AIR QUALITY IN GUERNSEY

SCREENING AND ASSESSMENT DOCUMENT

July 2015

Office of Environmental Health and Pollution Regulation

Executive Summary

Clean air is a basic requirement of human health and well-being. Air pollution, however, continues to pose a significant threat to health worldwide.

Ambient air quality has been monitored across the Island by the Office of Environmental Health and Pollution Regulation since 1992. A strong evidence base exists that demonstrates that generally air quality is good on-Island but there is increasing evidence that there are pollutants that pose notable concern locally and that there are also 'hot spots' where there are localised high concentrations of pollutants.

The States of Guernsey has made a commitment, through the States Strategic Plan and Environmental Plan, to protect human health and the natural environment and to make adaptations to reduce the Island's carbon footprint and our impact on climate change.

There are, however, no locally-adopted air quality standards and there are insufficient regulatory mechanisms to address point or line sources of pollution. Without legally-grounded and locally proportionate standards and a regulatory framework it will not be possible to address current issues of concern and prevent further exceedances which will have a corresponding impact upon the health of Islanders.

In order to ensure that the Island is protected from current and emergent sources of pollution Part VII (Air Pollution) of the Environmental Pollution (Guernsey) Law, 2004 should be implemented to provide clearly defined locally-relevant standards against which to benchmark and to provide a regulatory framework to ensure that compliance can be achieved.

The importance of local air quality and on-Island pollution sources must also continue to be acknowledged at a strategic level by the States of Guernsey to ensure that regulatory and strategic activities align and to ensure the effective management of local air quality.

Contents

1 Introduction

1.1 Overview

Clean air is a basic requirement of human health and well-being. Air pollution, however, continues to pose a significant threat to health worldwide. Air pollution is known to cause and exacerbate a wide range of diseases, ill health and conditions such as cancer, asthma, coronary heart disease etc.

In 2005, a World Health Organisation (WHO) assessment of the burden of disease due to air pollution, identified that more than two million premature deaths each year can be attributed to the effects of urban outdoor and indoor air pollution.

The WHO set out air quality guidelines for the most significant pollutants and these guidelines were recommended to be used by policy makers at national and local level when setting standards.

1.2 Local Perspective

This report follows the 2010 'Air Quality Screening and Assessment' document and it seeks to provide a detailed review of air quality monitoring data collected in 2014 whilst also presenting a trend analysis of 2010 – 2014 data.

This report focuses on sources and levels of local ambient (outdoor) air pollution in comparison with the standards and objectives set in UK law. The 'standards' set concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment. An 'objective' is the target date on which exceedances of a Standard must not exceed a specified number. EU 'Limit' values are legally binding EU parameters that must not be exceeded and 'target' values are to be attained where possible by taking all necessary measures not entailing disproportionate costs.

Whilst these standards and objectives are not currently applicable to Guernsey, they can be considered to be a benchmark to measure Guernsey's current position against and for future standards to be implemented in local legislation.

This report details previous data and associated levels of compliance as well as the current level of compliance with air quality objectives. These data can be referenced to ensure that any future developments do not have a detrimental impact on air quality and that air pollution is prevented, or the risk minimised, to protect human health and the environment of Guernsey.

1.3 Aims and Objectives

The aims and objectives of this paper can be summarised as follows (Figure 1A)

Figure 1A Aims and Objectives

Aim

- To establish a longitudinal quantitative evidence base detailing the standard of the Island's ambient air quality levels

Objectives

- To identify existing sources of air pollution on Guernsey
- To review Guernsey's measured air quality data against air quality objectives
- To provide an holistic overview to inform a proposed local air quality strategy
- To provide a foundation which future screening can be assessed against to allow trend analysis of local air quality standards

This document is intended to present a quantitative appraisal of current and historical compliance and to provide an evidence base to inform environmental policy and legislation, most notably Part VII (Air Pollution) of the Environmental Pollution (Guernsey) Law, 2004.

This document will inform States of Guernsey Strategic Objectives through the provision of evidence to construct policies and strategies to protect and improve;

- the quality of life of Islanders
- the Island's economic future
- The Island's environment, unique cultural identity and rich heritage

and it will contribute to Environmental Policy objectives (Figure 1B).

Figure 1B States Strategic Plan Objectives Impacted by this Report

OVERALL STATES OBJECTIVES

Policies which protect the natural environment and its biodiversity by accounting for the wider impacts that human activity has on it

Maintenance and enhancement of Guernsey's standing in the global community

ENVIRONMENTAL POLICY OBJECTIVES

Climate change adaptation

Carbon footprint and energy consumption reduction

This report is also intended to facilitate the delivery of the two of the key tenets of the Health and Social Services Department's 2020 Vision; promoting good health and wellbeing across the community and protecting people through high-quality, well regulated services.

2 Air Quality Objectives

Objectives for air pollution are concentrations over a given time period that are considered to be acceptable in light of evidence about the effects of each pollutant on health and the environment.

The most relevant standards against which to compare Guernsey's air quality levels are the objectives adopted in the UK that are defined in the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland, published in 2007 and the standards that are contained within the Air Quality Standards Regulations 2010 (figures 2A and 2B).

Figure 2A UK Air Quality Objectives 2007

Pollutant	Objective	Measured as	Achieved by
Benzene All Authorities	16.25 $\mu g/m^3$	Running Annual Mean	31/12/03
Benzene England & Wales only	5 $\mu g/m^3$	Annual Mean	31/12/10
Benzene Scotland & Northern Ireland only	3.25 $\mu g/m^3$	Running Annual Mean	31/12/10
1,3-Butadiene	2.25 $\mu g/m^3$	Running Annual Mean	31/12/03
Carbon monoxide England, Wales & Northern Ireland only	10.0 mg/m^3	Max daily running 8 Hour Mean	31/12/03
Carbon monoxide Scotland only	10.0 mg/m^3	Running 8 Hour Mean	31/12/03
Lead	0.5 $\mu g/m^3$	Annual Mean	31/12/04
	0.25 $\mu g/m^3$	Annual Mean	31/12/08
Nitrogen dioxide	200 $\mu g/m^3$ Not to be exceeded > 18 times per year	1 Hour Mean	31/12/05
	40 $\mu g/m^3$	Annual Mean	31/12/05
Nitrogen Oxides**	(V) 30 $\mu g/m^3$	Annual Mean	31/12/00
Ozone*	100 $\mu g/m^3$	Running 8 hour Mean Daily max of running 8 hr mean not to be exceeded >10 times per year	31/12/05
Particles (PM_{10}) (gravimetric) All authorities	50 $\mu g/m^3$ Not to be exceeded > 35 times per year	24 Hour Mean	31/12/04
	40 $\mu g/m^3$	Annual Mean	31/12/04

Particles (PM_{10}) Scotland only	50 µg/m^3 Not to be exceeded >7 times per year	24 Hour Mean	31/12/10
	18 µg/m^3	Annual Mean	31/12/10
Particles ($PM_{2.5}$) Exposure Reduction Authorities in UK (except Scotland)	25 µg/m^3	Annual Mean	2020
Particles ($PM_{2.5}$) Exposure Reduction Authorities in Scotland only	12 µg/m^3	Annual Mean	2020
Particles ($PM_{2.5}$) Exposure Reduction Authorities in UK urban areas	Target of 15% reduction in concentrations at urban background	Annual Mean	Between 2010 & 2020
Polycyclic aromatic hydrocarbons All authorities	0.25 ng/m^3	Annual Mean	31/12/10
Sulphur dioxide	266 µg/m^3 Not to be exceeded > 35 times per year	15 Minute Mean	31/12/05
	350 µg/m^3 Not to be exceeded > 24 times per year	1 Hour Mean	31/12/04
	125 µg/m^3 Not to be exceeded >3 times per year	24 Hour Mean	31/12/04
	(V) 20 µg/m^3	Annual Mean	31/12/00
	(V) 20 µg/m^3	Winter Mean (01 Oct – 31 Mar)	31/12/00
µg/m^3 – micrograms per cubic metre mg/m^3 – milligrams per cubic metre *Ozone is not included in the Regulations ** Assuming NO_x is taken as NO_2			

