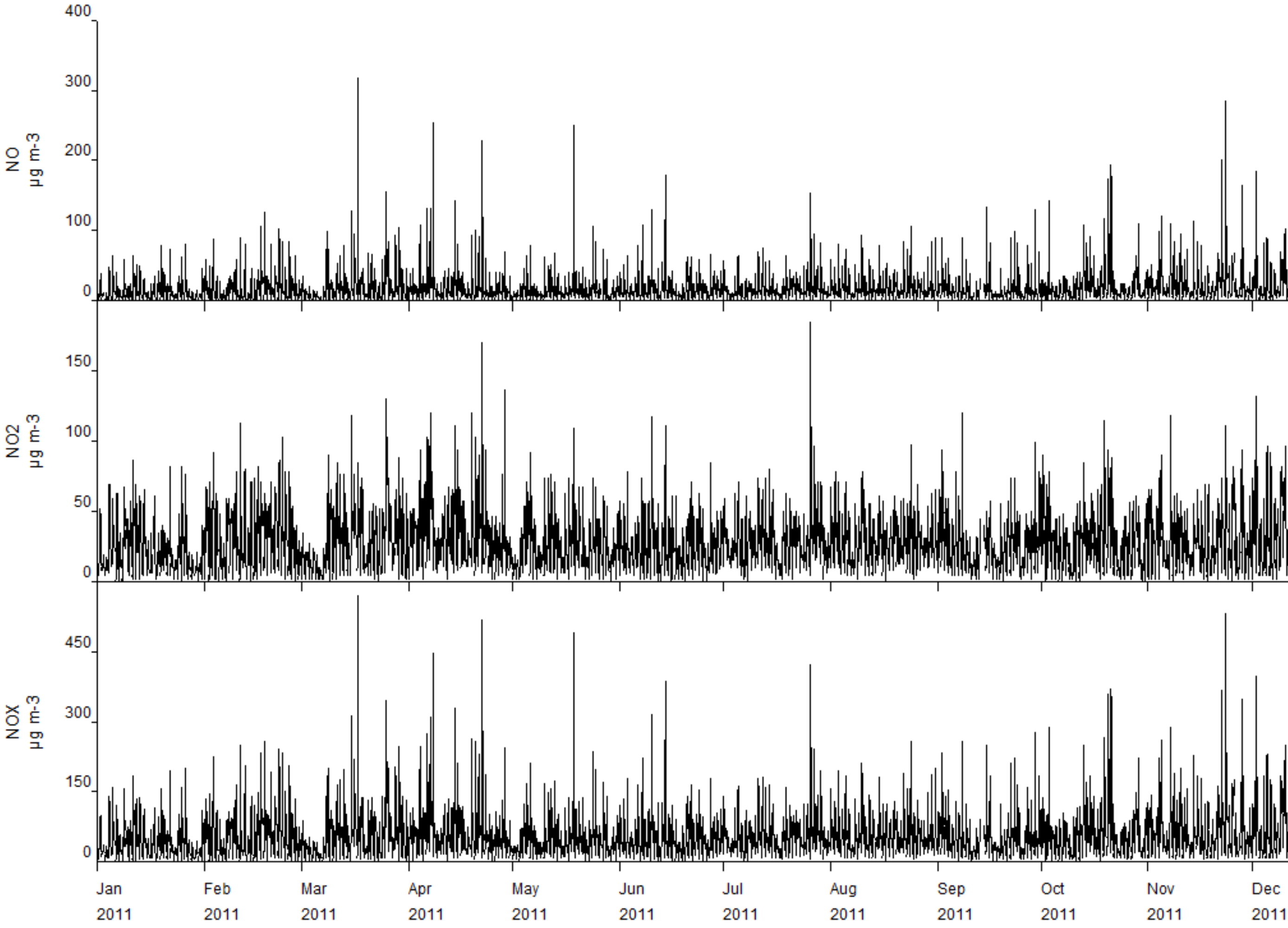


Table 4-2: K = kerbside, R = roadside, UB = urban background, S = suburban, R= rural. Although reported by the analyst to two decimal places, the monthly mean results reported here have been rounded to the nearest integer, in view of the estimated uncertainty of ±25% on diffusion tube measurements. (There are two exceptions - Les Quennevais and Rue des Raisies – where concentrations are typically less than 10 µg m^{-3}: these sites' results are given to one decimal place).

Individual monthly mean NO_2 results ranged from 3.6 µg m^{-3} (in August at the rural Rue des Raisies site), to 58 µg m^{-3} (in April at the kerbside Beaumont site).

One tube went missing from a site: the March tube at New Street.

Results from the Halkett Place site (where diffusion tubes are co-located with an automatic analyser) were used to calculate a bias adjustment factor of 0.92 - see Appendix 3. Annual mean NO_2 concentrations (after application of this bias adjustment factor) ranged from 6.4 µg m^{-3} (at the rural Rue des Raisies site) to 36 µg m^{-3} at the kerbside Weighbridge site in the centre of St Helier. The latter site has historically produced relatively high results.

Figure 4-1 Time series plots of hourly mean pollutant concentrations at Halkett Place, 2011

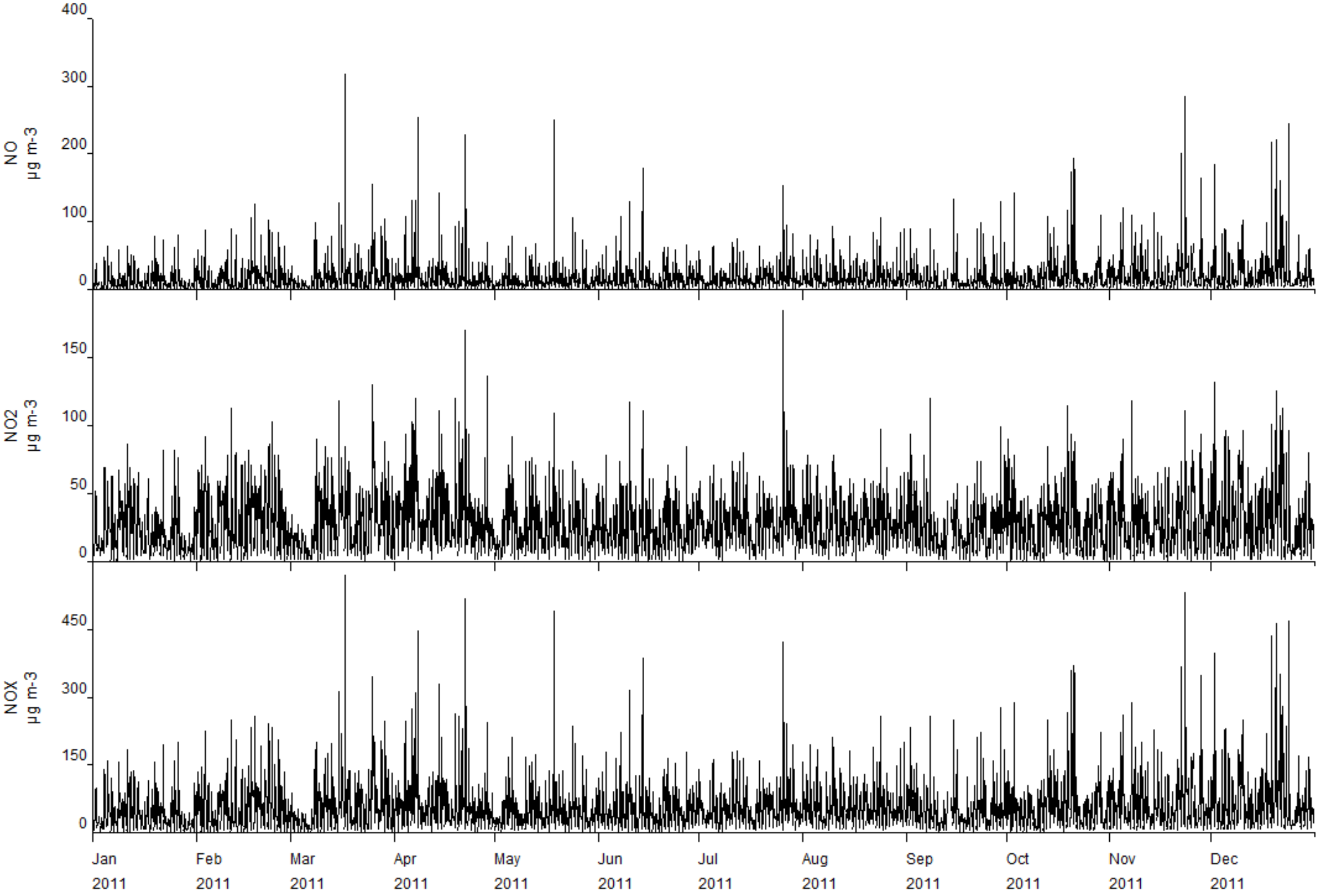
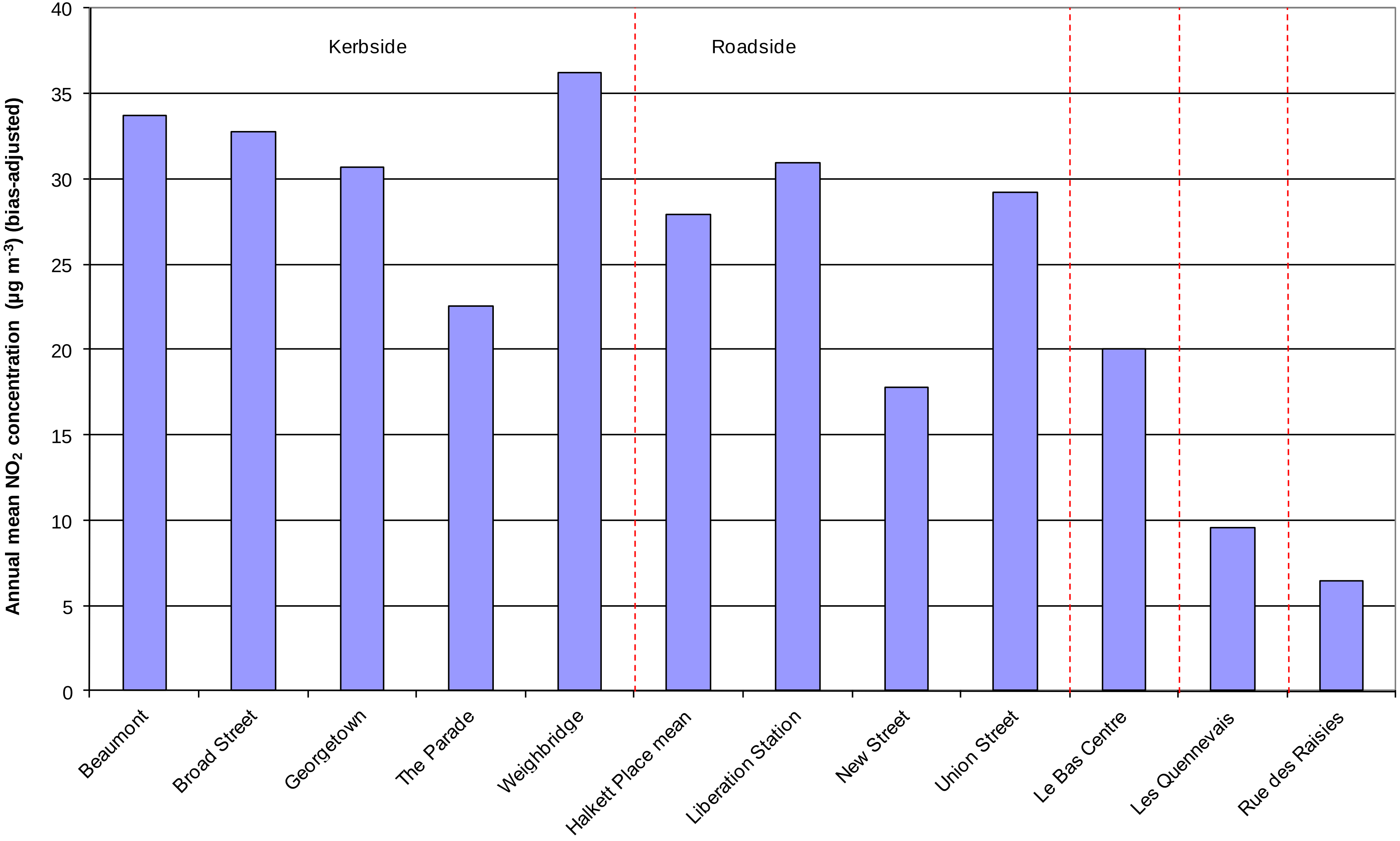


Table 4-2 NO_2 Diffusion Tube Results 2011, Jersey. Concentrations (rounded) in µg m^{-3}

Site	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	**Annual Mean µg m^{-3}**	**Annual mean x BAF µg m^{-3}**
Beaumont (K)	39	30	42	58	37	39	35	34	31	31	34	30	37	34
Broad Street (K)	33	38	31	40	34	40	34	33	38	36	35	35	36	33
Georgetown (K)	36	25	34	49	33	32	33	29	35	30	40	25	33	31
The Parade (K)	28	28	29	13	18	26	22	25	26	26	29	24	24	23
Weighbridge(K)	32	32	39	47	41	44	36	40	38	38	38	47	39	36
Halkett Place tube 1	28	26	34	39	29	33	27	27	26	28	30	32	-	-
Halkett Place tube 2	31	30	33	38	27	32	27	29	30	28	30	30	-	-
Halkett Place tube 3	31	26	33	41	30	31	29	29	29	29	31	31	-	-
Halkett Place mean (R)	30	27	33	39	29	32	27	28	28	29	30	31	30	28
Liberation Station (R)	33	28	36	44	32	36	32	30	33	30	34	34	34	31
New Street (R)	26	23	No data	24	14	19	14	15	17	17	22	20	19	18
Union Street (R)	29	31	36	41	26	33	25	29	34	31	35	32	32	29
Le Bas Centre(UB)	23	22	20	25	19	21	18	20	22	26	25	20	22	20
Les Quennevais (S)	12.5	8.6	19.1	28.6	6.6	6.9	6.7	7.0	5.4	6.7	11.8	4.4	10.4	10
Rue des Raisies (Ru)	8.3	7.4	13.9	9.0	4.4	5.1	4.8	3.6	7.2	6.3	8.9	5.0	7.0	6.4

March tube stolen from New Street.

