2012 Air Quality Updating and Screening Assessment

for the

City & County of Swansea

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

September 2012

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Executive Summary

The Environment Act 1995, Part IV established a national framework for air quality management that requires all local authorities to conduct air quality reviews of their areas having had regard to any guidance issued. If the reviews undertaken indicate that the objective for any of the identified pollutants will not be met by the date for compliance then an Air Quality Management Area must be declared.

The City and County of Swansea following the first round of review and assessment concluded that there was a requirement to declare the Hafod area as an Air Quality Management Area due to exceedences of the nitrogen dioxide annual mean objective. This area was declared in September 2001 and a map outlining the area can be seen within Annexe 1.

During August 2010 and due to exceedences of the nitrogen dioxide annual mean objective being measured within the Sketty and Fforestfach areas of the authority, the Hafod Air Quality Management Area was amended by Council to include these newly identified areas and renamed the Swansea Air Quality Management Area 2010. The areas now making up the Swansea Air Quality Management Area 2010 can be seen within Annexe 2.

This report contains the latest air quality monitoring results within the City and County of Swansea. The conclusions reached are that the objectives for benzene, lead and sulphur dioxide will be met and that there is no requirement to proceed further with these pollutants. However, there is evidence that the annual mean objective for nitrogen dioxide of 40ug/m^3 will continue to be exceeded within the existing Swansea Air Quality Management Area 2010. Latest monitoring undertaken also indicates newly identified areas of exceedences of the nitrogen dioxide annual mean objective outside of the Swansea Air Quality Management Area 2010 within the Mumbles, Uplands, Morriston, St.Thomas and city centre areas of the authority. Several other

areas also exhibit the potential to exceed the annual mean objective as the measured annual means are within the range 37-40 ug/m^3.

It is proposed to amend the existing Swansea Air Quality Management Area 2010 to include these newly identified failing areas. This decision has been taken due to the latest monitoring results confirming the exceedences first reported within the Progress Report 2011. Revised guidance issued by DEFRA during April 2012 to predict nitrogen dioxide concentrations in future years now indicates that the annual mean objective may not be achieved until after 2020 at some sites. Updates on the situation will be provided within future reporting. Reports will now be presented to Council with the recommendation that these areas be added to the Swansea Air Quality Management Area 2010 and be renamed to the Swansea (NO_2) Air Quality Management Area 2012.

Potential PM_{10} exposure has also been identified resulting from proposed activity at a landfill site in Cwmrhydyceirw. However, whilst the site has been issued with a permit by the Environment Agency, activity remains limited, and further details on the operator’s future intentions are awaited. In the meantime basic nuisance dust and PM_{10} monitoring works have continued locally around the facility.

The City and County of Swansea participates in the UK Heavy Metals Monitoring Network and has monitoring stations within the Glais, Clydach and Morriston areas monitoring the high level stack discharge from the nickel refinery within Clydach. During late 2007 the company installed improved abatement management on the high level stack discharge. Additional monitoring stations had been established during 2007/2008 both upwind and downwind of the release point taking the total monitoring locations to four. Two of these stations have been adopted onto the UK Heavy Metals Monitoring network. Monitoring results for 2009 -2011 have indicated for the first time in recent year’s compliance with the 4th Daughter Directive critical threshold monitoring target value for nickel at all monitoring stations. It is envisaged monitoring at all four stations will continue for the foreseeable future to confirm continued and ongoing compliance with the 4^{th} Daughter Directive critical threshold monitoring target value for nickel.

Due to budgetary restraints, progress with implementation of the measures contained within the authorities Air Quality Action Plan has been slow. Impending additional budgetary restraints may in effect mean that development of the plan will cease except for some Nowcaster delivery i.e. 3 roadside message signs as part of the Swansea “Boulevard” project which aims to bridge the divide between the city centre and maritime quarter/foreshore.