Figure 2B Standards within the Air Quality Standards Regulations 2010

Pollutant	Averaging Period	Limit Value	Margin of Tolerance
SO_2	One hour	350 µg/m^3 not to be exceeded >24 times a calendar year	150 µg/m^3 (43%)
	One day	150 µg/m^3 not to be exceeded >3 times a calendar year	-
NO_2	One hour	200 µg/m^3 not to be exceeded >18 times a calendar year	-
	Calendar year	40 µg/m^3	-
Benzene	Calendar year	5 µg/m^3	-

CO	Max daily 8 hour mean	10 mg/m^3	-
Lead	Calendar year	0.5 µg/m^3	100%
PM_{10}	One day	50 µg/m^3 not to be exceeded >35 times a calendar year	50%
	Calendar year	40 µg/m^3	20%
$PM_{2.5}$	Calendar year	25 µg/m^3 by 01/01/15	20% on 11th June 2008, decreasing on the next 1st January & every 12 months thereafter by equal annual percentages to reach 0% by 01/01/14

Pollutant	Target for Total Content in PM_{10} Fraction Averaged Over Calendar Year	Compliance date
Arsenic	6 ng/m^3	31/12/12
Cadmium	5ng/m^3	31/12/12
Nickel	20 ng/m^3	31/12/12
Benzo(a)pyrene	1 ng/m^3	31/12/12

Pollutant	Objective	Averaging Period	Target Value
Ozone	Protection of human health	Max daily 8 hour mean	120 µg/m^3 not to be exceeded on >25 days per calendar year averaged over three years
	Protection of vegetation	May to July	AOT 40 (calculated from 1 h values) 18000 µg/m^3 .h averaged over 5 years

Pollutant	Averaging Period	Target Value
Particles ($PM_{2.5}$)	Calendar Year	25 µg/m^3

3 Monitoring Strategy

3.1 Overview

The Office of Environmental Health and Pollution Regulation has monitored air quality across the Island since 1992, however, the monitoring strategy adopted by the department has varied over time in response to emergent standards and objectives, the levels measured, potential local risk factors and due to resource management limitations.

The department has maintained a number of permanent air quality monitoring stations, predominantly in urbanised areas, to provide real-time continuous monitoring of the parameters that are perceived to present the greatest local risk. The number and location of the stations, the equipment used, the support service provider and the parameters measured have varied since inception in 1999 and figure 3A provides an overview of the variations in the permanent air quality monitoring sites.

Figure 3A Permanent Air Quality Monitoring Stations

	Year			
	1999 – 2008	**2009**	**2010 - 2013**	**2014 – present**
Stations & parameters monitored	Brock Road Youth Centre NO_x, SO_2 and PM_{10}	Brock Road Youth Centre NO_x and PM_{10}	Brock Road Youth Centre NO_x and PM_{10}	-
	Lukis House NO_x and CO levels	Lukis House NO_x and CO	Lukis House NO_x and CO	Lukis House NO_x and CO
	St Saviour Reservoir O_3	St Saviour Reservoir O_3	St Saviour Reservoir O_3	-
	-	-	Bulwer Avenue NO_x, SO_2 and PM_{10}	Bulwer Avenue NO_x, SO_2 and PM_{10}

Nitrogen dioxide and sulphur dioxide levels are also monitored on a monthly basis using diffusion tubes situated around Guernsey. The numbers and locations of tubes have varied in response to specific monitoring needs (e.g. as part of the Environmental Impact Assessment for the proposed Suez energy-from-waste plant) but an Island-wide geographic dispersion has been maintained since inception in 1992 in order to provide an overview of the levels of the pollutants of key local concern.

Diffusion tubes are a simple and cost-effective method to provide indicative measurements of ambient air quality and they are particularly useful for assessment against annual mean objectives. The low cost per tube permits sampling at a number of locations and this is, therefore, useful in highlighting 'hot spots' of high concentrations, such as alongside major roads.

3.2 Rationale for Pollutants not Monitored

The UK Air Quality Objectives 2007 specify objectives for eleven pollutants and the Air Quality Standards Regulations 2010 provide target values for an additional four pollutants. The Office of Environmental Health and Pollution Regulation currently monitors five of these pollutants (CO, NO_2, NO_x, PM_{10} and SO_2) but does not monitor for the remaining ten (benzene, 1,3-butadiene, lead, ozone, $PM_{2.5}$, polycyclic aromatic hydrocarbons, arsenic, cadmium, nickel and benzo(a)pyrene). The monitoring strategy is determined on a risk-basis and subject to resource limitations. An overview and rationale is presented below regarding the parameters that are not currently monitoring. It should also be highlighted that the monitoring strategy is subject to annual review and may change in the future.

3.2.1 Benzene

The air quality standard for benzene represents a risk to the population which is exceedingly small and due to (locally-prohibitively) high monitoring costs, there are currently only 4 sites across the whole of the UK (Harwell, London Eltham, London Marylebone Road and Auchencorth Moss) where benzene levels are routinely monitored as part of the United Kingdom’s Automatic Hydrocarbon Network.

Since January 2000, EU legislation has reduced the maximum benzene content of petrol to 1%, from a previous upper limit of 5%. Emissions of benzene from the storage and distribution of petrol can also be controlled by vapour recovery systems although these are not mandatory in Guernsey.

Locally the main source of benzene emissions is from motor vehicles. Benzene was monitored in Guernsey by AEA Technology in 2000 in conjunction with an air quality baseline survey relating to the proposed Lurgi ‘waste to energy’ plant. The data did not indicate any exceedances of the air quality objective. In 2013 benzene was monitored at 6 sites across the Island over a 1 month period. The levels were below the detectable limits of the monitoring equipment at five of the sites and was 1.4 $\mu g/m^3$ (monthly mean) at the remaining site. This is not directly comparable to the UK objective values as these are 5 $\mu g/m^3$ as an annual mean and 3.25 $\mu g/m^3$ as a running annual mean. It does, however, indicate that benzene levels are unlikely to pose an immediate concern.

Technical Guidance LAQM TG(03) provides five categories against which local benzene levels can be assessed and these categories have subsequently been used to estimate contributors to local benzene levels. Given the scale of contributing factors on Guernsey and having considered historical data it is unlikely that the air quality objective for benzene would be exceeded.

3.2.3 1,3-Butadiene

1,3-Butadiene is derived mainly from the combustion of petroleum in motor vehicle engines and from other sources of combustion of fossil fuels and accidental fires.

Risks to the general population from the levels currently found in the atmosphere in the United Kingdom (UK) are exceedingly small. The UK Government has, however, still set very low levels as the required standard in the air we breathe.

Similar to benzene, 1,3-butadiene is monitored at four stations across the UK as part of the Automatic Hydrocarbon Network. In 2013, at the Marylebone Road monitoring site in central London, the annual mean level was 0.21 $\mu g/m^3$ which is considerably below the 2.25 $\mu g/m^3$ running annual mean objective.

Guernsey does not monitor 1,3-butadiene due to the aforementioned low levels within the UK and as the levels of the compound have been shown to correlate closely with levels of CO and NO_x. These compounds are monitored within the Island and this, coupled with the great expense that is associated with 1,3-butadiene monitoring, has meant that the concept of a 1,3-butadiene monitoring system was rejected. The likelihood of the Air Quality objective for 1,3-butadiene being exceeded in Guernsey is, however, considered negligible.

3.2.4 Lead

The two main sources of exposure for the general public can be considered to be contamination of drinking water from lead pipes and contamination of the air from industrial sources.

In the UK there has been a steady decline in lead levels in the air over the past 20 years and the phased introduction of unleaded petrol has continued this improvement.

Lead is not measured in Guernsey as airborne lead levels have been shown to be decreasing since 1981. This is due to the aforementioned phased removal of leaded fuel and introduction of unleaded petrol during the 1990s. Despite the increase in petrol consumption over recent years lead emission from traffic has decreased significantly and atmospheric concentrations of lead are typically well under the thresholds set by the EU.

The likelihood of the Air Quality objective for lead being exceeded in Guernsey is negligible and further monitoring is currently not considered necessary.