Figure 4-2 Comparison of Annual Mean Nitrogen Dioxide Concentrations at All Jersey Sites, 2011 (Bias Adjusted)



4.1.3 Precision and Accuracy of NO_2 Diffusion Tubes

Diffusion tubes are an indicative monitoring technique: although they are economical and easy to use, they do not give the same level of precision and accuracy as more expensive automatic monitoring methods. For this reason, as explained in section 2.3 above, the Local Air Quality Management Technical Guidance LAQM.TG(09)[20] states that when using diffusion tubes for indicative NO_2 monitoring, correction should be made where applicable for any systematic bias (i.e. over-read or under-read) compared to the automatic chemiluminescent technique, which is the reference method for NO_2.

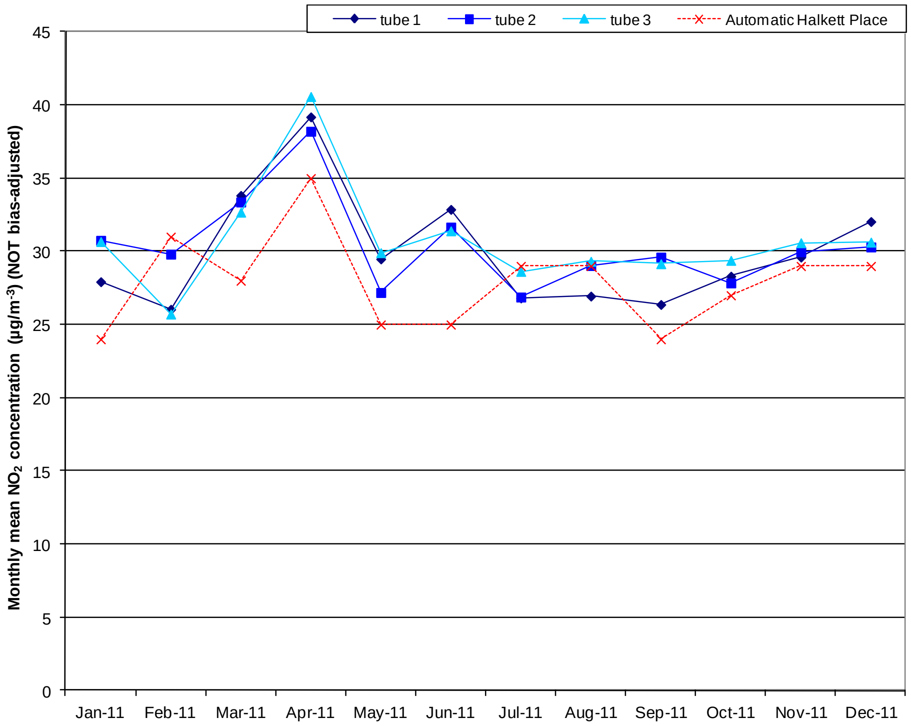
This is usually done by co-locating diffusion tubes with a chemiluminescent analyser and comparing the results of the two methods. The co-location site in this study was Halkett Place. By exposing diffusion tubes in triplicate at this site, it was possible to compare their precision and accuracy with that of the automatic monitor, and to calculate a “bias adjustment factor” which could be applied to the annual mean NO_2 concentrations measured at the other diffusion tube sites, in order to correct for any “bias”.

The mean NO_2 concentration as measured by the diffusion tubes was 30 µg m^{-3}, compared to 28 µg m^{-3} as measured by the reference automatic method. The automatic monitor achieved at least 75% data capture in each month. The “bias adjustment factor” calculated for the whole year was 0.92.

Exposing tubes in triplicate allowed an investigation of diffusion tube precision. Precision may be expressed in terms of the coefficient of variation (CV) of the three replicate measurements. This parameter, also known as the relative standard deviation, is the standard deviation expressed as a percentage of the mean. For diffusion tubes exposed in triplicate, the CV is usually expected to be within 10% on average. This is based purely on experience of what a competent laboratory is typically able to achieve, although it can be affected by conditions at the site. At Central Market, the CV of the monthly tube triplets ranged from 2% to 8%, with a mean of 5%.

Figure 4-3 shows the monthly mean NO_2 concentrations, as measured by diffusion tubes and by the automatic analyser, at Halkett Place. Agreement between the two methods was good.

Figure 4-3 Co-location Results at Halkett Place



4.2 Comparison with NO_2 Guidelines, Limit Values, and Objectives

Limit values, AQS objectives and WHO guidelines for NO_2 are shown in Appendix 1. These are based on the hourly and annual means.

The WHO non-mandatory guideline[17] for NO_2 is that the annual mean should not exceed 40 µg m^{-3} NO_2. The Ambient Air Quality Directive[18] contains limit values for NO_2 as follows:

- 200 µg m^{-3} as an hourly mean, not to be exceeded more than 18 times per calendar year. To have been achieved by 1st January 2010.
- 40 µg m^{-3}as an annual mean, for protection of human health. To have been achieved by 1st January 2010.
- There is also a limit for annual mean total oxides of nitrogen (NO_X), of 30 µg m^{-3}, for protection of vegetation (relevant in rural areas).

The UK Air Quality Strategy[19] contains objectives for NO_2, which are very similar to the EC Directive limits above: the only difference being that they had to be achieved by 31st December 2005.

The 1-hour mean at the Halkett Place automatic monitoring site remained below 200 µg m^{-3} throughout 2011. Therefore this site met the EC Directive limit value and AQS objective for this parameter. The annual mean concentration of 28 µg m^{-3} as measured by the automatic analyser at Halkett Place was well within the EC limit value of 40 µg m^{-3}.

Because of the long sampling period of diffusion tubes, it is only possible to compare the results from the diffusion tube sites in this study against limit values relating to the annual mean. Annual mean NO_2 concentrations did not exceed 40 µg m^{-3} at any sites in 2011. Therefore, all diffusion tube sites met the limit value for annual mean NO_2 concentration.

The highest annual mean concentration of 36 µg m^{-3} (after bias adjustment) was measured at Weighbridge, an urban kerbside site in the centre of St Helier that has recorded some of Jersey's highest annual mean NO_2 concentrations throughout previous years of this survey.

The 30 µg m^{-3} limit for protection of vegetation is only applicable at rural sites, and is therefore only relevant to Rue des Raisies. The annual mean NO_2 concentration of 5.8µg m^{-3} at this rural site was well within the limit value.

4.3 Diurnal and Seasonal Variation in NO_2 Concentration

4.3.1 Diurnal variation in NO_2 concentration at Halkett Place

Figure 4-4 shows how concentrations of nitrous oxide (NO), nitrogen dioxide (NO_2) and total oxides of nitrogen (NOx) typically varied over the course of the day during 2011, as measured by the automatic monitor at Halkett Place.

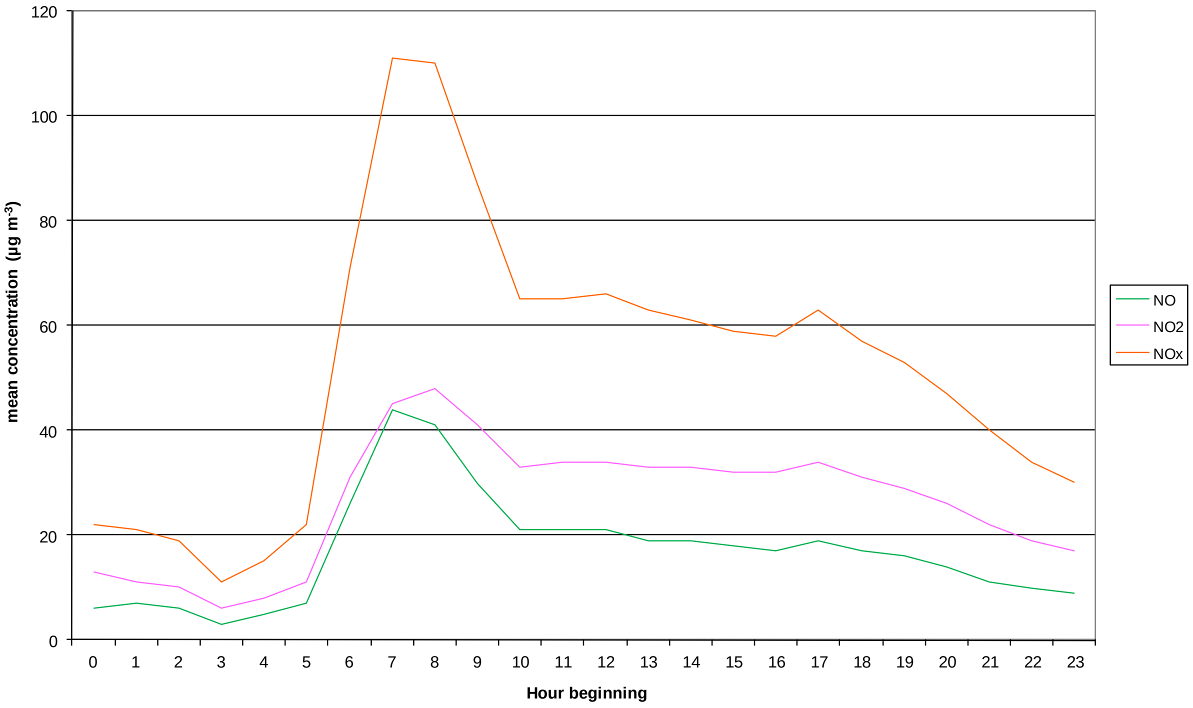
The curve for NO (which is a primary pollutant, i.e. directly emitted from source, and arises from road vehicles and other combustion sources) shows a sharp morning peak at 0700 - 0800. Concentrations then decrease during the late morning, remaining on a “plateau” for the rest of the afternoon, before concentrations begin to fall again at around 1700. There is barely any afternoon or evening rush-hour peak.

For NO_2, which has both primary (directly emitted) and secondary (due to oxidation of NO) components, there is also an early morning peak, decreasing to a plateau through the rest of the morning and afternoon. There is a small peak at the time of the afternoon rush hour, but it is much less pronounced than that observed in the morning.

Based on AEA's experience with data from the Automatic Urban and Rural Network, the morning peak in NO and NO_2 is typical for urban sites, reflecting the increased levels of these pollutants associated with morning rush-hour traffic. However, at Halkett Place it is particularly early and particularly sharp. This may be explained by the fact that there is a market at Halkett Place every day except Sundays: the peak coincides with the time at which the market traders arrive and set up for the day. In addition, a skip lorry arrives at this time to collect the previous day's refuse. It is believed that vehicle emissions from these activities are responsible for the distinctive morning pattern at Halkett Place.

Halkett Place does not exhibit a substantial afternoon or evening rush-hour peak (as observed at many roadside AURN sites). This is unusual for an urban site: in the afternoon, concentrations of oxidising agents, particularly ozone, in the atmosphere tend to increase, leading to enhanced oxidation of NO to NO_2. This typically causes the afternoon NO_2 peak at many urban sites to be higher than the morning NO_2 peak. However, this is not the case at Halkett Place. The likely reason is that there is no afternoon traffic "rush hour" in this area. Most traffic is associated with the market and with shoppers, and occurs during the morning - afternoons are relatively quiet.

Figure 4-4 Diurnal variation in concentrations of NO, NO_2 and total NOx at Halkett Place, 2011

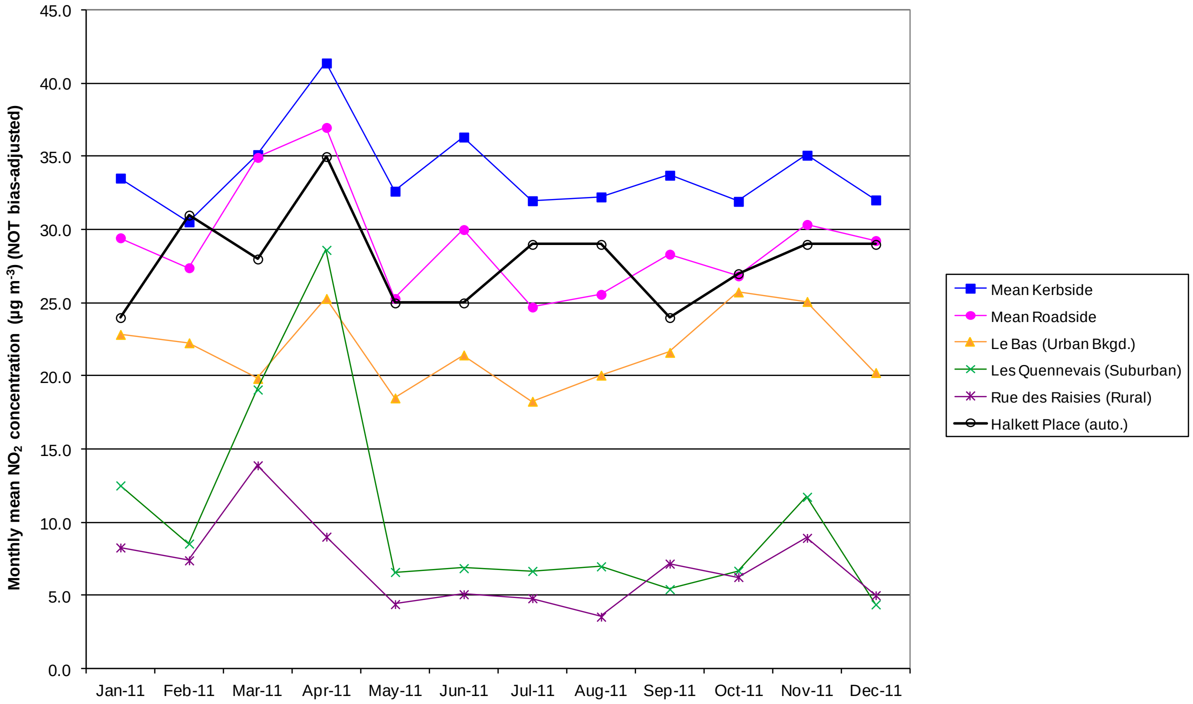


4.3.2 Seasonal variation in NO_2 concentration

Figure 4-5 shows the monthly mean NO_2 concentrations measured at the diffusion tube sites and at Halkett Place. This shows the mean of the five kerbside sites, mean of the four roadside sites, and the monthly means measured at the single urban background site (Le Bas Centre), urban residential site (Les Quennevais) and rural site (Rue des Raisies). Monthly means (based on the same periods as the diffusion tube exposures) are also shown for the Halkett Place automatic site.

The typical pattern in UK urban areas is for NO_2 concentrations to be generally higher in the winter and lower in the summer. However, the sites in Jersey have not shown any consistent seasonal pattern in recent years: 2011 was no exception. Both the diffusion tubes and the automatic analyser recorded the highest monthly mean of the year in April 2011.