Additionally, due to the increasing financial pressures being faced by the authority, real-time automatic measurements at the Morfa Groundhog site ceased during early 2011. Consideration is being given to disposal of the equipment. Real time monitoring for the pollutants carbon monoxide and hydrogen sulphide have ceased at all remaining sites. Sulphur dioxide is now only measured at one location in Swansea at the St.Thomas DOAS.

The authority’s network of passive nitrogen dioxide tube monitoring has also been scaled back significantly due to budgetary pressures and the staff resources required to operate such an extensive network. All sites that have consistently returned a bias corrected annual mean below 30ug/m^3 have been discontinued with the exception of those sites within or near to the Swansea Air Quality Management Area where these sites may prove useful in assessing the benefit if any of measures taken within the AQMA.

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1. Introduction

1.1 Description of Local Authority Area

The City and County of Swansea unitary authority covers a mixed area of extensive coastline, rural villages and the City of Swansea itself. The latest Census (March 2011) estimate for the population of Swansea is 239,000. The 2011 Census also indicates some important changes within the age profile from the previous 2000 Census:-

- **Aged under-5**: a significant growth of around 1,100 (+8.8%)
- **Aged 5-14 years** (school-age): a decline of 1,600 (-6.0%), probably due in large part to reductions in the number of births recorded in the late 1990's / early 2000's.
- **15-19 age** group: an increase of around 1,200 (+7.8%). This could mainly reflect the increasing inflow of 18 and 19 year olds to Swansea's universities.
- **20-24**: a pronounced growth of almost 5,000 (+31.8%) over the ten-year period, again linked to increasing levels of student in-migration and initial retention, including those from elsewhere in Wales, the UK and (to some extent) overseas.
- **25-29**: a significant increase in the population of this cohort over the period by 3,100(+24.5%). This growth could be attributable to a number of factors, including economic in-migration and the retention of graduates.
- **30-39**: a moderate decrease of 1,200 (-3.8%).
- **40-49**: an increase of 9.7% (+2,900), possibly linked to the 1960s 'baby boom'.
- **50-64**: a steady increase of 8.5% (+3,500), again slightly higher than the equivalent overall rate of population increase for Swansea over the period (+6.9%)
- **Older population** (all aged 65+): an increase of 1,900 (+4.6%), indicative of an ageing population, in line with established national trends. However, population growth in the older groups has been most dramatic in the population aged over 85,which is estimated to have increased in Swansea by 900 (+18.8%) over the ten year period from around 4,900 in 2001 to 5,800 in 2011.

To the west of the City of Swansea stands the gateway to the Gower Peninsula, an officially designated Area of Outstanding Beauty that boasts wide-open beaches and rugged shorelines. To the east of the City and County of Swansea lies the only major operational traditional "heavy industry" in the form of the Tata Steelworks complex at Port Talbot. Heavy industry has declined steadily within the boundaries of the authority during the last century. This former industrial activity has left its scars – most notably to the Lower Swansea Valley. From the early 1970's the areas once blighted by slag heaps have undergone extensive remediation and greening. New “light industry” and retail outlets have moved back into the Lower Swansea Valley following the establishment of Enterprise Zone’s and industrial parks. Considerable regeneration is now ongoing within the Swansea area notably the docks re-development and within the city centre/marina area.

The major source of pollution is now vehicular. The topography of the Lower Swansea Valley is complex and it is thought that this aggravates pollution loading in the area. Swansea is connected to major road and rail links. The M4 motorway travels through northern area of the authority, connecting Swansea with Carmarthenshire in the west and to Cardiff and Bristol to the east. The major artery routes of the A483, A4067 and A48 connect Swansea city centre with the M4 motorway junctions to the north. Local traffic also use these routes as primary routes into the city centre.

Swansea is well served with rail links to the majority of the UK. The Inter-City 125 service from London Paddington terminates at Swansea. Local services operate from Swansea to mid and West Wales. A major locomotive-servicing centre operates within Swansea at Landore Diesel Sheds, primarily to service the power units of the Inter City 125 service. The majority of diesel locomotives operated by First Great Western are also serviced and maintained at this facility.