3.2.5 Ozone (O_3)

Ozone is a pollutant that is greatly affected by transboundary air flows and for this reason it is difficult to control at a local level and instead a more international, and global, approach must be taken.

Ozone was monitored locally from 1999 – 2010. Annually, 10 exceedances are allowed of the 100 µg/m^3 8-hour mean level and between 2008 – 2009 there were only 3 exceedances of this level.

As previously stated ozone is a pollutant that is greatly affected by transboundary airflows and for this reason it cannot be controlled at a local level but the likelihood of the Air Quality objective for ozone being exceeded in Guernsey is considered unlikely.

3.2.6 $PM_{2.5}$

Particles less than 2.5 micrometers in diameter ($PM_{2.5}$) are referred to as "fine" particles and are believed to pose the greatest health risks. Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning etc) and certain industrial processes.

$PM_{2.5}$ are currently not measured on-Island but a percentage of PM_{10} particles that are monitored will be composed of the smaller $PM_{2.5}$ particles. Given that Guernsey's annual mean level of PM_{10} in 2014 was 27 µg/m^3, it is reasonable to hypothesise that the 25 µg/m^3 UK objective for $PM_{2.5}$ would have been achieved but there is uncertainty whether the 12 µg/m^3 Scottish target level would be exceeded on-Island.

Given the greater risk to health posed by $PM_{2.5}$ particles, consideration is recommended to the provision of local monitoring facilities and this should be considered during the natural replacement process of the existing particulate monitoring equipment.

3.2.7 Polycyclic Aromatic Hydrocarbons and Benzo(a)pyrene

Polycyclic aromatic hydrocarbons (PAHs) are a group of persistent organic compounds, some of which are toxic and have possible carcinogenic properties; they are produced via incomplete combustion of carbon containing fuels from industrial, commercial, vehicular and residential sources. Benzo[a]pyrene is commonly used as an indicator species and target values refer to benzo(a)pyrene as a representative of PAHs.

Benzo(a)pyrene and other PAHs are classed as persistent organic pollutants (POPs) under the United Nations Economic Commission for Europe (UNECE) POPs protocol. PAHs' release to the environment is quite widespread as they are a product of incomplete combustion. Major man-made sources are vehicle emissions and wood and coal combustion and PAHs are also present in small quantities in tobacco smoke. Natural sources of PAHs include volcanoes and natural fires. Industrial manufacture of PAHs for use in dyes is very limited in comparison to its production from combustion sources.

Although environmental concentrations are highest near emission sources, the presence of PAHs in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport. This raises the possibility of adverse health and wildlife effects occurring in places remote from the site of emission.

Vehicle emissions and domestic and commercial burning and combustion will be the major local contributors to local levels of PAHs although there are no major industrial contributors on-Island.

There is currently no evidence to determine whether the target values for benzo(a)pyrene and PAHs could be achieved locally as there are no representative monitoring data and the impact of vehicle emissions and wood and coal combustion cannot be quantified. Consideration should, therefore, be given to running a short-term monitoring programme, after which the merits of further monitoring can be verified.

3.2.8 Arsenic, Cadmium and Nickel

Arsenic is released to the atmosphere from both natural and anthropogenic (manmade) sources. The principal natural source is volcanic activity, with minor contributions by exudates from vegetation and windblown dusts. Man-made emissions to air arise from the smelting of metals, the combustion of fuels, especially of low-grade brown coal and the use of pesticides.

Globally approximately 85–90% of total airborne cadmium emissions arise from anthropogenic sources, mainly from smelting and refining of nonferrous metals, fossil fuel combustion and municipal waste incineration. The natural source of cadmium is volcanic emissions.

Combustion of coal and other fossil fuels leads to release of nickel to the atmosphere. Other sources of atmospheric nickel include emissions from mining and refining operations, steel production, nickel alloy production, electroplating, and municipal waste incineration. Sources of nickel in water and soil include wastewater from municipal sewage treatment plants. Nickel oxide has been identified in residual fuel oil and in atmospheric emissions from nickel refineries. Vehicles running on petrol and diesel fuel can also contribute to nickel emissions to the atmosphere.

With regard to arsenic, cadmium and nickel, there are currently no industrial processes on-Island that are likely to be significant point source contributors. Transboundary influences cannot be discounted although they are likely to be negligible, especially given the regional topography and the distance to major environmental sources (i.e. volcanoes).

The likelihood of the target values for arsenic, cadmium and nickel being exceeded in Guernsey is considered unlikely and there is currently no imminent necessity for these parameters to be monitored.

4 2014 Compliance

Figures 4A – 4F summarise the 2014 ambient air quality data that was collected from the permanent monitoring stations and the diffusion tubes. Figures 4B and 4E detail the compliance of data from the permanent monitoring stations with the UK air quality standards. Figures 4G and 4H depict the data from the diffusion tubes for 2014.

In the following tables, a green shaded box represents data that comply with the objective, standard or target value and a red shaded box shows an exceedance of the required level. A '-' indicates that no data were collected. The bandings referred to in rows 2 – 5 of figures 4A and 4D refer to the Department for Environment, Food and Rural Affairs' (DEFRA) Daily Air Quality Index (DAQI).

Figure 4A 2014 Bulwer Avenue Permanent Monitoring Station Data Overview

	NO	NO_2	NO_x	SO_2	PM_{10}
Number of days low	-	212	-	0	267
Number of days moderate	-	0	-	0	9
Number of days high	-	0	-	0	2
Number of days very high	-	0	-	0	0
Max 15 minute SO_2 (µg/m^3)	-	-	-	-	-
Max daily mean (µg/m^3)	94	116	217	17	82
Annual max (µg/m^3)	568	180	1050	45	196
Annual mean (µg/m^3)	12	23	41	9	27
Annual data capture (%)	57.6	57.6	57.6	19.7	84.3

Figure 4B Compliance of Bulwer Avenue Data with Air Quality Standards

Pollutant	Air Quality Standard	Exceedances	Days
PM_{10}	Daily mean > 50 µg/m^3 (UK)	11	11
PM_{10}	Annual mean > 40 µg/m^3 (UK)	0	-
PM_{10}	Daily mean > 50 µg/m^3 (Scotland)	11	11
PM_{10}	Annual mean > 18 µg/m^3 (Scotland)	1	-
NO_2	Hourly mean > 200 µg/m^3	0	0
NO_2	Annual mean > 40 µg/m^3	0	-
SO_2	15 minute mean > 266 µg/m^3	0	0
SO_2	Hourly mean > 350 µg/m^3	0	0
SO_2	Daily mean > 125 µg/m^3	0	0
SO_2	Annual mean > 20 µg/m^3	0	-
SO_2	Winter mean > 20 µg/m^3	0	-