Figure 4-5 Monthly mean NO_2 concentrations (NOT bias adjusted) at Diffusion Tube sites and Halkett Place



4.3.3 Comparison with UK NO_2 data

Table 4-3 compares the annual NO_2 concentration measured at Halkett Place with those measured at a selection of UK air quality monitoring stations using automatic (chemiluminescent) NO_2 analysers. The automatic data have been fully ratified. The sites used for comparison are as follows:

- Exeter Roadside – a roadside site in the centre of Exeter, Devon.
- Plymouth Centre – an urban centre site in the coastal city of Plymouth, Devon.
- Brighton Preston Park – an urban background site in Brighton, Sussex.
- Southend on Sea – an urban background site in the coastal town of Southend, Essex.
- Lullington Heath – a rural site in East Sussex.
- Yarner Wood – a rural moorland site in Devon.

Table 4-3 Comparison of NO_2 in Jersey with UK Automatic Sites

Site	**2011 Annual mean NO_2 concentration, µg m^{-3}**
Exeter Roadside	32
Plymouth Cente	30
Brighton Preston Park	16
Southend on Sea	22
Lullington Heath	7.4
Yarner Wood	4.0
Halkett Place (auto.)	28

After bias adjustment, the annual mean NO_2 concentrations measured at the kerbside and roadside sites in Jersey (rounded to the nearest integer) ranged from 18 to 36 µg m^{-3}. The annual means at Exeter Roadside and Plymouth Roadside (32 µg m^{-3} and 30 µg m^{-3} respectively) were within this range, and both were higher than the annual mean of 28 µg m^{-3} measured by the automatic analyser at Halkett Place. The Jersey urban background site at Le Bas Centre had a (bias adjusted) annual mean NO_2 concentration of 20 µg m^{-3}, comparable with the annual means from the urban background sites in Southend and Brighton Preston Park. The residential background site at Les Quennevais had a bias-adjusted annual mean NO_2 concentration of 10 µg m^{-3}: this is a little higher than the rural Lullington Heath site. The bias-adjusted annual mean of 6.4 µg m^{-3} at the Jersey rural background site, Rue des Raisies was comparable with that measured at Lullington Heath, and slightly higher than the more remote Yarner Wood site in Devon.

4.3.4 Trends in Nitrogen Dioxide at Long-Running Sites

There are ten sites in the survey which have been in operation since 2005 or earlier, and therefore have five or more years' data. The annual mean NO_2 concentrations are shown in Table 4-4 and illustrated in Figure 4-6. These data are not adjusted for diffusion tube bias; prior to 2002 there was no reliable information on which to carry out bias adjustment, so for consistency, unadjusted data are used in this section.

Annual mean NO_2 concentrations at the kerbside, roadside and urban background sites (Weighbridge, Georgetown, Beaumont, the Parade, Broad Street, and Le Bas) gave cause for concern in the early years of the study (2000 to 2003). Several exceeded the EC Directive limit value of 40 µg m^{-3}, and there was no sign of concentrations decreasing. However, from 2004 onwards, concentrations began to decrease, and all are now comfortably within the limit value, after application of the bias adjustment factor.

Table 4-4 Annual mean NO_2 concentrations at Diffusion Tube Sites, µg m^{-3} (not bias adjusted)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Beaumont	45	45	42	47	39	42	39	40	37	34	36	37
Broad Street	40	39	44	42	44	38	39	35	34	35	32	36
Georgetown	44	44	41	47	38	37	42	37	33	31	34	33
The Parade	37	37	37	39	34	31	29	28	26	24	26	24
Weighbridge	49	49	48	50	44	44	48	41	34	33	36	39
New Street						26	26	25	24	18	19	19
Union Street						33	39	32	28	30	30	32
Le Bas Centre	31	31	31	31	27	25	26	23	22	21	21	22
Les Quennevais		11	11	14	12	12	10	10.3	10.1	8.0	8.7	10.4
Rue Des Raisies	7	7	8	10	6	7	6	6.8	6.5	6.4	6.2	7.0

Figure 4-6 Annual Mean NO_2 Concentrations (not adjusted for diffusion tube bias).

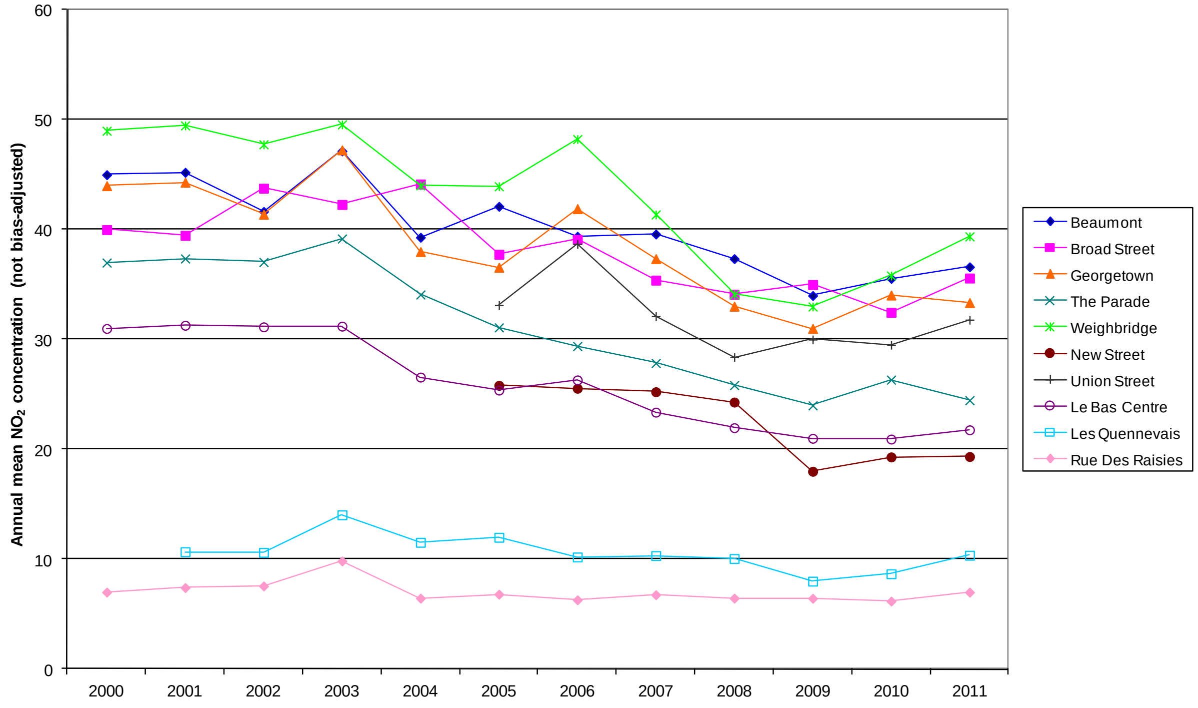


Figure 4-6 illustrates how annual mean concentrations remained stable from 2000 to 2003, then typically decreased between 2003 and 2009. However, this downward trend appears to have flattened off after 2009.

Annual mean concentrations in 2011 were similar to those measured in 2010, though in most (but not all) cases slightly higher. This reflects trends seen in the UK.

A report in 2007 by the Air Quality Expert Group (AQEG)[21] highlighted the fact that NO_2 concentrations in the UK were no longer decreasing. They attributed this to:

(i) an increased proportion of diesel cars on the road

(ii) use of pollution control devices (such as catalytically regenerative traps) on buses - these reduce the overall NO_X emissions but increase the proportion emitted as NO_2.

(iii) Increasing background concentration of O_3, which promotes the oxidation of emitted NO to NO_2.

The AQEG report can be found at: http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/quality/air/airquality/publications/primaryno2-trends/documents/primary-no-trends.pdf

4.4 Hydrocarbons

Hydrocarbons were monitored at a total of eight sites during part or all of 2011: Beresford Street was relocated to Halkett Place in September after repeated tube thefts and the Airport site was relocated to Route de L'Hermite in October. The Clos St Andre site was closed and not relocated, reducing the number of BTEX sites to five.

Full monthly results of the hydrocarbon survey for all eight sites are shown in Appendix 4, Tables A4.1 to A4.8. A summary of annual average hydrocarbon concentrations is shown in Table 4-5. This table also shows the limits of detection (LoD). These depend on the exposure period, so values for both 4-week and 5-week exposures are shown. There were numerous instances throughout the year when the reported results were less than the limit of detection.

Where this was the case, the value was treated as equal to the limit of detection for the purposes of calculating the annual mean.

Travel blank values are included in Appendix 4 (Table A4.9). These would usually be expected to give consistently lower results than the exposed tubes. However, this was not always the case in 2011. Travel blank results were frequently comparable to exposed tube results, or in several months (notably April), higher. This was the case in 2010 also.

Table 4-5 Summary of Average Hydrocarbon Concentrations (µg m^{-3}), Jersey, 2011

Site	Benzene	Toluene	Ethylbenzene	m+p Xylene	o Xylene
Beresford Street (5 months Feb-Jun only)	1.0	4.4	1.0	3.2	1.1
Le Bas Centre	1.0	5.1	1.1	2.6	0.9
Handsford Lane (paint spraying)	0.5	1.9	1.8	6.5	2.0
Faux Bie (Houses near petrol station)	1.3	6.2	1.0	3.6	1.3
Clos St Andre (9 months Jan-Sep only)	0.4	1.6	0.4	1.0	0.3
Airport (9 months Jan-Sep only)	0.3	0.8	0.2	0.5	0.1
La Route de L'Hermite (3 months Oct-Dec only)	0.2	0.3	0.1	0.1	0.1
Halkett Place (4 months Sep – Dec only)	0.7	3.0	0.7	2.2	0.8
Limit of detection concentration equivalent (assuming 4 week exposure)	0.04	0.02	0.02	0.02	0.02
Limit of detection concentration equivalent (assuming 5 week exposure)	0.03	0.02	0.02	0.02	0.02

An unusually high toluene concentration was measured at Le Bas Centre in May. This has not been rejected as there is no evidence that it is not genuine. (A similar toluene peak was observed last year at the Airport site).

The site at Faux Bie (which is at the nearest housing to a petrol station) measured highest annual mean concentrations of both benzene and toluene, as was the case in 2010. It is likely that the evaporation of these compounds from fuel, as it is stored or dispensed, is the cause.

As in previous years, the Handsford Lane site (near a paint spraying process) measured highest levels of xylenes. However, benzene and toluene concentrations at Handsford Lane were lower than those at Beresford Street or Le Bas; the paint spraying process is not a significant source of benzene or toluene.

Graphical representations of monthly mean hydrocarbon concentrations are shown in Figures 4-7 to 4-14. All eight figures use an identical y-axis, for ease of comparison.

Figure 4-7 Monthly mean hydrocarbon concentrations at Beresford Street, 2011

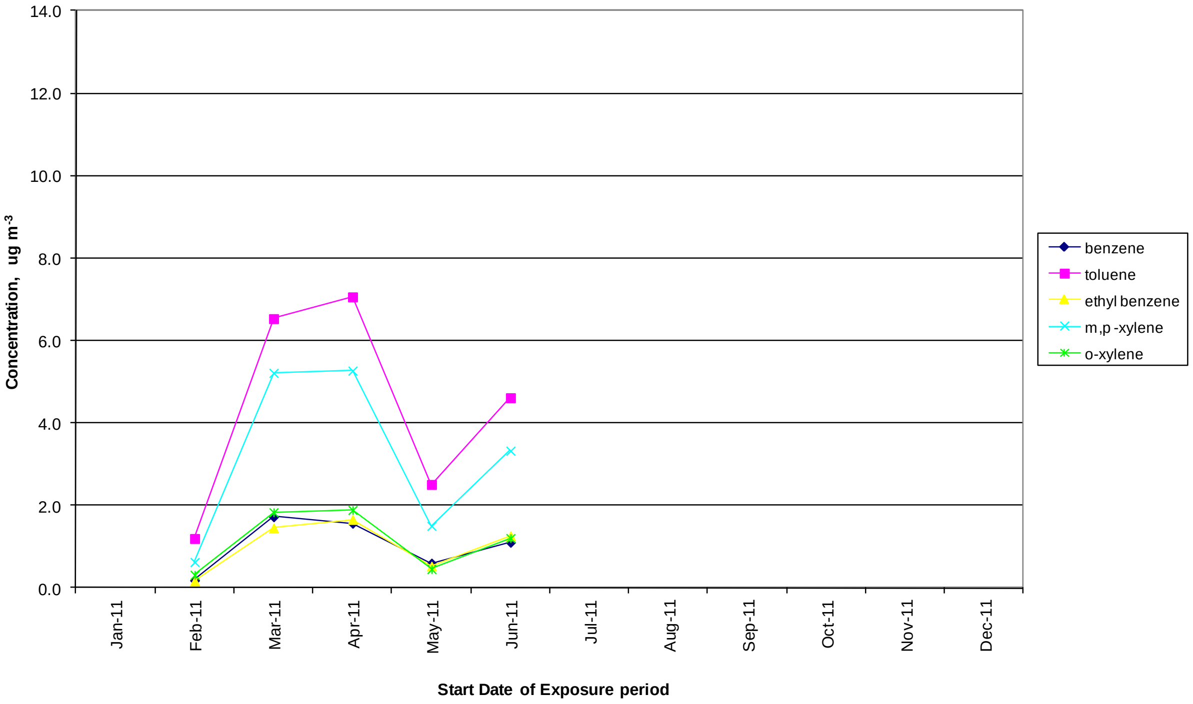


Figure 4-8 Monthly mean hydrocarbon concentrations at Halkett Place, 2011

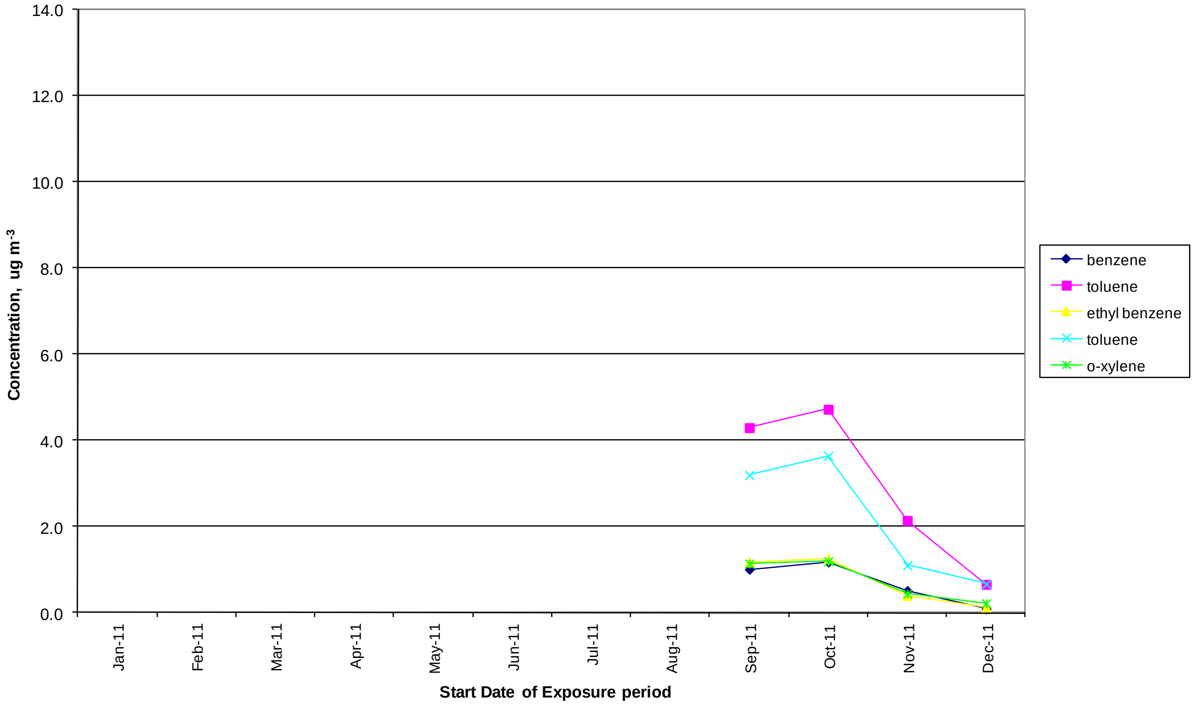


Figure 4-9 Monthly mean hydrocarbon concentrations at Le Bas Centre, 2011

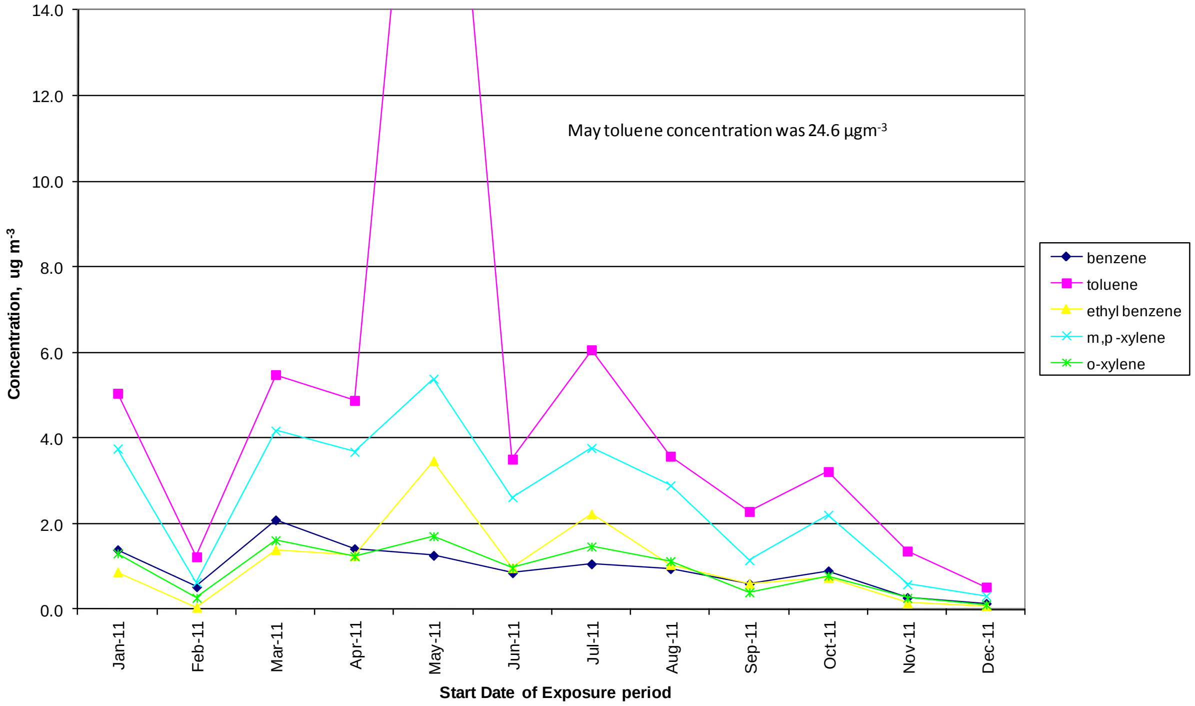


Figure 4-10 Monthly mean hydrocarbon concentrations at Handsford Lane, 2011

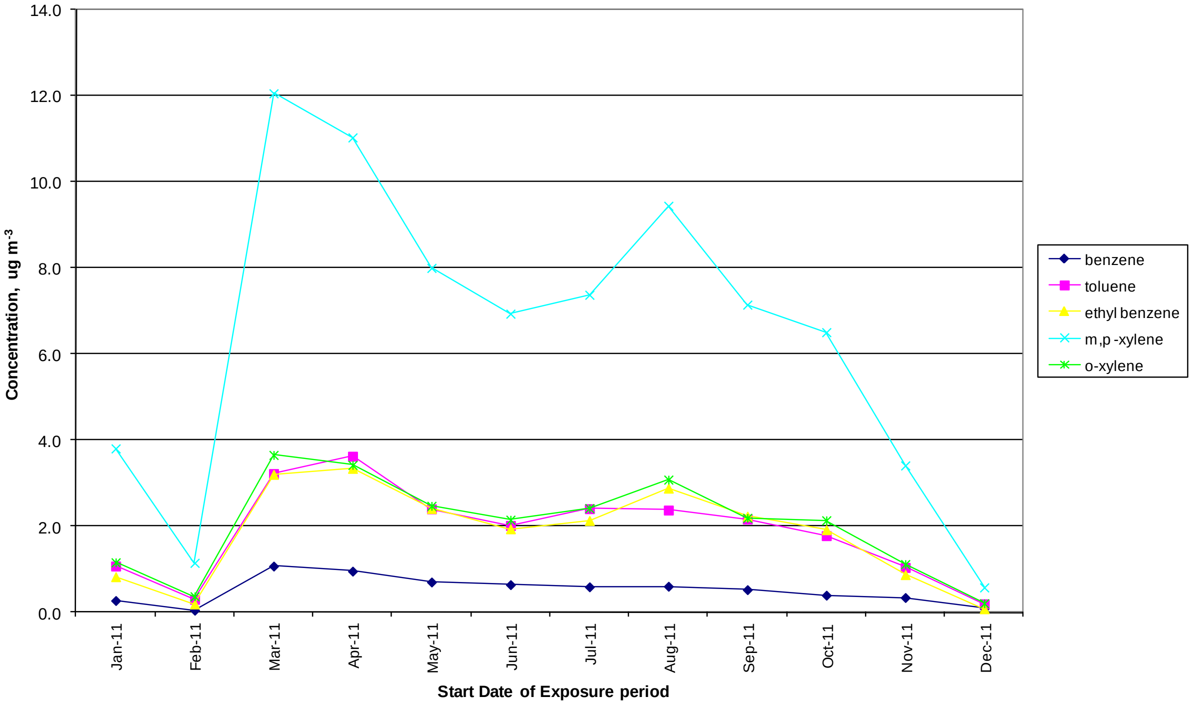


Figure 4-11 Monthly mean hydrocarbon concentrations at Faux Bie, 2011

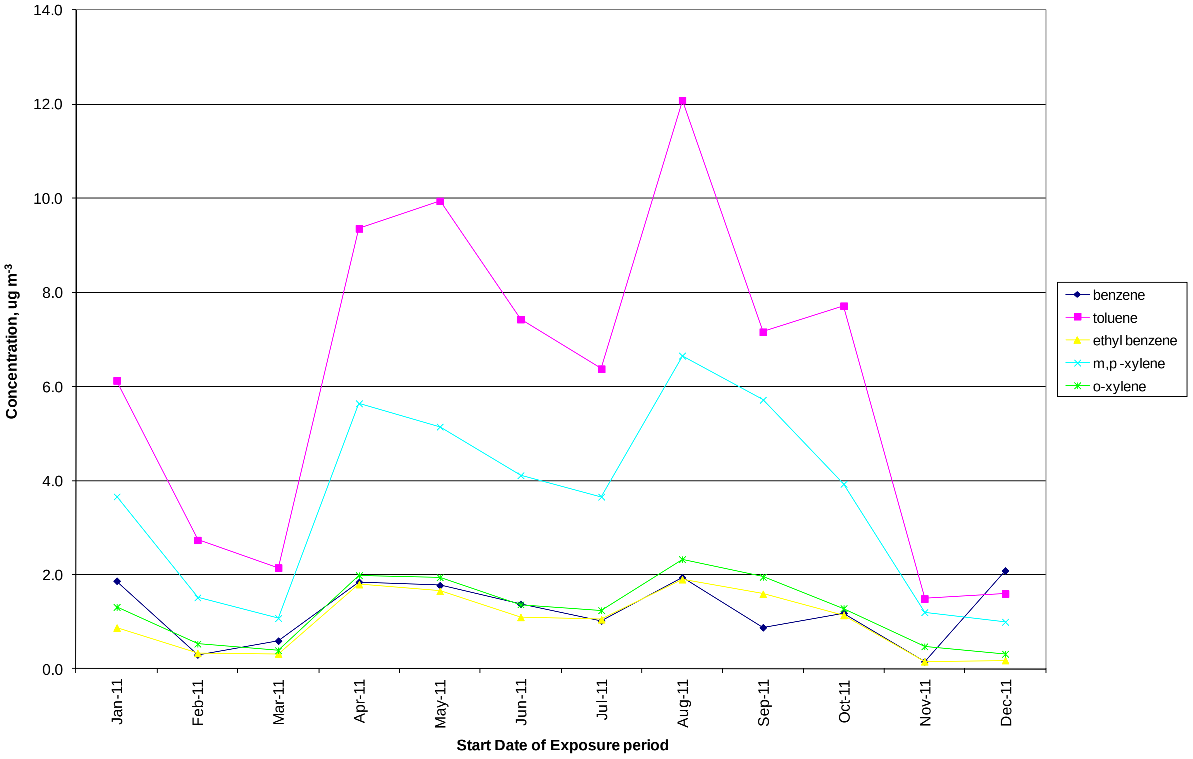


Figure 4-12 Monthly mean hydrocarbon concentrations at Clos St Andre, 2011

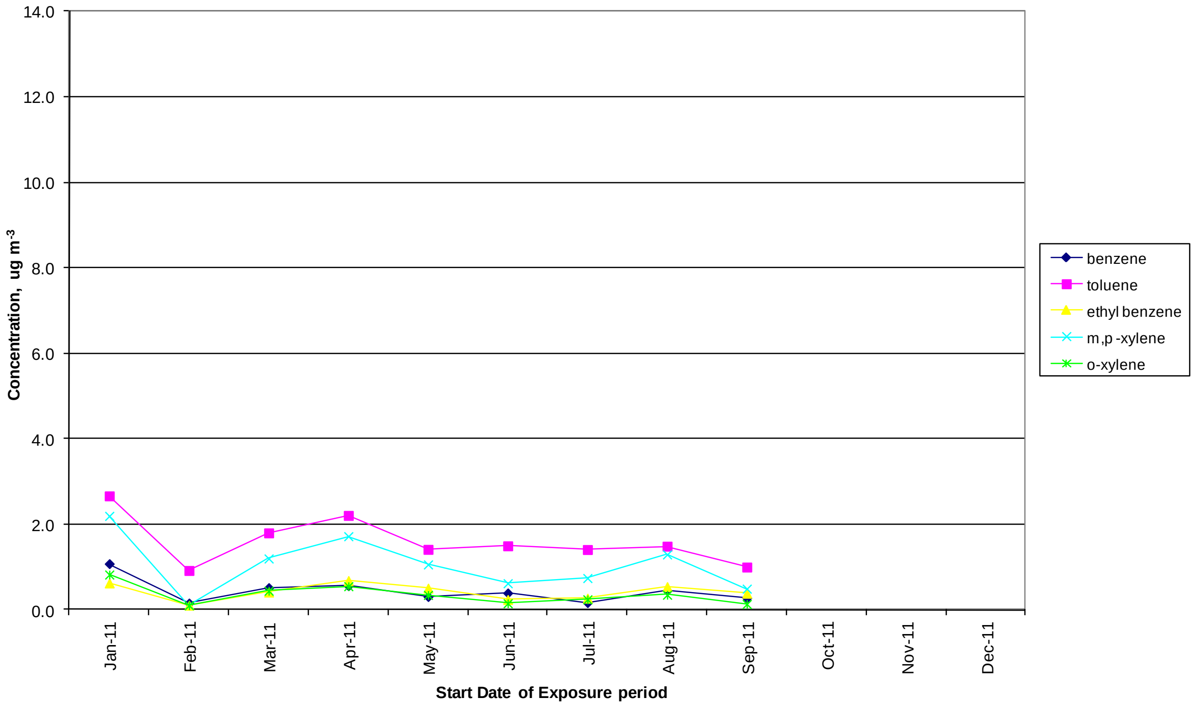


Figure 4-13 Monthly mean hydrocarbon concentrations at the Airport, 2011

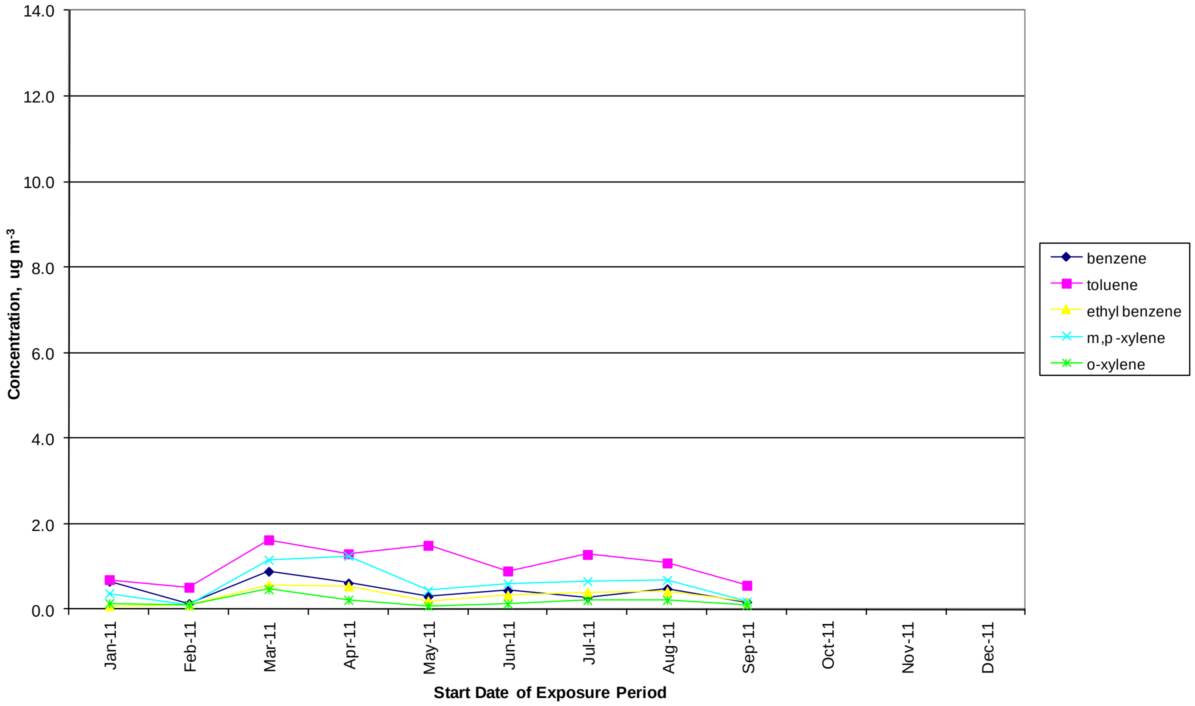
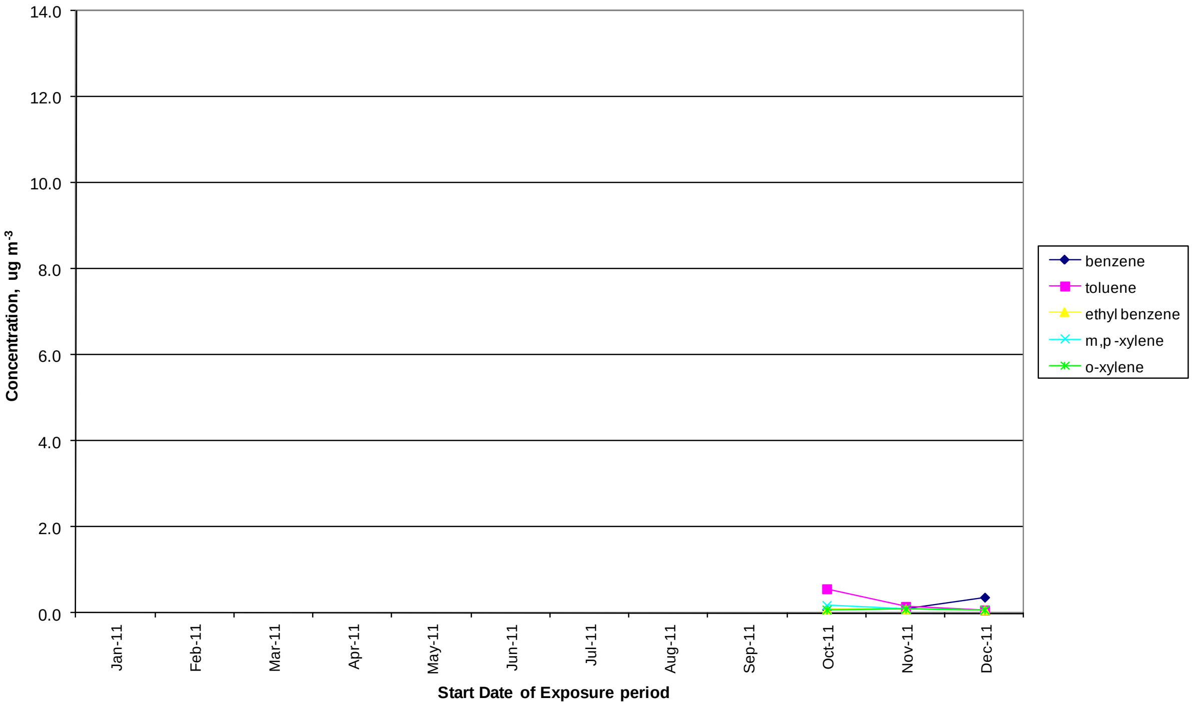


Figure 4-14 Monthly mean hydrocarbon concentrations at La Route de L'Hermite, 2011



Of all the sites, Clos St Andre (now closed), the Airport site, and La Route de L'Hermite (which replaced the Airport site) typically recorded the lowest concentrations of all the BTEX hydrocarbons.

Measured hydrocarbon concentrations were very low (frequently below the detection limit) at the new site at La Route de L'Hermite. This site is located on the northern perimeter of the airfield, and is unlikely to be representative of air quality around the terminal. If the low results continue it may be worth relocating it closer to the terminal.

4.4.1 Comparison With Limit Values and Objectives

Of the hydrocarbon species monitored, only benzene is the subject of any applicable air quality standards. The EC Directive on Ambient Air Quality and Cleaner Air for Europe[18] sets a limit of 5 µg m^{-3} for annual mean benzene, to be achieved by 2010. All sites met this limit in 2011, though only Le Bas, Handsford Lane, Faux Bie, Clos St Andre and the Airport had 75% data capture (the minimum necessary to calculate a representative annual mean). All these sites have been within the Directive limit value since 2000 or earlier.

The UK Air Quality Strategy[19] sets the following objectives for benzene:

- 16.25 µg m^{-3} (for the running annual mean), to have been achieved by 31st December 2003
- 5 µg m^{-3} (for the calendar year mean), to have been achieved by 31st December 2010 in England and Wales. This is the same as the EC limit value.
- 3.25 µg m^{-3} (for the calendar year mean), to have been achieved by 31st December 2010 in Scotland and Northern Ireland.

These AQS objectives are not at present mandatory in Jersey.

The annual mean benzene concentration (which can be considered a good indicator of the running annual mean) was well within the 2003 objective of 16.25 µg m^{-3} at all the Jersey sites with sufficient data capture. The calendar year mean benzene concentration was below 3.25 µg m^{-3} at all Jersey sites with sufficient data capture. Therefore these sites meet the tightest AQS objectives for benzene (those applying to Scotland and Northern Ireland).