Figure 4C Graphs of Bulwer Avenue 2014 Data

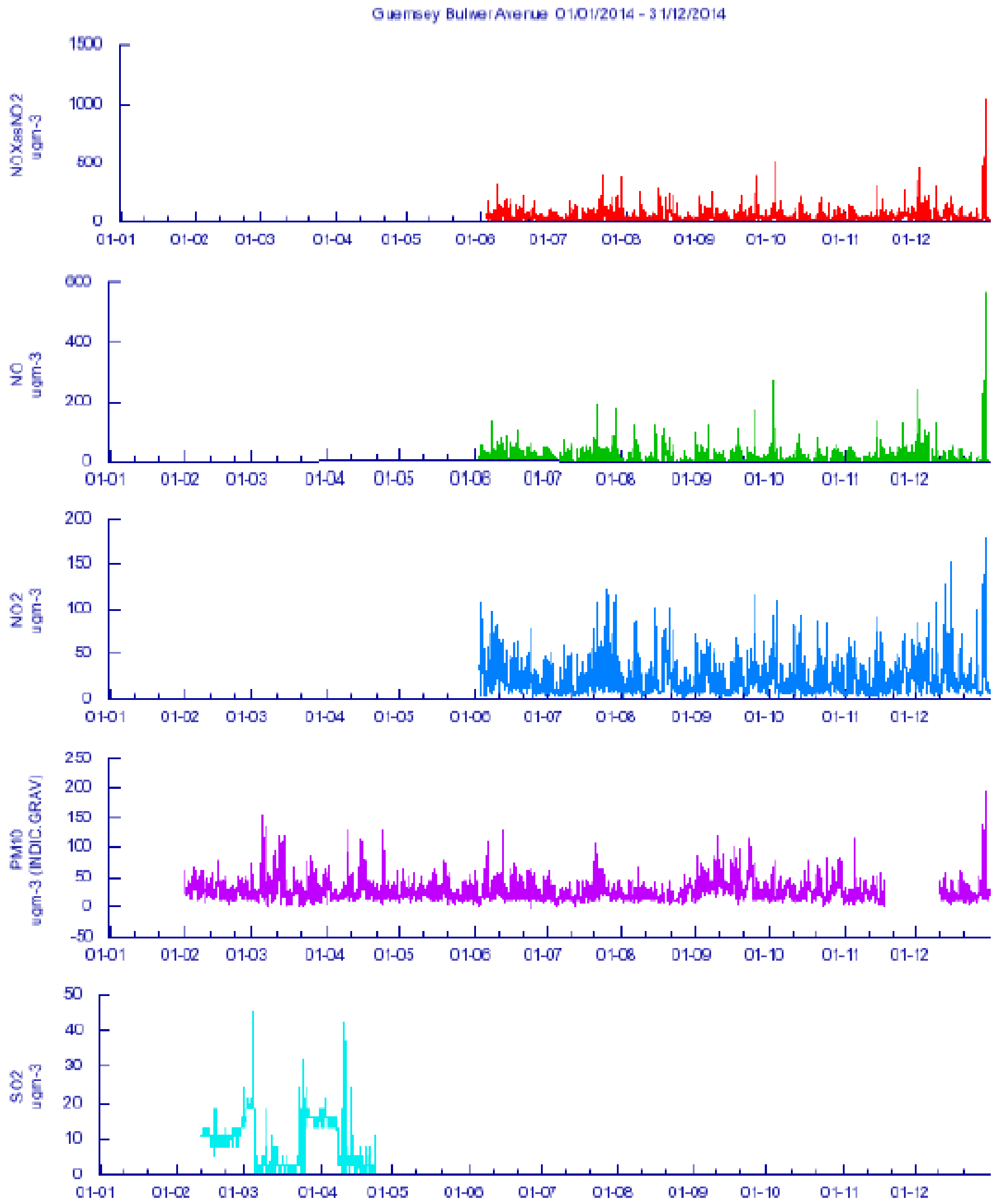


Figure 4D 2014 Lukis House Permanent Monitoring Station Data Overview

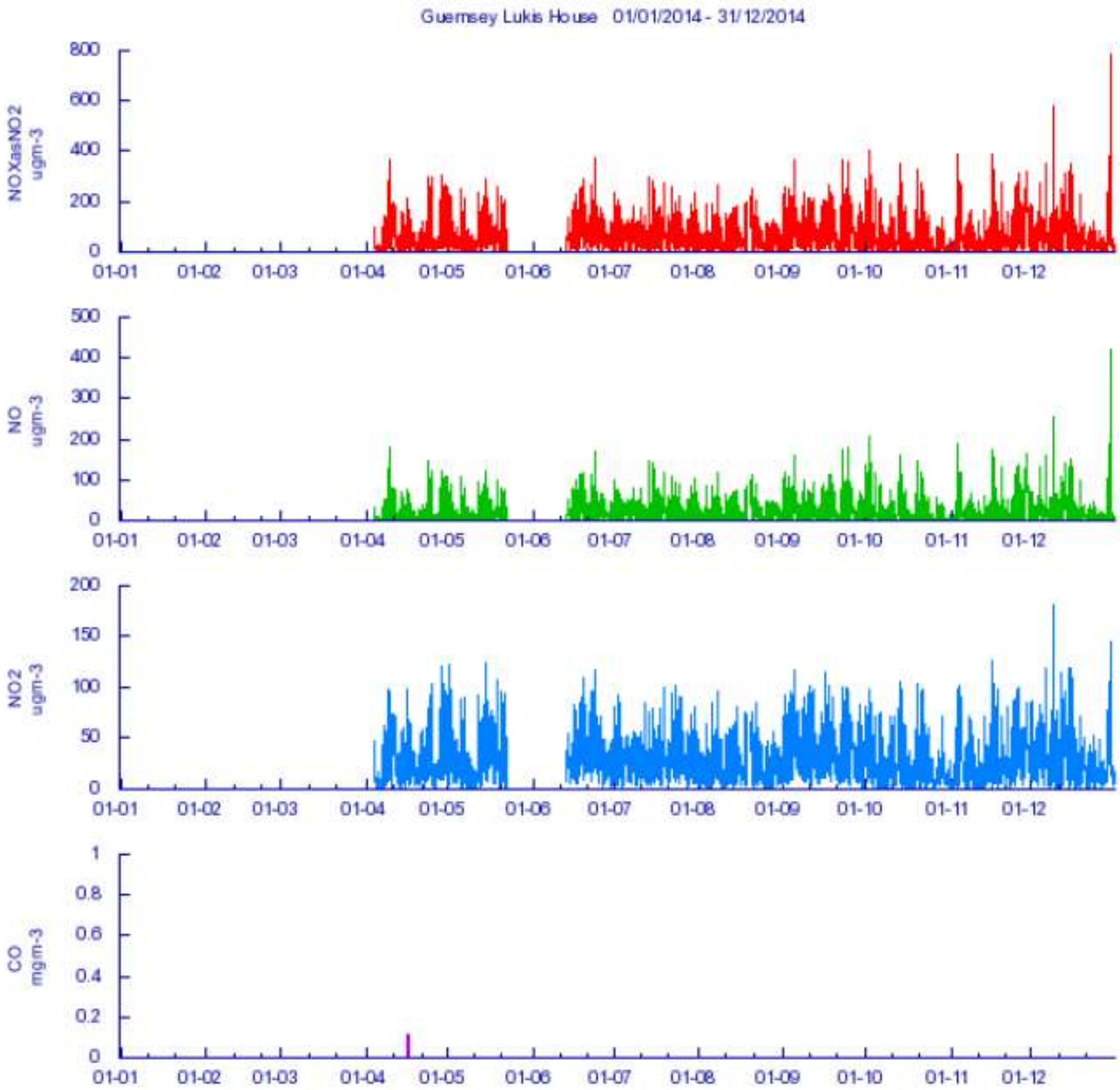
	NO	NO_2	NO_x	CO
Number of days low	-	252	-	0
Number of days moderate	-	0	-	0
Number of days high	-	0	-	0
Number of days very high	-	0	-	0
Max 8 hour CO (µg/m^3)	-	-	-	-
Max daily mean (µg/m^3)	85	66	189	-
Annual max (µg/m^3)	419	182	788	0
Annual mean (µg/m^3)	24	30	68	0
Annual data capture (%)	67.9	67.9	67.9	0.26

Figure 4E Compliance of Lukis House Data with Air Quality Standards

Pollutant	Air Quality Standard	Exceedances	Days
CO	Daily max 8 hour running mean > 10 µg/m^3	0	0
CO	Hourly mean > 200 µg/m^3	0	0
NO_2	Annual mean > 40 µg/m^3	0	-