4.4.2 Comparison with UK Benzene Data

Benzene is measured at urban sites throughout the UK, by the Non-Automatic Hydrocarbons Network. This network uses the pumped-tube sampler, which is defined within Europe as a reference method.

Table 4-6 compares benzene data from the Jersey sites, with four sites in the Non-Automatic Hydrocarbon Network:

- Plymouth Centre – an urban centre site in the coastal city of Plymouth, Devon.
- Southampton Centre – an urban centre site in the coastal city of Southampton.
- Birmingham Tyburn Roadside – a roadside site alongside a major route into Birmingham city centre.
- Grangemouth – an industrial site near an oil refinery in central Scotland.

Insufficient data was obtained from the Beresford Street site to calculate a valid annual mean, so it has not been included in
Table 4-6.

It is important to note that the Non-Automatic Hydrocarbon Network uses a different measurement technique to the Jersey sites. Therefore this comparison should be treated as *indicative only*. In future years it may be worth considering installing a pumped tube sampler at key sites.

Table 4-6 Comparison with Benzene Concentrations at Other UK Sites, 2011

Site	**2011 Annual Mean Benzene, µg m^{-3}**
Jersey Sites	
Le Bas Centre	1.0
Handsford Lane (paint spraying process)	0.5
Faux Bie (petrol station)	1.3
Clos St Andre	0.4
Airport	0.3
Mainland UK sites	
Plymouth	0.51
Southampton	0.68
Birmingham Tyburn Roadside	0.79
Grangemouth	1.34

The annual mean benzene concentration at Jersey's urban background site (Le Bas Centre) was higher than those measured at the UK Network urban centre sites such as Southampton and Plymouth, and also higher than the annual mean at Birmingham Tyburn Roadside. The annual mean benzene concentration at Faux Bie (near the petrol station) was higher than any of these, and comparable to that at the industrial Grangemouth site.

It is possible that benzene concentrations at the Jersey sites are genuinely slightly higher than those at similar sites in the UK network: alternatively the BTEX tubes may be giving slightly higher results than the reference pumped tube method.

4.4.3 Comparison with Previous Years' Hydrocarbon Results

Figure 4-15 to Figure 4-19 show how annual mean hydrocarbon concentrations at the six Jersey sites have changed over the years of monitoring. These data are also provided in tabular form in Appendix 4. The graphs do not show the former sites at Springfield Garage (closed 2009) and Elizabeth Lane (closed 2003). This will be the last annual report in this series to show trends at Beresford Street, Clos St Andre and the Airport (all now closed).

Annual mean levels of hydrocarbons in 2011 were comparable with those measured in the previous two years. It is important to remember that pollutant concentrations are expected to show considerable year-to-year variation, due to meteorological and other factors. Year-to year changes are therefore of less importance than the observation of long-term trends, which are discussed below.

Figure 4-15 Trends in Benzene Concentration

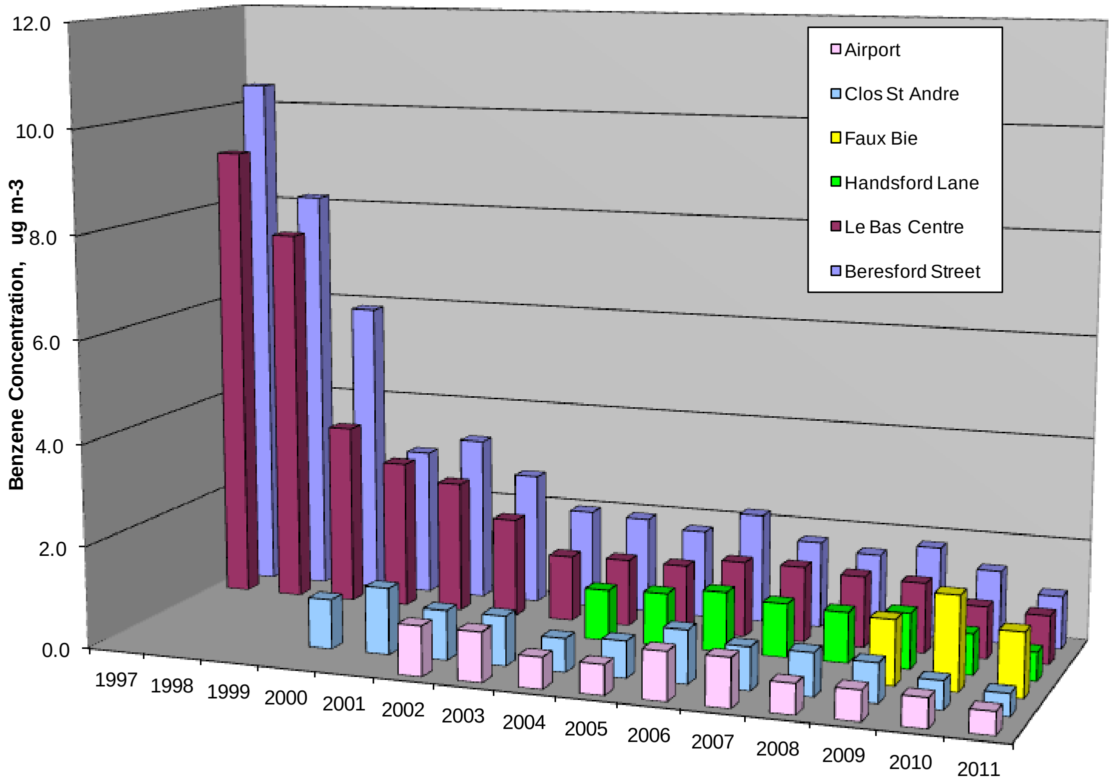


Figure 4-16 Trends in Toluene Concentration

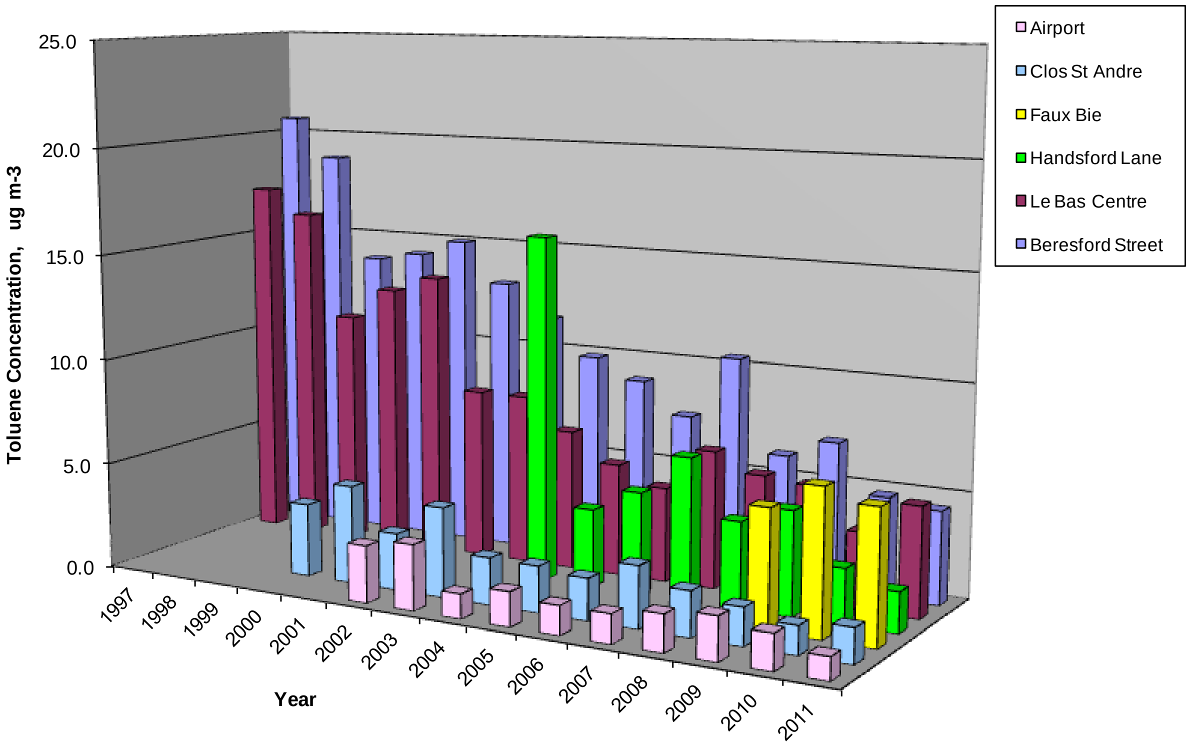


Figure 4-17 Trends in Ethylbenzene Concentration

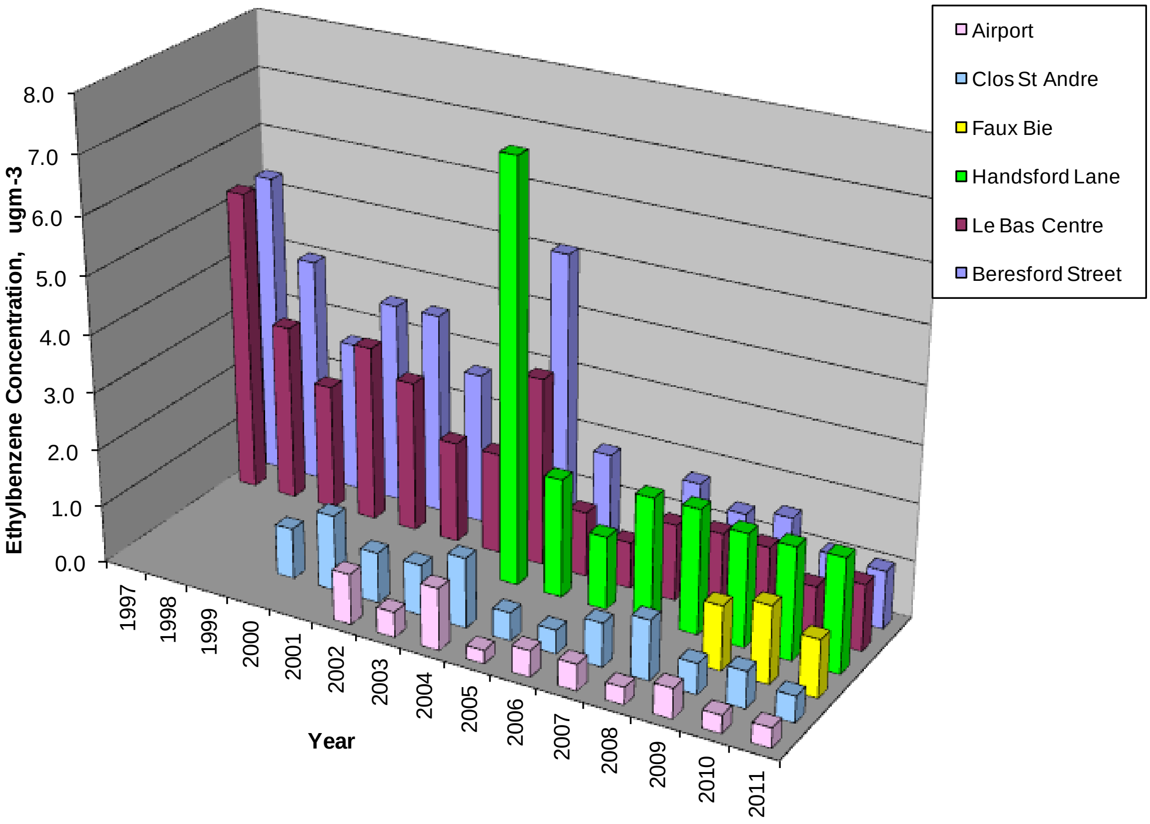


Figure 4-18 Trends in m+p- Xylene Concentration

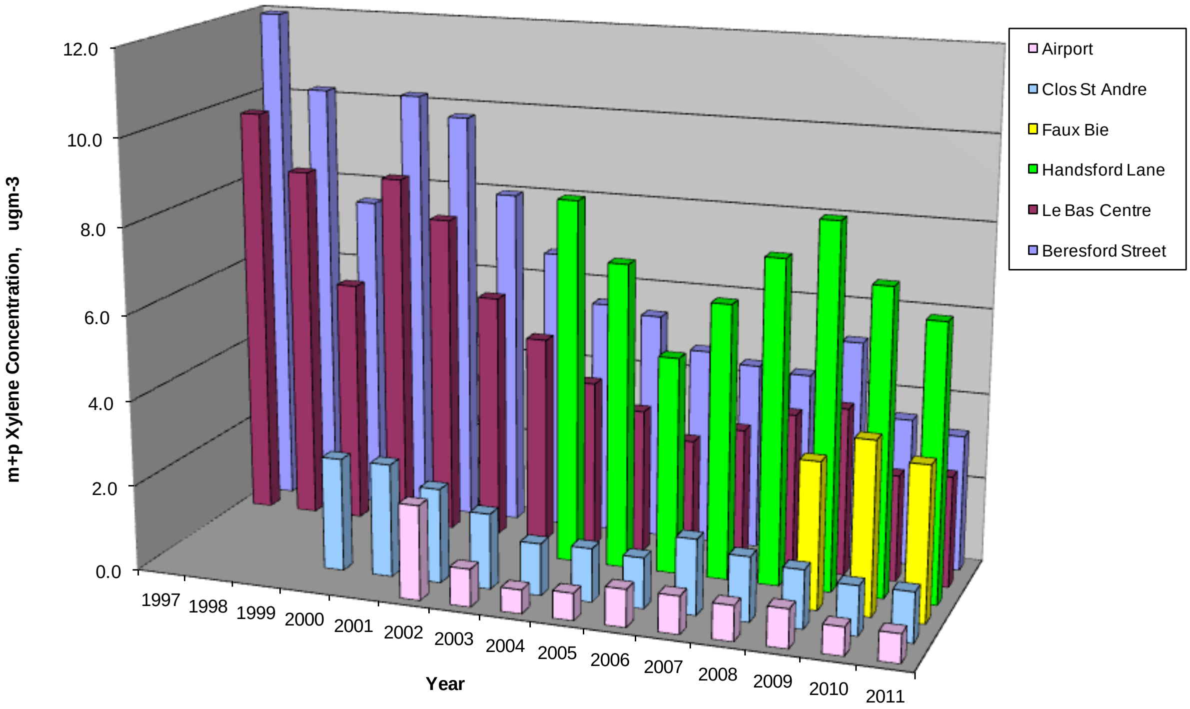
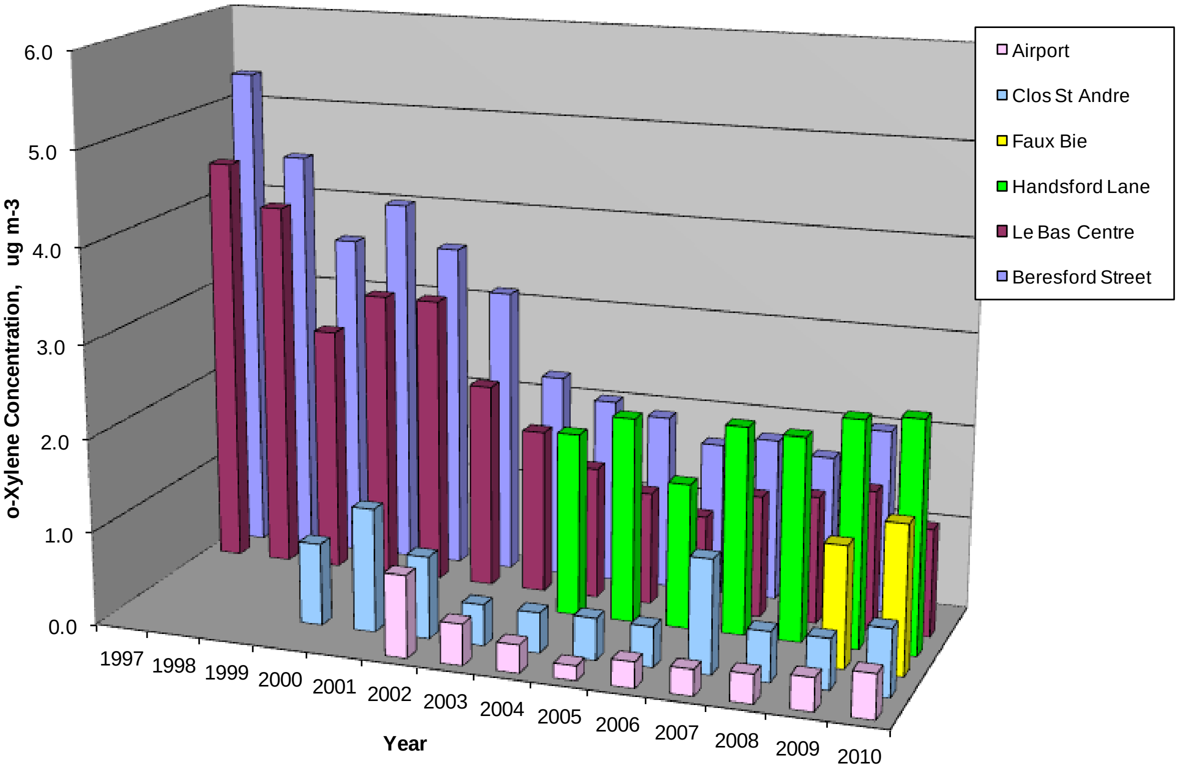


Figure 4-19 Trends in o-Xylene Concentration



Most hydrocarbon species appear to have decreased over the ten years of monitoring, being in most cases lower now than in the late 1990s. Key observations include:

- Benzene showed a marked drop in 2000 due to the maximum permitted benzene content of petrol sold in the UK being reduced from 2% in unleaded (5% in super unleaded), to 1% as of 1st January 2000. Concentrations have remained stable (with small fluctuations) since around 2004.
- Toluene concentrations show a downward trend over the earlier years of the survey (1997-2004), but no clear pattern in recent years.
- Ethylbenzene concentrations have generally decreased. The high annual mean measured at Handsford Lane in 2004 (its first year of monitoring) does not appear to be typical of the site in subsequent years.
- Concentrations of xylenes are now generally lower than in the early years of the survey. However, at Handsford Lane (near the paint spraying process), concentrations of m+p xylene and of o xylene have fluctuated since 2006, after having decreased in the early years of monitoring at this site.
- The Airport site does not appear to show a clear downward trend in any hydrocarbon concentrations: however, levels there were consistently low.

5 Conclusions

AEA has continued the ongoing air quality monitoring programme in Jersey during 2011, on behalf of the States of Jersey Public Health Services. 2011 was the fifteenth year of monitoring. Oxides of nitrogen were monitored at one automatic monitoring station, located in a roadside position at the Central Market, Halkett Place in St Helier. This was supplemented by diffusion tubes for indicative monitoring of NO_2 at 12 sites around the island. Diffusion tubes were also co-located (in triplicate) with the automatic site at Halkett Place.

Hydrocarbons (benzene, toluene, ethyl benzene and xylenes, collectively termed BTEX) were measured at six sites, also using diffusion tubes. The sites were located at a range of different locations on the island, and two have been in operation since 1997. Two of these sites had to be relocated during the 2011, one because of repeated tube thefts and one because a smoking area had been set up nearby. A further site was closed as it was no longer necessary to monitor at that location.

Conclusions of the monitoring programme were as follows:

5.1 NO_2 results

1. The maximum hourly mean NO_2 concentration at the Halkett Place automatic monitoring station was 185 µg m^{-3}. The EC Directive limit value (and AQS objective) for 1-hour mean NO_2 concentration is 200 µg m^{-3}, with 18 exceedences permitted per calendar year; as the maximum hourly mean reported by this site was well within this value, Halkett Place met the limit value and objective.
2. The annual mean NO_2 concentration at Halkett Place was 28 µg m^{-3}, as measured by the automatic analyser. This is well within the EC Directive limit value and AQS objective of 40 µg m^{-3} for annual mean NO_2. Having achieved compliance by 2010 as required, the States of Jersey must continue to demonstrate ongoing compliance.
3. Diffusion tubes exposed in triplicate alongside the automatic analyser showed good agreement with the reference method, giving an annual mean of 30 µg m^{-3}.
4. Annual mean NO_2 concentrations at all 12 diffusion tube monitoring sites were within the EC limit value, and were generally comparable with previous year's results.
5. The diurnal variation in concentrations of oxides of nitrogen at Halkett Place was generally typical of an urban site, but with a particularly early (and sharp) morning rush-hour peak, and barely any afternoon rush hour peak. This is thought to be due to traffic patterns around the site: there is early morning traffic associated with the market and with waste collection from the previous day.
6. Monthly mean NO_2 concentrations at the diffusion tube sites showed no clear seasonal pattern, as observed in previous years.
7. Annual mean NO_2 concentrations at most of the 12 diffusion tube sites were slightly higher than those measured in 2010.
8. Annual mean NO_2 concentrations at kerbside and roadside were lower than in the earlier years of the survey, although the decreasing trend observed since around 2003 appears to have flattened off. Concentrations of this pollutant at the urban background, residential and rural sites are stable, and well below the limit value and AQS objective.

5.2 Hydrocarbon diffusion tube results

1. Annual mean benzene concentrations at all five sites were well within the EC Directive limit value of 5 µg m^{-3}. Having achieved compliance by 2010 as required, the States of Jersey must continue to demonstrate ongoing compliance.
2. Measured hydrocarbon concentrations were very low (frequently below the detection limit) at the new site at La Route de L'Hermite. This site is located on the northern perimeter of the airfield, well away from the majority of airport traffic. If the low results continue it may be worth relocating it closer to the airport terminal.
3. Annual mean concentrations of BTEX hydrocarbons were comparable with those measured in recent years.

It is recommended that the monitoring programme be continued, to demonstrate continuing compliance with air quality limit values and objectives. Also, consideration should be given to aligning the monitoring programme with the requirements of Jersey's Air Quality Strategy.

6 Acknowledgements

AEA gratefully acknowledges the help and support of the staff of the States of Jersey Environmental Health Services, in this monitoring study.

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Appendices

Appendix 1: Air Quality Limit Values, Objectives and Guidelines

Appendix 2: Calibration Procedures for Automatic Analyser

Appendix 3: Nitrogen Dioxide Diffusion Tubes; Bias Adjustment Factor

Appendix 4: BTEX Diffusion Tubes: Monthly Dataset and Annual Means 1997-2011

Appendix 1 – Air Quality Limit Values, Objectives and Guidelines

Air Pollution Guidelines Used in this Report.