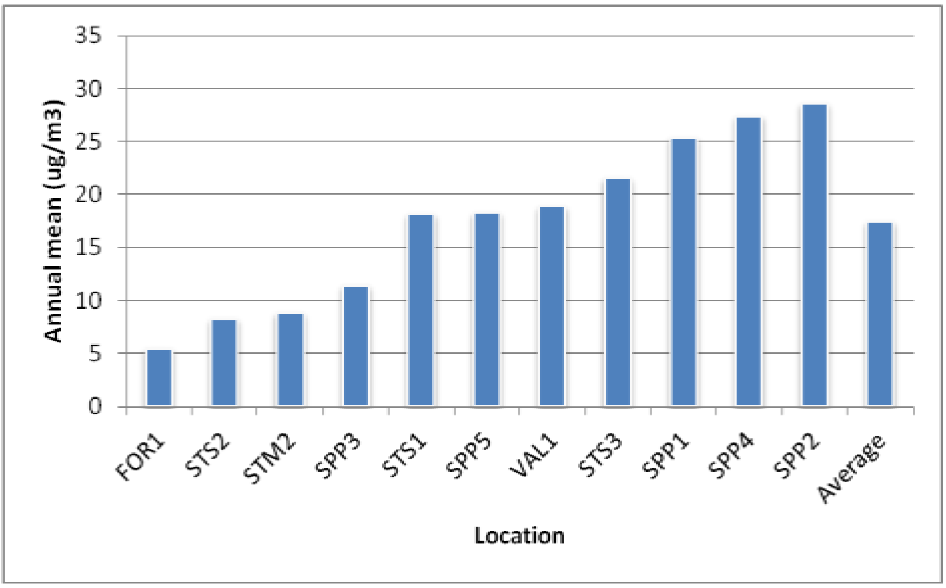
Figures 4B and 4E demonstrate that in 2014 the parameters measured at the permanent monitoring stations were compliant with the UK standard values. Figure 4B does, however, highlight that in 2014 Guernsey did not comply with the more stringent Scottish standards for PM_{10}. The monitoring location is on a busy thoroughfare between St Sampson and St Peter Port and it is also an industrialised area. This is likely to account for one of the areas most prone to particulate contamination on-Island but, nevertheless, it cannot be ignored that this location would not meet the necessary standards that are required in Scotland. It should also be noted that these data are based on 84% data capture and additional monitoring may affect the number of exceedances noted. These data indicate that particulates are a pollutant of concern on-Island and that monitoring of particulates should remain a high priority.

Figure 4F Graphs of Lukis House 2014 Data



Figures 4G and 4H provide the annual mean levels of NO_2 and SO_2 as recorded using diffusion tubes at various locations spanning the Island. It should be noted that at the time that this document was produced the 2014 bias adjustment data were not available therefore the 2013 adjustment figures were used. There has been no notable variance in the adjustment ratios over the previous 5 years therefore this will not lead to any significant changes and is noted as a technical observation.

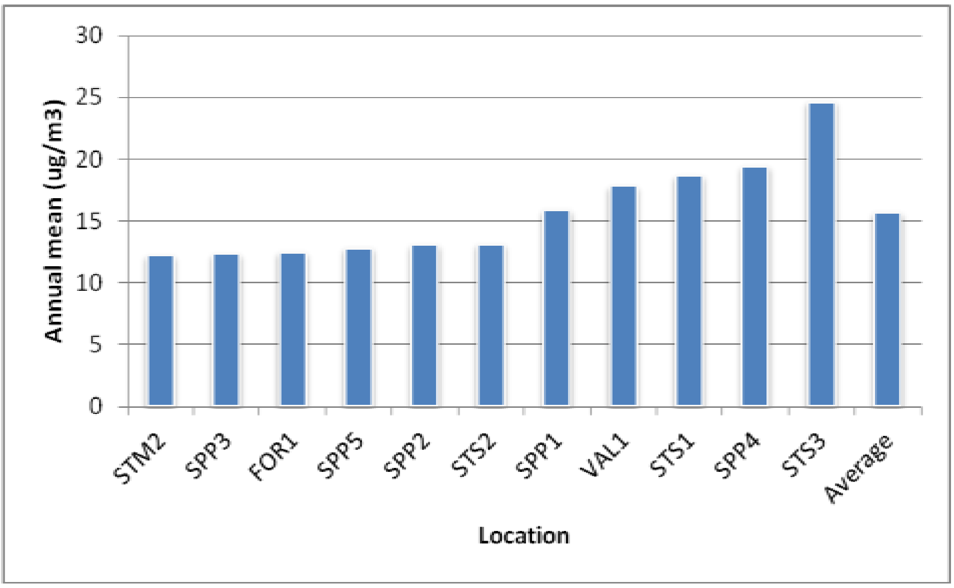
Figure 4G Annual Mean NO_2 Levels by Monitoring Location (Diffusion Tubes)



Abbreviaton	Location
FOR1	Corbiere
SPP1	College Street
SPP2	Fountain Street
SPP3	Commercial Arcade
SPP4	Albert Statue
SPP5	Trinity Square
STM2	PEH
STS1	Southside
STS2	La Passee
STS3	Les Banques
VAL1	Vale Avenue

The annual mean objective level for NO_2 is 40 µg/m^3 and figure 4G clearly illustrates that this level is being achieved as an Island average and across each individual monitoring location. The levels monitored by the Albert Statue, Fountain Street and College Street are, however, higher than other roadside locations and they indicate 'hot spot' areas for localised pollution (whilst remaining within compliance parameters) likely to be attributable to traffic.

Figure 4H Annual Mean SO_2 Levels by Monitoring Location (Diffusion Tubes)



Abbreviaton	Location
FOR1	Corbiere
SPP1	College Street
SPP2	Fountain Street
SPP3	Commercial Arcade
SPP4	Albert Statue
SPP5	Trinity Square
STM2	PEH
STS1	Southside
STS2	La Passee
STS3	Les Banques
VAL1	Vale Avenue

The objective levels for SO_2 are set over 15 minute, 1 hour and 24 hour mean periods therefore the annual mean cannot be directly compared to these limits. These levels are reviewed against the permanent monitoring station data. The target values for SO_2 are 20 µg/m^3 as both an annual and winter mean. The diffusion tube data illustrate that the annual mean target value is being achieved as an Island average and at 10 of the monitoring locations but it is being exceeded at Les Banques. The College Street, Vale Avenue, Southside and Albert Statue locations are all above an annual mean of 15 µg/m^3 and are therefore locations of concern due to the proximity to the target value. Similar to the SO_2 diffusion tube comments, these high readings are likely to be related to traffic and congestion issues.

5 Trend Analysis of Historic Compliance (2010 – 2014)

The 2010 Air Quality Screening and Assessment Document provided a snapshot of air quality on Guernsey and this document seeks to provide historical context to bridge between current data and the last report. A trend analysis of data from 2010 to 2014 has therefore been provided and the data are presented in figure 5A.

Figure 5A Compliance with National Air Quality Objectives and European Directive Limit and Target Values for the Protection of Human Health

	Objective	Measured as	Site	2010	2011	2012	2013	2014
SO_2	266 $\mu g/m^3$ Exceeded < 35 / yr	15 Minute Mean	Bulwer Avenue	0 exceedances	0 exceedances	0 exceedances	0 exceedances	0 exceedances
			Brock Road	0 exceedances	0 exceedances	-	-	-
	350 $\mu g/m^3$ Exceeded < 24 / yr	1 Hour Mean	Bulwer Avenue	0 exceedances	0 exceedances	0 exceedances	0 exceedances	0 exceedances
			Brock Road	0 exceedances	0 exceedances	-	-	-
	125 $\mu g/m^3$ Exceeded < 3 / yr	24 Hour Mean	Bulwer Avenue	20 exceedances	1 exceedance	0 exceedances	0 exceedances	0 exceedances
			Brock Road	0 exceedances	0 exceedances	-	-	-
	(V) 20 $\mu g/m^3$	Annual Mean	Bulwer Avenue	14.1	5.7	14.8	8.1	9
			Brock Road	10.6 (Sept – Dec)	8.9 (Jan – Oct)	-	-	-
	(V) 20 $\mu g/m^3$	Winter Mean (Oct – Mar)	Bulwer Avenue	7.1 (Oct – Nov)	10.9 (Nov – Dec)	24.0	5.5	-
			Brock Road	8.1	-	-	-	-
CO	10.0 mg/m^3	Max daily running 8 Hour Mean	Lukis House	1.1 (Sept – Oct)	1.3	2.9 (Jan – July)	1.2 (Jan – Nov)	1.5 (Jan-March)
PM_{10}	50 $\mu g/m^3$ Exceeded < 35 / yr	24 Hour Mean	Bulwer Avenue	58 exceedances (Sept – Dec)	99 exceedances (Jan – Oct)	-	-	11 exceedances
	40 $\mu g/m^3$	Annual Mean	Bulwer Avenue	40.5 (Sept – Dec)	57.7 (Jan – Oct)	-	-	27
	50 $\mu g/m^3$ Exceeded < 7 / yr	24 Hour Mean	Bulwer Avenue	58 exceedances (Sept – Dec)	99 exceedances (Jan – Oct)	-	-	11 exceedances
	18 $\mu g/m^3$	Annual Mean	Bulwer Avenue	40.5 (Sept – Dec)	57.7 (Jan – Oct)	-	-	27