UK and International Ambient Air Quality Limit Values, Objectives and Guidelines

Nitrogen Dioxide

Guideline Set By	Description	Criteria Based On	Value(1) / μgm^{-3} (ppb)
The Air Quality Strategy(2)	Objective for Dec. 31st 2005, for protection of human health	1-hour mean	200 (105) Not to be exceeded more than 18 times per calendar year.
Set in regulations(3) for all UK:	Objective for Dec. 31st 2005, for protection of human health	Annual mean	40 (21)
Not intended to be set in regulations:	Objective for Dec. 31st 2000, for protection of vegetation.	Annual mean NO_x (NO_x as NO_2)	30 (16)
European Community **1985 NO_2 Directive (4)** Limit remains in force until fully repealed 01/01/2010.	Limit Value	Calendar year of data: 98%ile of hourly means.	200 (105)
ED Directive on Ambient Air Quality and Cleaner Air for Europe(5)	Limit Value for protection of human health. To be achieved by Jan. 1st 2010	1 hour mean	200 (105) not to be exceeded more than 18 times per calendar year
	Limit Value for protection of human health. To be achieved by Jan. 1st 2010	Calendar year mean	40 (21)
	Limit Value (total NO_x) for protection of vegetation. To be achieved by Jul. 19th 2001	Calendar year mean	30 (16)
World Health Organisation(6) **(Non-Mandatory Guidelines)**	Health Guideline	1-hour mean	200
	Health Guideline	Annual mean	40

(1) Conversions between μg m^{-3} and ppb are as used by the EC, i.e. 1ppb NO_2 = 1.91 μg m^{-3} at 20°C and 1013 mB.

(2) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007, The Stationery Office, ID 5611194 07/07.

(3) Air Quality Regulations 2007 (SI 2007/64), Air Quality Standards (Wales) Regulations 2007 (Welsh SI 2007 717 (W63)), Air Quality Standards (Scotland) Regulations 2007 (SSI 2007 No. 182), Air Quality Standards (Northern Ireland) Regulations 2007 (Statutory Rule 2007 No. 265)

(4) Council Directive 85/203/EEC.

(5) Council Directive 2008/50/EC.

(6) WHO Air Quality Guidelines for Europe (2000).

Benzene

Guideline Set By	Description	Criteria Based On	Value(1) / μgm^{-3} (ppb)
The Air Quality Strategy(2,3) **All UK**	Objective for Dec. 31st 2003	Running annual mean	16.25 (5)
England(4) **& Wales**(5) **only:**	Objective for Dec. 31st 2010	Annual mean	5 (1.54)
Scotland(6) **& Northern Ireland**	Objective for Dec. 31st 2010	Running annual mean	3.25 (1.0)
ED Directive on Ambient Air Quality and Cleaner Air for Europe (8)	Limit Value. To be achieved by Jan 1st 2010	Annual calendar year mean	5 (1.5)

(1) Conversions between $\mu g\ m^{-3}$ and ppb are those used by the EC, i.e. 1ppb benzene = 3.25 $\mu g\ m^{-3}$ at 20°C and 1013 mB.

(2) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007, The Stationery

Office, ID 5611194 07/07.

(3) Air Quality (England) Regulations 2000 (SI 2000/928), Air Quality (Scotland) Regulations 2000 (SSI 2000/97), Air Quality (Wales) Regulations 2000 (SI 2000/1940 (W138)).

(4) Air Quality (Amendment) (England) Regulations 2002 (SI 2002/3043)

(5) Air Quality (Amendment) (Wales) Regulations 2002 (SI 2002/3182 (W298))

(6) Air Quality (Amendment) (Scotland) Regulations 2002 (SI 2002/297)

(7) Council Directive 2008/50/EC.

Toluene

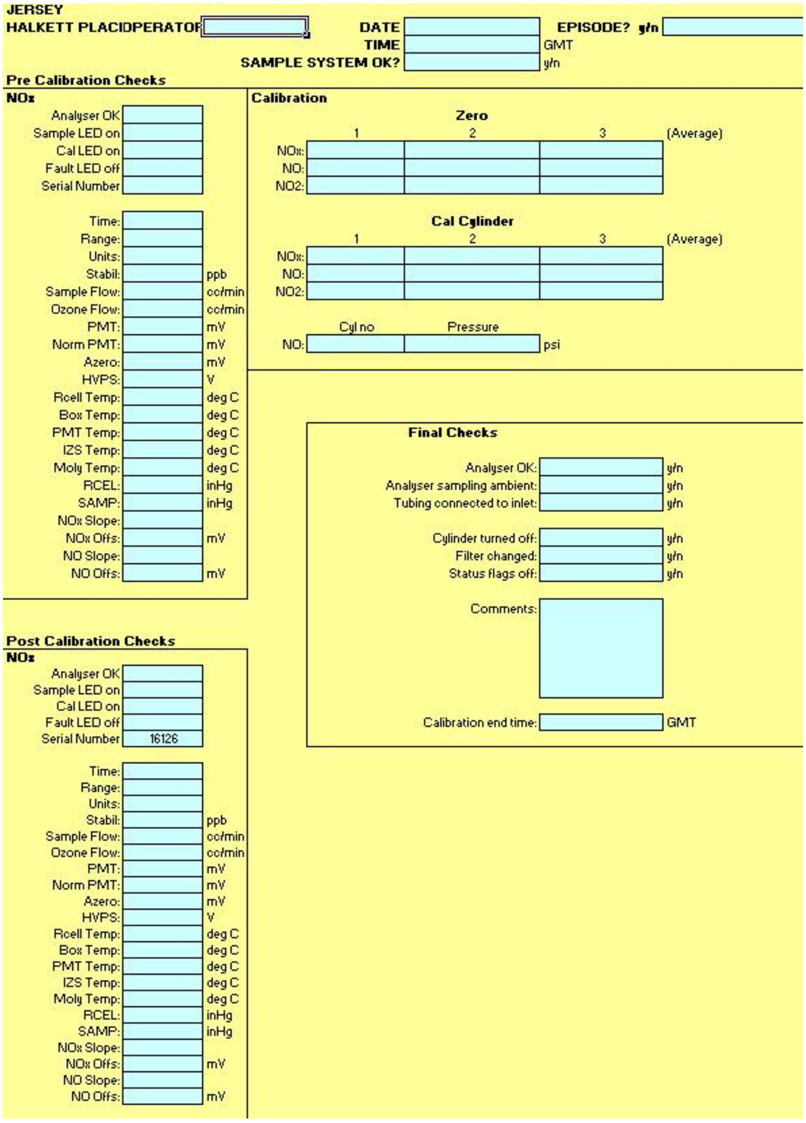
Guideline Set By	Description	Criteria Based On	Value(1) / μgm^{-3} (ppb)
World Health Organisation(8) **(Non-Mandatory Guideline)**	Health Guideline	1-week mean	260 μgm^{-3} or 0.26 mgm^{-3}

(8) WHO Air Quality Guidelines for Europe (2000).

Appendix 2 – Calibration Procedures for Automatic Analyser

The analyser at Halkett Place is calibrated monthly by the Environmental Health team. Standard gas calibration mixtures are used to check the instrument's span, and chemically scrubbed air is used to check the instrument's zero. All gas calibration standards used for routine analyser calibration are certified against traceable primary gas calibration standards at the Gas Standards Calibration Laboratory at AEA. The calibration laboratory operates within a specific and documented quality system and has UKAS accreditation for calibration of the gas standards used in this survey. The calibration form used is shown below.

Jersey Calibration Form



JERSEY

HALKETT PLACIDPERATOR

DATE

TIME GMT

SAMPLE SYSTEM OK? y/n

EPISODE? y/n

Pre Calibration Checks

NOx

Analyser OK

Sample LED on

Cal LED on

Fault LED off

Serial Number

Time:

Range:

Units:

Stabil: ppb

Sample Flow: cc/min

Ozone Flow: cc/min

PMT: mV

Norm PMT: mV

Azero: mV

HVPS: V

Rcell Temp: deg C

Box Temp: deg C

PMT Temp: deg C

IZS Temp: deg C

Moly Temp: deg C

RCEL: inHg

SAMP: inHg

NOx Slope:

NOx Offs: mV

NO Slope:

NO Offs: mV

Calibration

Zero

	1	2	3	(Average)
NOx:				
NO:				
NO2:				

Cal Cylinder

	1	2	3	(Average)
NOx:				
NO:				
NO2:				

	Cyl no	Pressure	
NO:			psi

Final Checks

Analyser OK: y/n

Analyser sampling ambient: y/n

Tubing connected to inlet: y/n

Cylinder turned off: y/n

Filter changed: y/n

Status flags off: y/n

Comments:

Calibration end time: GMT

Post Calibration Checks

NOx

Analyser OK

Sample LED on

Cal LED on

Fault LED off

Serial Number 16126

Time:

Range:

Units:

Stabil: ppb

Sample Flow: cc/min

Ozone Flow: cc/min

PMT: mV

Norm PMT: mV

Azero: mV

HVPS: V

Rcell Temp: deg C

Box Temp: deg C

PMT Temp: deg C

IZS Temp: deg C

Moly Temp: deg C

RCEL: inHg

SAMP: inHg

NOx Slope:

NOx Offs: mV

NO Slope:

NO Offs: mV

An important aspect of QA/QC procedures is the 12-monthly intercalibration and audit check undertaken every 12 months. This audit has two principal functions, firstly to check the instrument and the site infrastructure, and secondly to recalibrate the transfer gas standards routinely used on-site, using standards recently checked in the calibration laboratory. AEA's audit calibration procedures are UKAS accredited to ISO 17025.

Full intercalibration audits take place annually. At these visits, the essential functional parameters of the monitors, such as noise, linearity and, for the NO_X monitor, the efficiency of the NO_2 to NO converter are fully tested. In addition, the on-site transfer calibration standards are checked and re-calibrated if necessary, the air intake sampling system is cleaned and checked and all other aspects of site infrastructure are checked. In 2011 this exercise was combined with a full service of the analyser and sampler pump.

Appendix 3 – Nitrogen Dioxide Diffusion Tubes; Bias Adjustment Factor

The precision and accuracy of the diffusion tubes in this study were quantified by exposing them in triplicate alongside the automatic NOx analyser at Halkett Place. The percentage by which the diffusion tubes over-or under-estimate with respect to the automatic chemiluminescent analyser (defined within the European Community as the reference method for NO_2) is calculated as follows:

Percentage bias B = 100 x (D-C)/C

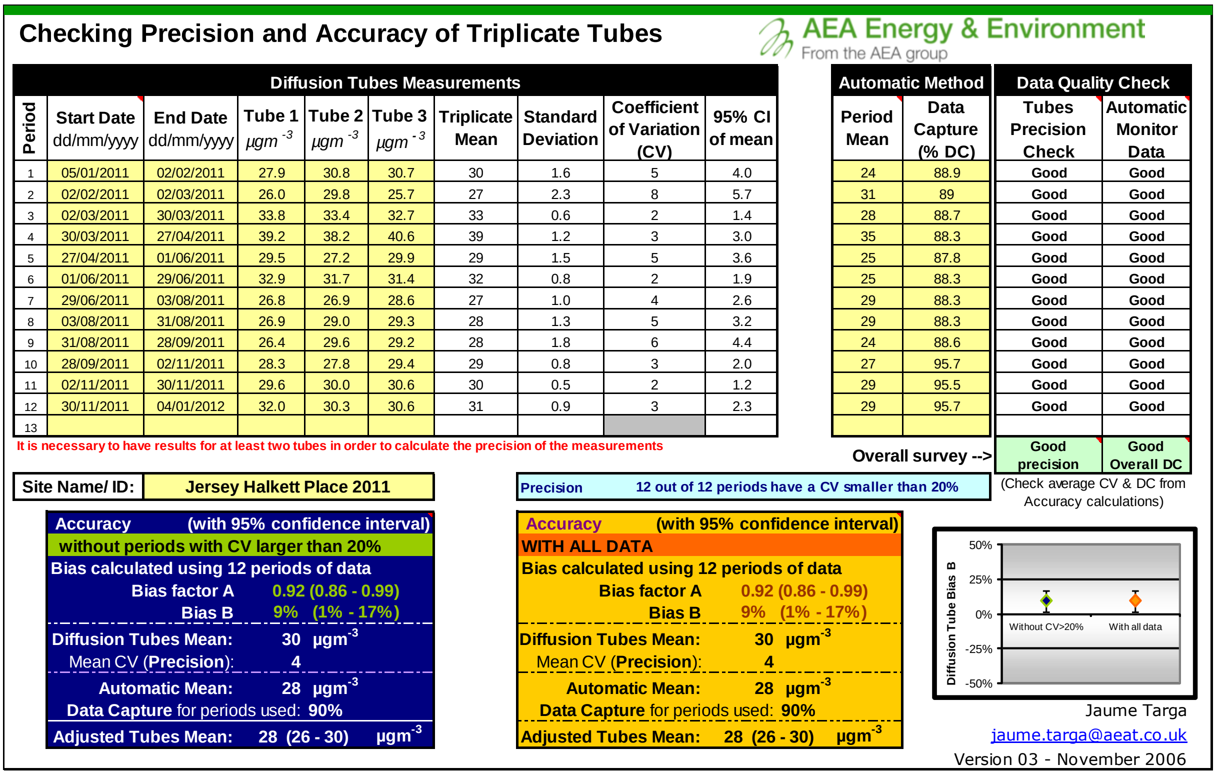
- where D = the average NO_2 concentration as measured using diffusion tubes and C is the average NO2 concentration as measured using the automatic analyser.

The diffusion tube annual mean concentrations measured at the other (non-co-located) sites can be adjusted for the diffusion tube over/under-read, by application of a bias adjustment factor, calculated as follows:

Bias adjustment factor = C/D (where D and C are the annual mean NO_2 concentrations as measured using diffusion tubes and the automatic analyser respectively, as above).

These calculations were carried out using a spreadsheet tool developed by AEA: see Figure A3.1 below. This spreadsheet shows the diffusion tube concentrations to 1 decimal place as reported by the analyst – but given the uncertainty on diffusion tube measurements it is only considered valid to report to the nearest integer in the report, except at the sites with lowest concentrations.

Figure A3.1 Precision and Bias Spreadsheet, showing Halkett Place dataset.



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	05/01/2011	02/02/2011	27.9	30.8	30.7	30	1.6	5	4.0	24	88.9	Good	Good
2	02/02/2011	02/03/2011	26.0	29.8	25.7	27	2.3	8	5.7	31	89	Good	Good
3	02/03/2011	30/03/2011	33.8	33.4	32.7	33	0.6	2	1.4	28	88.7	Good	Good
4	30/03/2011	27/04/2011	39.2	38.2	40.6	39	1.2	3	3.0	35	88.3	Good	Good
5	27/04/2011	01/06/2011	29.5	27.2	29.9	29	1.5	5	3.6	25	87.8	Good	Good
6	01/06/2011	29/06/2011	32.9	31.7	31.4	32	0.8	2	1.9	25	88.3	Good	Good
7	29/06/2011	03/08/2011	26.8	26.9	28.6	27	1.0	4	2.6	29	88.3	Good	Good
8	03/08/2011	31/08/2011	26.9	29.0	29.3	28	1.3	5	3.2	29	88.3	Good	Good
9	31/08/2011	28/09/2011	26.4	29.6	29.2	28	1.8	6	4.4	24	88.6	Good	Good
10	28/09/2011	02/11/2011	28.3	27.8	29.4	29	0.8	3	2.0	27	95.7	Good	Good
11	02/11/2011	30/11/2011	29.6	30.0	30.6	30	0.5	2	1.2	29	95.5	Good	Good
12	30/11/2011	04/01/2012	32.0	30.3	30.6	31	0.9	3	2.3	29	95.7	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Site Name/ ID: Jersey Halkett Place 2011

Precision 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.92 (0.86 - 0.99)
Bias B 9% (1% - 17%)
Diffusion Tubes Mean: 30 μgm^{-3}
Mean CV (**Precision**): 4
Automatic Mean: 28 μgm^{-3}
Data Capture for periods used: 90%
Adjusted Tubes Mean: 28 (26 - 30) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.92 (0.86 - 0.99)
Bias B 9% (1% - 17%)
Diffusion Tubes Mean: 30 μgm^{-3}
Mean CV (**Precision**): 4
Automatic Mean: 28 μgm^{-3}
Data Capture for periods used: 90%
Adjusted Tubes Mean: 28 (26 - 30) μgm^{-3}

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Version 03 - November 2006

Appendix 4 - BTEX Diffusion Tubes: Monthly Dataset and Annual Means 1997-2011

Table A4.1 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Beresford Street

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	missing	missing	missing	missing	missing
2-Feb-11	0.2	1.2	0.2	0.6	0.3
2-Mar-11	1.7	6.5	1.5	5.2	1.8
30-Mar-11	1.6	7.1	1.7	5.3	1.9
27-Apr-11	0.6	2.5	0.5	1.5	0.5
1-Jun-11	1.1	4.6	1.3	3.3	1.2
29-Jun-11	missing	missing	missing	missing	missing
3-Aug-11	missing	missing	missing	missing	missing
31-Aug-11	-	-	-	-	-
28-Sep-11	-	-	-	-	-
2-Nov-11	-	-	-	-	-
30-Nov-11	-	-	-	-	-
Average	**1.0**	**4.4**	**1.0**	**3.2**	**1.1**

January, July and August 2011 tubes went missing from site. Monitoring was relocated to Halkett Place.

Table A4.2 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Halkett Place

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	-	-	-	-	-
2-Feb-11	-	-	-	-	-
2-Mar-11	-	-	-	-	-
30-Mar-11	-	-	-	-	-
27-Apr-11	-	-	-	-	-
1-Jun-11	-	-	-	-	-
29-Jun-11	-	-	-	-	-
3-Aug-11	-	-	-	-	-
31-Aug-11	1.0	4.3	1.2	3.2	1.1
28-Sep-11	1.2	4.7	1.3	3.6	1.2
2-Nov-11	0.5	2.1	0.4	1.1	0.4
30-Nov-11	0.1	0.7	0.1	0.7	0.2
Average	**0.7**	**3.0**	**0.7**	**2.2**	**0.8**

Table A4.3 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Le Bas Centre

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	1.4	5.0	0.9	3.8	1.3
2-Feb-11	0.5	1.2	0.0	0.6	0.3
2-Mar-11	2.1	5.5	1.4	4.2	1.6
30-Mar-11	1.4	4.9	1.3	3.7	1.2
27-Apr-11	1.3	24.6	3.5	5.4	1.7
1-Jun-11	0.9	3.5	1.0	2.6	1.0
29-Jun-11	1.1	6.1	2.2	3.8	1.5
3-Aug-11	0.9	3.6	1.0	2.9	1.1
31-Aug-11	0.6	2.3	0.6	1.1	0.4
28-Sep-11	0.9	3.2	0.7	2.2	0.8
2-Nov-11	0.3	1.4	0.1	0.6	0.3
30-Nov-11	0.1	0.5	(<0.08)	0.3	0.1
Average	**1.0**	**5.1**	**1.1**	**2.6**	**0.9**

Where the result was less than the limit of detection this is shown in brackets.

Table A4.4 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Handsford Lane

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	0.3	1.1	0.8	3.8	1.2
2-Feb-11	0.1	0.3	0.2	1.2	0.4
2-Mar-11	1.1	3.2	3.2	12.1	3.7
30-Mar-11	1.0	3.6	3.3	11.0	3.4
27-Apr-11	0.7	2.4	2.4	8.0	2.5
1-Jun-11	0.6	2.0	1.9	6.9	2.2
29-Jun-11	0.6	2.4	2.1	7.4	2.4
3-Aug-11	0.6	2.4	2.9	9.4	3.1
31-Aug-11	0.5	2.2	2.2	7.2	2.2
28-Sep-11	0.4	1.8	1.9	6.5	2.1
2-Nov-11	0.3	1.0	0.9	3.4	1.1
30-Nov-11	(<0.09)	0.2	(<0.08)	0.6	0.2
Average	**0.5**	**1.9**	**1.8**	**6.5**	**2.0**

Where the result was less than the limit of detection (LoD) this is shown in brackets. Results < LoD have been treated as equal to LoD for calculation of annual means.

Table A4.5 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Faux Bie

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	1.9	6.1	0.9	3.7	1.3
2-Feb-11	0.3	2.7	0.3	1.5	0.5
2-Mar-11	0.6	2.1	0.3	1.1	0.4
30-Mar-11	1.8	9.4	1.8	5.6	2.0
27-Apr-11	1.8	9.9	1.7	5.1	1.9
1-Jun-11	1.4	7.4	1.1	4.1	1.4
29-Jun-11	1.0	6.4	1.0	3.7	1.2
3-Aug-11	1.9	12.1	1.9	6.7	2.3
31-Aug-11	0.9	7.2	1.6	5.7	2.0
28-Sep-11	1.2	7.7	1.1	3.9	1.3
2-Nov-11	0.2	1.5	0.2	1.2	0.5
30-Nov-11	2.1	1.6	0.2	1.0	0.3
Average	**1.3**	**6.2**	**1.0**	**3.6**	**1.3**

Table A4.6 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Clos St Andre

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	1.1	2.7	0.6	2.2	0.8
2-Feb-11	0.2	0.9	(<0.11)	(<0.11)	(<0.11)
2-Mar-11	0.5	1.8	0.4	1.2	0.4
30-Mar-11	0.6	2.2	0.7	1.7	0.6
27-Apr-11	0.3	1.4	0.5	1.1	0.3
1-Jun-11	0.4	1.5	0.2	0.6	0.2
29-Jun-11	0.2	1.4	0.3	0.7	0.2
3-Aug-11	0.4	1.5	0.5	1.3	0.4
31-Aug-11	0.3	1.0	0.4	0.5	0.1
28-Sep-11	-	-	-	-	-
2-Nov-11	-	-	-	-	-
30-Nov-11	-	-	-	-	-
Average	**0.4**	**1.6**	**0.4**	**1.0**	**0.3**

Site closed end of September.

Where the result was less than the limit of detection (LoD) this is shown in brackets. Results < LoD have been treated as equal to LoD for calculation of annual means.

Table A4.7 Monthly mean Hydrocarbon Concentrations, $\mu g\ m^{-3}$ – Airport

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	0.7	0.7	0.1	0.4	0.1
2-Feb-11	0.1	0.5	(<0.11)	(<0.11)	(<0.11)
2-Mar-11	0.9	1.6	0.6	1.2	0.5
30-Mar-11	0.6	1.3	0.5	1.3	0.2
27-Apr-11	0.3	1.5	0.2	0.4	0.1
1-Jun-11	0.4	0.9	0.3	0.6	0.1
29-Jun-11	0.3	1.3	0.4	0.7	0.2
3-Aug-11	0.5	1.1	0.4	0.7	0.2
31-Aug-11	0.2	0.6	0.2	0.2	(<0.11)
28-Sep-11	-	-	-	-	-
2-Nov-11	-	-	-	-	-
30-Nov-11	-	-	-	-	-
Average	**0.4**	**1.1**	**0.3**	**0.6**	**0.2**

Site closed end of September.

Where the result was less than the limit of detection (LoD) this is shown in brackets. Results < LoD have been treated as equal to LoD for calculation of annual means.

Table A4.8 Monthly mean Hydrocarbon Concentrations, $\mu g\ m^{-3}$ – La Route de L'Hermite

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	-	-	-	-	-
2-Feb-11	-	-	-	-	-
2-Mar-11	-	-	-	-	-
30-Mar-11	-	-	-	-	-
27-Apr-11	-	-	-	-	-
1-Jun-11	-	-	-	-	-
29-Jun-11	-	-	-	-	-
3-Aug-11	-	-	-	-	-
31-Aug-11	-	-	-	-	-
28-Sep-11	(<0.09)	0.6	0.1	0.2	(<0.08)
2-Nov-11	(<0.12)	0.2	(<0.11)	(<0.11)	(<0.11)
30-Nov-11	0.4	(<0.08)	(<0.08)	(<0.08)	(<0.08)
Average	**0.2**	**0.3**	**0.1**	**0.1**	**0.1**

Site started up October, replacing the Airport.

Where the result was less than the limit of detection (LoD) this is shown in brackets. Results < LoD have been treated as equal to LoD for calculation of annual means.

Table A4.9 Monthly mean Hydrocarbon Concentrations, μg m^{-3} – Travel Blanks

Start Date	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5-Jan-11	0.20	0.12	0.16	0.08	0.07
2-Feb-11	0.31	0.35	0.16	0.10	0.03
2-Mar-11	0.27	1.05	0.87	1.95	0.61
30-Mar-11	1.44	23.84	5.06	8.85	3.66
27-Apr-11	0.35	3.81	0.32	0.70	0.20
1-Jun-11	0.09	0.19	0.15	0.07	0.04
29-Jun-11	0.22	0.26	0.16	0.11	(<0.08)
3-Aug-11	0.55	2.59	0.64	0.52	0.20
31-Aug-11	0.31	5.40	0.41	0.51	0.14
28-Sep-11	0.13	0.08	0.08	0.06	0.04
2-Nov-11	0.13	0.14	0.16	0.17	0.03
30-Nov-11	0.16	0.08	0.12	0.05	0.01
Average	**0.3**	**3.2**	**0.7**	**1.1**	**0.5**

Where the result was less than the limit of detection (LoD) this is shown in brackets. Results < LoD have been treated as equal to LoD for calculation of annual means.

Table A4.10 Comparison of Hydrocarbon Concentrations, Jersey, 1997 - 2011.

	benzene, $\mu g\ m^{-3}$	toluene, $\mu g\ m^{-3}$	ethylbenzene $\mu g\ m^{-3}$	m+p xylene, $\mu g\ m^{-3}$	o-xylene, $\mu g\ m^{-3}$
Beresford Street					
1997	10.4	20.7	5.3	11.9	5.3
1998	8.1	18.8	4.0	10.2	4.4
1999	5.9	13.8	2.7	7.5	3.5
2000	2.9	14.2	3.5	10.2	4.0
2001	3.3	14.9	3.5	9.7	3.5
2002	2.6	13.0	2.7	8.0	3.1
2003	2.0	11.5	2.2	6.6	2.2
2004	1.9	9.8	5.1	5.5	2.0
2005	1.7	8.9	1.8	5.3	1.9
2006	2.2	7.4	1.3	4.6	1.6
2007	1.7	10.4	1.7	4.4	1.8
2008	1.6	6.1	1.4	4.3	1.6
2009	1.8	6.9	1.5	5.2	2.0
2010	1.4	4.7	1.1	3.5	1.5
Le Bas Centre					
1997	9.1	17.2	5.3	9.7	4.4
1998	7.5	16.1	3.1	8.4	4.0
1999	3.6	11.1	2.2	5.7	2.7
2000	2.9	12.6	3.1	8.4	3.1
2001	2.6	13.4	2.7	7.5	3.1
2002	2.0	8.0	1.8	5.7	2.2
2003	1.3	8.0	1.8	4.9	1.8
2004	1.3	6.6	3.3	3.9	1.4
2005	1.3	5.3	1.1	3.4	1.2
2006	1.5	4.4	0.8	2.8	1.0
2007	1.5	6.5	1.3	3.2	1.3
2008	1.4	5.6	1.4	3.7	1.4
2009	1.4	5.4	1.4	3.9	1.5
2010	1.0	3.6	0.9	2.5	1.2
2011	1.0	5.1	1.1	2.6	0.9
Handsford Lane					
2004	1.0	16.1	7.3	8.5	2.0
2005	1.0	3.7	2.1	7.1	2.2
2006	1.2	4.8	1.3	5.1	1.6
2007	1.1	6.7	2.2	6.4	2.2
2008	1.0	4.0	2.2	7.6	2.2

	benzene, $\mu g\ m^{-3}$	toluene, $\mu g\ m^{-3}$	ethylbenzene $\mu g\ m^{-3}$	m+p xylene, $\mu g\ m^{-3}$	o-xylene, $\mu g\ m^{-3}$
2009	1.1	4.9	2.0	8.5	2.4
2010	0.8	2.6	2.0	7.1	2.5
2011	0.5	1.9	1.8	6.5	2.0
Faux Bie					
2009	1.3	5.5	1.1	3.4	1.3
2010	1.8	6.7	1.4	4.0	1.6
2011	1.3	6.2	1.0	3.6	1.3
Clos St Andre					
2000	1.0	3.4	0.9	2.7	0.9
2001	1.3	4.6	1.3	2.7	1.3
2002	1.0	2.7	0.9	2.2	0.9
2003	1.0	4.2	0.9	1.8	0.4
2004	0.7	2.2	1.2	1.2	0.4
2005	0.7	2.2	0.5	1.3	0.5
2006	1.0	2.0	0.4	1.2	0.4
2007	0.8	2.9	0.8	1.8	1.2
2008	0.8	2.1	1.0	1.5	0.5
2009	0.8	1.7	0.5	1.4	0.5
2010	0.5	1.3	0.6	1.2	0.7
2011	0.4	1.6	0.4	1.0	0.3
Airport					
2002	1.0	2.7	0.9	2.2	0.9
2003	1.0	3.1	0.4	0.9	0.4
2004	0.6	1.1	1.1	0.6	0.3
2005	0.6	1.6	0.2	0.6	0.2
2006	1.0	1.4	0.5	0.9	0.3
2007	1.0	1.4	0.5	0.9	0.3
2008	0.6	1.7	0.3	0.8	0.3
2009	0.6	2.0	0.5	0.9	0.4
2010	0.6	1.6	0.3	0.7	0.5
2011	0.4	1.1	0.3	0.6	0.2

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