NO_2	200 µg/m^3 Exceeded < 18 / yr	1 Hour Mean	Bulwer Avenue	3 (Jan – Oct)	0 exceedances	0 exceedances	8 exceedances	0 exceedances
			Lukis House	0 exceedances	0 exceedances	0 exceedances	0 exceedances	0 exceedances
			Brock Road	0 exceedances	0 exceedances	-	-	-
	40 µg/m^3	Annual Mean	Bulwer Avenue	21.3	20.3	26.4	53.2	23
			Lukis House	45.8 (Sept – Dec)	48.8	27.8	26.8	30
			Brock Road	7.4 (Sept – Dec)	9.8 (Jan – Oct)	-	-	-
NO_x	(V) 30 µg/m^3	Annual Mean	Bulwer Avenue	40 (March – Dec)	38.3	38.5 (Jan – June)	-	41
			Lukis House	108.8 (Sept – Dec)	109.8	77.0	39.4 (Jan – March & Nov)	68
			Brock Road	9.8 (Sept – Dec)	12.2 (Jan – Oct)	-	-	-

5.1 Sulphur Dioxide

The sulphur dioxide levels measured at Bulwer Avenue and Brock Road have complied with the 15 minute, 1 hour, 24 hour and annual mean values between 2011 and 2014. In 2010 20 exceedances of the 24 hour mean value were noted at the Bulwer Avenue site. No more than 3 exceedances are supposed to be achieved per calendar year. Having reviewed the historical data, serious concerns have been raised about the validity of the readings, especially as problems were reported with the analysing equipment. These readings cannot, however, be discarded outright although caution is recommended when considering the implications of these data, especially as only one other exceedance has been noted over the following four years.

In 2012 there was an exceedance of the winter mean value (24 µg/m^3 rather than the target value of 20 µg/m^3) but a significant decrease was, however, visible the following year.

There is variation with the annual mean sulphur dioxide levels that have been measured with peaks noted in 2010 and 2012. The 2012 annual mean was the highest recorded (14.8 µg/m^3) although this is notably within the 20 µg/m^3 target value.

5.2 Carbon monoxide

The maximum daily running 8 hour mean levels recorded between 2010 and 2014 were considerably lower than the 10.0 mg/m^3 objective value with 2.9 mg/m^3 being the highest level over the 5 year period. Whilst the 2012 maximum value is notably greater than the other years over the period the trend for the values over the 5 year period is relatively static. It should be highlighted that the 2012 value is the maximum 8 hour value over the year and generally the monitored levels were consistently low across the monitoring period. This is especially noteworthy considering this was monitored at a roadside site on a busy thoroughfare in St Peter Port.

5.3 PM_{10} Particles

Breaches of the 24 hour and annual mean UK and Scottish values were observed at the Bulwer Avenue site in 2010 and 2011. In 2014 the UK standards were achieved but the Scottish standards were exceeded. Trend analysis is difficult as there is concern over the validity of the 2010 and 2011 data. There is, however, strong confidence in the 2014 data and these raise concern that Scottish standards are being breached locally.

5.4 Nitrogen Dioxide and Nitrogen Oxides

Up to 18 exceedances of the 1 hour mean objective level for NO_2 are permissible and this was achieved at the Lukis House, Brock Road and Bulwer Avenue sites across the monitoring period. 8 exceedances were noted in 2013 but generally no exceedances were witnessed throughout the period.

The annual mean level for NO_2 was complied with in 2010 and 2011 at Brock Road. The 2011 annual mean was the highest recorded at this site but it was only 9.8 µg/m^3 which is considerably under the 40 µg/m^3 objective value. At Lukis House, the annual mean level was exceeded in 2010 and 2011 and then subsequently complied, with incremental annual decreases, from 2012 – 2014. This trend was not mirrored at the Bulwer Avenue site where compliance was achieved between 2010 – 2012 and an exceedance in 2013 was followed by compliance in 2014. Other than the exceedance in 2013 the NO_2 levels monitored at Bulwer Avenue remain relatively constant over the monitoring period considered.

The Lukis House site NO_x data presented an increasing annual mean from 2010 – 2011, a decrease for two year and a further increase in 2014. Exceedances of the annual mean NO_x value were noted across the monitoring period. Similarly Bulwer Avenue data failed to comply with the standards from 2010 – 2014 although the data remained relatively static. The Brock Road site, conversely, remained compliant in 2010 and 2011. Failure of the NO_x standard at two sites across the period in questions demonstrates that NO_x is a pollutant of concern and risk locally.

5.5 Data Capture

When considering the data within figure, 4A, 4D and 5A it is clear that there have been notable periods where data capture has been poor across all of the stations. Difficulties with the equipment malfunctioning and the cost associated with running three permanent air quality monitoring stations led to a rationalisation of sites and equipment in 2014. Since a new contract was undertaken in 2014 equipment failure has continued to hamper data capture. The age of the equipment and the fact that service engineers have to visit from the UK (as there are no local service providers) continues to pose a risk to the integrity of data and this is acknowledged but remains unsatisfactory. The department is refining the contract with the service provider to try to improve data capture but further investment is necessary to maintain and upgrade equipment. Budget challenges have already led to a reduction in sampling locations and equipment and financial investment is necessary to ensure that proportionate local air quality monitoring facilities are maintained on-Island.

5.6 Nitrogen Dioxide and Sulphur Dioxide Diffusion Tubes

Figures 5B and 5D illustrate the annual mean levels of the monitored pollutants averaged across all of the monitoring sites. Figure 5C and 5E illustrate the annual average levels across the individual monitoring locations from 2010 – 2014.

The target value for SO_2 is 20 $\mu g/m^3$ as both an annual and winter mean is being achieved as an Island annual value and this is a positive observation. There is, however, a clear and notable rise in annual levels since 2011 with an Island annual average of 15.7 $\mu g/m^3$ measured in 2014. If the same rate of increase between 2013 and 2014 was observed between 2014 and 2015, this would lead to an exceedance of the target value. The 2014 data (Section 4) depict that there is already an exceedance of the target value at one monitoring location with four other sites presenting concern. Figure 5C further illustrates the general trend of increasing annual mean levels across most monitoring locations with a further exceedance noted in the Commercial Arcade (SPP3) in 2012. Localised and Island-wide levels of SO_2 are, therefore, issues that should be addressed as a priority if compliance is to be achieved and maintained.

Figure 5B Annual Island Average SO_2 Levels by Year

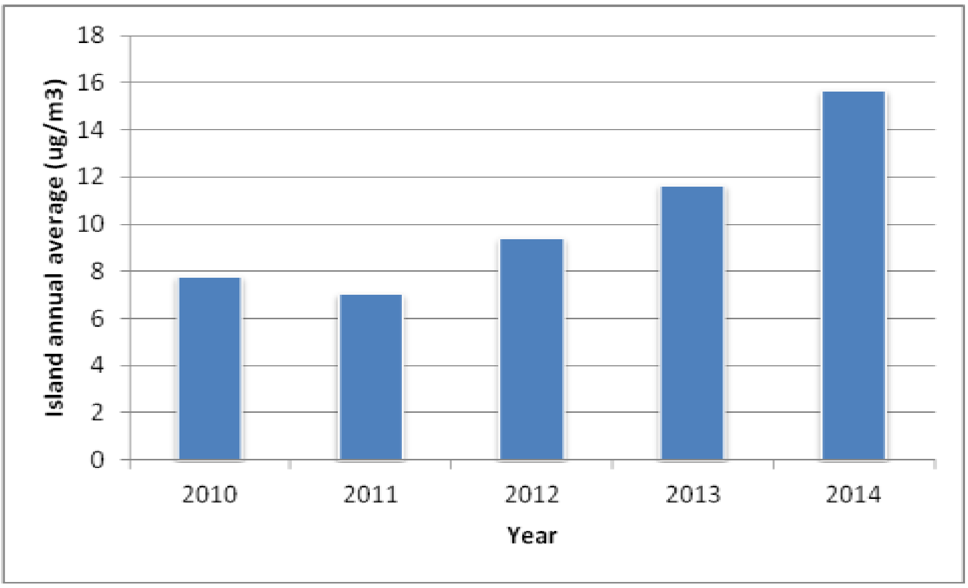
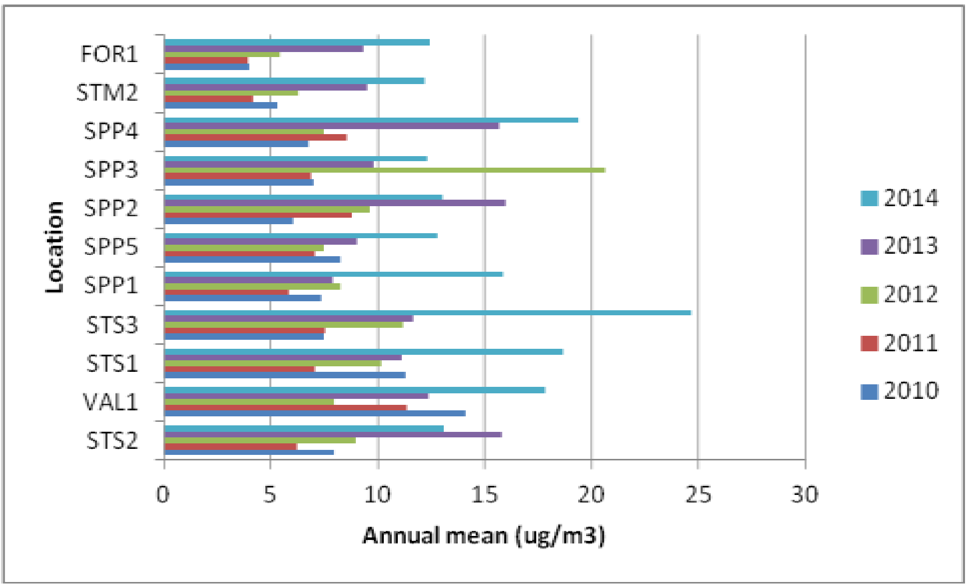


Figure 5C Annual Average SO_2 Levels by Year by Monitoring Location



Abbreviaton	Location	Abbreviaton	Location
FOR1	Corbiere	STM2	PEH
SPP1	College Street	STS1	Southside
SPP2	Fountain Street	STS2	La Passee
SPP3	Commercial Arcade	STS3	Les Banques
SPP4	Albert Statue	VAL1	Vale Avenue
SPP5	Trinity Square		

Figure 5D Annual Island Average NO_2 Levels by Year

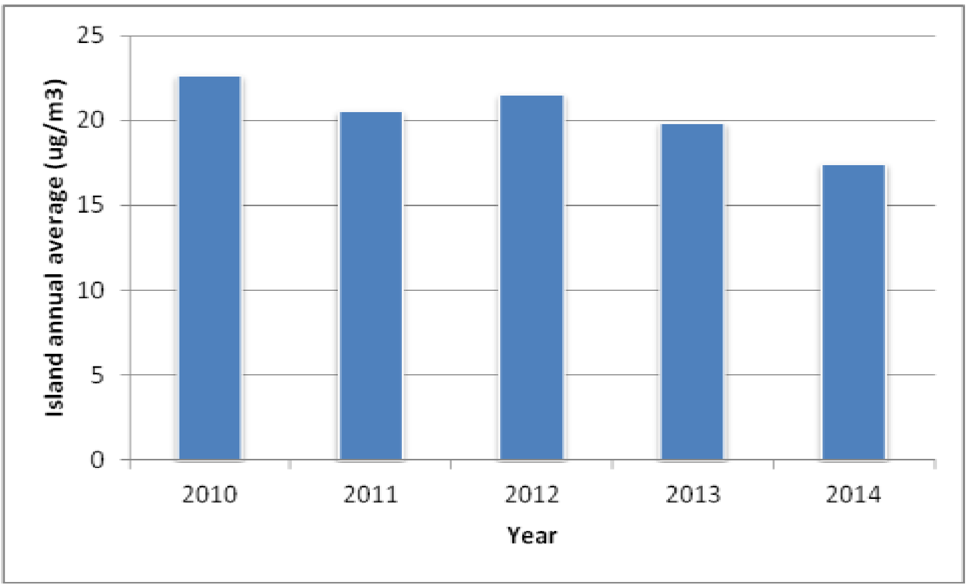
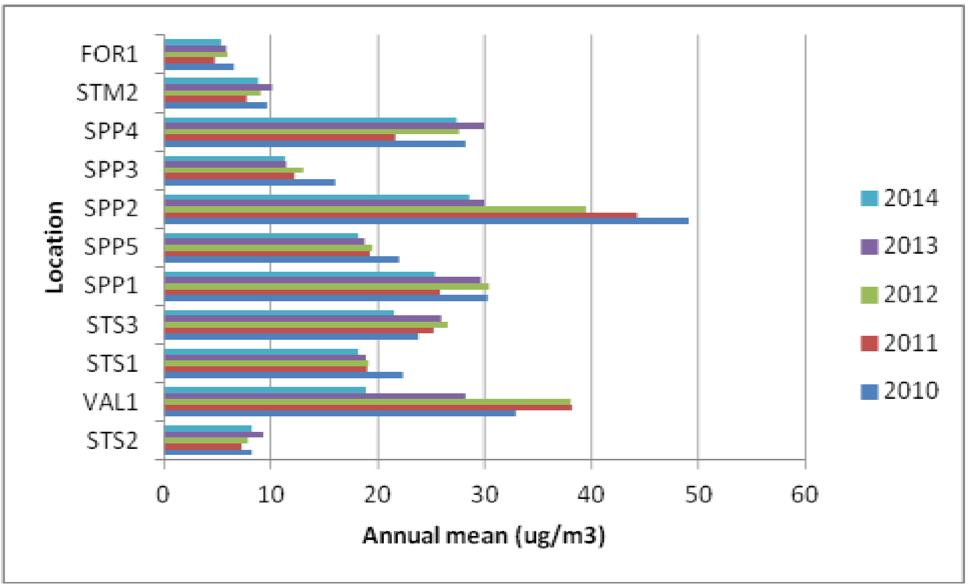


Figure 5E Annual Average NO_2 Levels by Year by Monitoring Location



Abbreviaton	Location	Abbreviaton	Location
FOR1	Corbiere	STM2	PEH
SPP1	College Street	STS1	Southside
SPP2	Fountain Street	STS2	La Passee
SPP3	Commercial Arcade	STS3	Les Banques
SPP4	Albert Statue	VAL1	Vale Avenue
SPP5	Trinity Square		

The annual mean objective level for NO_2 is 40 µg/m^3 and figure 5D illustrates that this level is being complied with as an Island average and also that there is a downward trend in NO_2 levels across the Island. Whilst the noted downward trend is a promising observation this should not overshadow the observations in Section 4 that there are still localised roadside locations of concern where traffic is causing compliant, yet elevated levels of concern. This is further emphasised by figure 5E which shows that exceedances of the annual mean level were measured at the Fountain Street (SPP2) site in 2010 and 2011. The 2012 Fountain Street annual mean level and the 2011 and 2012 Vale Avenue (VAL1) annual mean levels are also close to breaching the prescribed UK limit.

5.7 Overall Trends

The sulphur dioxide trends observed using the diffusion tubes are not mirrored by data from the permanent monitoring stations. The data from the permanent monitoring stations indicate low roadside annual mean readings in 2013 and 2014 but with raised levels in 2010 and 2012. The diffusion tube data, however, indicate an Island average increase since 2011 with a peak of 15.7 µg/m^3 measured in 2014. Closer scrutiny of the data indicates that one site (Les Banques) was exceeding the annual mean level with 4 additional roadside sites in St Peter Port and St Sampson with levels of concern (in 2014). The diffusion tube data indicate that raised sulphur dioxide levels are associated with local hotspots in ‘urban’ locations and that these levels are contributing to an overall rise, of concern, of the Island average value.

There are no issues of current concern regarding the overall trend for carbon monoxide levels as the monitored levels remain relatively static and in 2014 they were only 15% of the permissible daily running 8 hour mean value. It should, however, be highlighted that there was very limited data capture in 2014 (<1%) and the monitoring equipment remains non-operational. Whilst the historical data do not predict local problems with this pollutant, lack of ability to monitor compliance presents a risk.

Historical data for particulates are of questionable validity but 2014 data demonstrate that Guernsey complied with UK standards but not the more rigorous standards applied to Scotland. The fact that $PM_{2.5}$ are not monitored locally and cannot be quantified means that particulates remain a pollutant of risk.

It is difficult to readily compare the nitrogen dioxide trends observed using the permanent monitoring stations with the diffusion tube data due to the variable quality and periods of data capture from the permanent monitoring stations. The general trend of declining island-average levels of nitrogen dioxide shown by the diffusion tubes is not reflected in the data from the permanent monitoring stations. The nitrogen dioxide data from Bulwer Avenue in 2013 and Lukis House in 2010 and 2011 indicate exceedances of concern. The 2013 Bulwer Avenue data remains an anomaly as the Lukis House exceedances are believed to be unreliable data. With these exceedances withstanding, the data from both sites generally shows relatively static annual mean levels. This, however, masks 'hot spots' of concern regarding air quality that can be illustrated by the exceedances recorded using diffusion tubes at Fountain Street and the elevated levels monitored at Value Avenue.

The continued failure to comply with the standards for nitrogen oxides across two permanent monitoring sites throughout the monitoring period is also an area of concern.

6 Conclusions

Whilst Guernsey cannot be considered to be an urban area there is a high percentage of vehicle ownership and use which means that road transport is a significant contributor to local pollution levels. The other major contributors to local pollution are the Power Station, airplane and boat movements to and from the airport and ports and the domestic use of fossil fuels.

The contribution of the Power Station is the greatest point source on-Island although due to the efflux velocity from, and height of, the stack the dispersion and subsequent dilution of pollutants substantially reduces the on-Island impact of pollutants. It should also be noted that the Power Station is only a contributor during phases of energy production and the majority of electricity used on Guernsey is generally imported via the cable link with France.

Over the five year period considered for this report, it is positive to note that ongoing compliance with standards for carbon monoxide and nitrogen dioxide has been achieved. Whilst air quality across the island is generally shown to be compliant, it is clear that there are pollutants (sulphur dioxide, particulates and nitrogen dioxides) and locations of concern. Failure to take action to prevent continued exceedances or to address areas of increasing pollutant concentrations will lead to increasing negative health impacts on-Island.

It, therefore, remains of concern that there are no locally-adopted air quality standards and that there are insufficient regulatory mechanisms to address point or line sources of pollution. In order to ensure that the Island is protected from current and emergent sources of pollution Part VII (Air Pollution) of the Environmental Pollution (Guernsey) Law, 2004 should be implemented to provide clearly defined locally-relevant standards against which to benchmark and to provide a regulatory framework to ensure compliance can be achieved.

The States Strategic Plan, Environmental Policy Plan and HSSD's 20:20 Vision show a commitment to providing a safe and sustainable local environment and high-level, long-term strategic considerations must continue to ensure that these themes are embedded within existing and new strategies and policies. Health improvement policies driven by or allied to the States, as well as those run by the private and third sectors should encourage a reduction in motor vehicle use or a decreased reliance on fossil fuels locally.

A solid evidence base exists to demonstrate the level of historical and ongoing compliance with UK objectives and targets and it is imperative that this is maintained and that investment is made into the air quality monitoring programme. Whilst a clear rationale has been provided why it is not necessary, proportionate or cost-effective to monitor all of the parameters within the UK air quality objectives further consideration should be given regarding the scope of future monitoring programmes. Consideration of equipment to monitor $PM_{2.5}$ particles is a key consideration, especially given the exceedance of the Scottish standards in 2014. It is also recommended that a short-term assessment of benzo(a)pyrene and / or polycyclic aromatic hydrocarbons is considered to quantify local levels and to provide evidence to support whether further monitoring is necessary.

The Office of Environmental Health and Pollution Regulation will continue to monitor air quality standards locally and will report annually. Real-time data from the permanent air quality monitoring stations can also be publically accessed via http://guernseyair.ricardo-aea.com/

7 Abbreviations

CO	Carbon monoxide
CO_2	Carbon dioxide
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DOE	Department of the Environment (UK)
EPAQS	Expert Panel on Air Quality Standards (UK)
mg/m^3	Milligrams (of pollutant) per cubic metre of air. This is one thousand times larger than the $\mu g/m^3$ unit
ng	Nanogram i.e. 10^{-9} gram or one billionth of a gram
nm	Nanometre i.e. 10^{-9} metres or one billionth of a metre
NO	Nitrogen monoxide, also termed nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_3	Ozone
PM_{10}	Particulate matter with a diameter of 10 microns (10µm) or less
$PM_{2.5}$	Particulate matter with a diameter of 2.5 microns (2.5µm) or less
ppb	Parts per billion i.e. the concentration of a pollutant in air in terms of volume ratio. 1ppb means that for every billion (10^9) units of air, there is one unit of pollutant present
ppm	Parts per million i.e. 1ppm means that for every million (10^6) units of air there is one unit of pollutant present
SO_2	Sulphur dioxide
SO_x	Sulphur oxides
µm	Micron / micrometer i.e. one millionth of a metre; 10^{-6}m.
µg	Microgram i.e. one millionth of a gram; 10^{-6}g.
$\mu g/m^3$	Micrograms (of pollutant) per cubic metre of air. It means that one cubic metre of air contains one millionth of a gram of pollutant
UNECE	United Nations Economic Commission for Europe

8 References

Committee on the Medical Effects of Air Pollutants (COMEAP), 2009. *Long-Term Exposure to Nitrogen Dioxide: Epidemiological Evidence of Effects on Respiratory Morbidity in Children*, Didcot.

Committee on the Medical Effects of Air Pollutants (COMEAP), 2009. *Long-Term Exposure to Air Pollution: Effect on Mortality*, Didcot.

Department for the Environment, Food and Rural Affairs (DEFRA), 2003. *Part IV of the Environment Act 1995, Local Air Quality Management: Technical Guidance LAQM. TG(03)*, London.

Department for the Environment, Food and Rural Affairs (DEFRA), 2012. UK and EU Air Quality Limits. *DEFRA*. Available at: http://uk-air.defra.gov.uk/air-pollution/uk-eu-limits [Accessed March 24, 2015].

Department for the Environment, Food and Rural Affairs (DEFRA), 2013. Daily Air Quality Index. *DEFRA*. Available at: http://uk-air.defra.gov.uk/air-pollution/daqi [Accessed March 31, 2015].

Department for the Environment, Food and Rural Affairs (DEFRA), 2014. Automatic Hydrocarbon Network. *DEFRA*. Available at: http://uk-air.defra.gov.uk/networks/network-info?view=hc [Accessed March 24, 2015].

Public Health England (PHE), 2008. *Polycyclic aromatic hydrocarbons and benzo(a)pyrene.* PHE. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/316535/benzoapyrene_BaP_polycyclic_aromatic_hydrocarbons_PAH_guidance.pdf [Accessed 1st April 2015]

Royal Borough of Kensington and Chelsea, 2014. *2014 Air Quality Progress Report for The Royal Borough of Kensington and Chelsea*, London.

States of Guernsey, 2013. *Billet D'État VI 2013: Policy Council – States Strategic Plan 2013 – 2017*, Guernsey.

World Health Organisation (WHO), 2000. *Air Quality Guidelines for Europe: 2nd Edition*, Geneva.

World Health Organisation (WHO), 2005. *Air Quality Guidelines – A Global Update 2005*, Geneva.

World Health Organisation (WHO), 2006. *WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide*, Geneva.

Office of Environmental Health and Pollution Regulation
Longue Rue
St Martin
Guernsey
GY4 6LD
Channel Islands

Telephone: +44 (0) 1481 711161
Fax: + 44(0) 1481 238031
http://www.gov.gg/sampling