The older and established areas of Swansea comprise of traditional terraced housing. These areas tend to be, but are not exclusively within approximately 3 miles of the city centre. Areas of high density terraced housing still exist around the centres of population established during the Industrial Revolution.

As would be expected, new housing provision tends to be either of detached, or semi-detached, and during the last 20 – 30 years these developments have mainly been located in areas greater than 3 miles away from the city centre. This trend is changing however and within the last 5 years Swansea has seen the SA1 development within the old docks area provide a springboard for new housing development both within the SA1 development site and more lately within the marina area. This regeneration is now also extending into the heart of the city centre with several residential developments taking the place of retail/business premises or occupying the upper floors of former wholly retail premises.

The Tawe Riverside Corridor Proposals will, if implemented see, the regeneration of a large section of the lower Swansea Valley from the Quay Parade bridges up to the Morfa Retail Park. This area is subject to past historical industrial contamination from primarily metals processing and has been in decline for several decades. Some sites have been developed for industrial use but large sections of land remained in the same state following the lower Swansea Valley project of the late 1970's and early 1980's. This project dealt with the legacy of contamination by clearing derelict sites and undertaking limited remediation with extensive landscaping.

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in Wales** are set out in the Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138), Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Pollutant	**Concentration**	**Measured as**	**Date to be achieved by**
Benzene	16.25 µg/m³	Running annual mean	31.12.2003
	5.00 µg/m³	Annual mean	31.12.2010
1,3-Butadiene	2.25 µg/m³	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m³	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 µg/m³	Annual mean	31.12.2004
	0.25 µg/m³	Annual mean	31.12.2008
Nitrogen dioxide	200 µg/m³ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m³	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 µg/m³, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 µg/m³	Annual mean	31.12.2004
Sulphur dioxide	350 µg/m³, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m³, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m³, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in Wales

1.4 Summary of Previous Review and Assessments

The local authority review and assessment process is multi-staged. This Authority carried out its first stage review in 1999. The conclusion reached was to progress to a second and third stage review for Benzene, Particulate Matter (PM_{10}), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2).

In between these stages, the authority had to deal with, and resolve a burning, disused coal spoil tip at the former Brynlliw Colliery site. This absorbed most resources available between 1999 and 2000.

Along with all other local authorities, this authority has completed its stage 2 and stage 3 reviews. The third stage review and assessment concluded that despite the indication that the air quality objective for benzene would not be met that the declaration of an AQMA was not appropriate. Given the fundamental changes proposed to the Lower Swansea Valley's infrastructure and the technical improvements proposed in the reduction in the benzene content in fuel, it was recommended that a further benzene monitoring study be carried out for a period of at least 12 months. During the stage 3 process, it was determined that the authority would not breach the objectives laid down for Particulate Matter (PM_{10}) and Sulphur Dioxide (SO_2).

Section 83(1) of the Environment Act 1995 requires the Authority to designate as Air Quality Management Areas (AQMA's) those areas where it is likely that the standards for any of the identified pollutants would be exceeded. As a result of the detailed work carried out in the authorities' third stage review and assessment it was found that areas of the Hafod were likely to fail the NO_2 annual mean objective of 40$\mu g/m^3$ by the compliance date of 31st December 2005.

On the 12th September 2001 the Authority declared The Hafod Air Quality Management Area (NO_2), cited as the City & County of Swansea (Hafod Air Quality Management Area (NO_2)) Order 2001. The Order came into force on the 14th September 2001. Annexe 1 contains a map indicating the AQMA area.

The Stage 4 review required under Section 84(1) of the Environment Act 1995 confirmed the earlier findings and that the declaration of the Hafod AQMA was justified as several locations were projected to fail the nitrogen dioxide (NO_2) annual mean objective in 2005.

Section 84 of the Environment Act 1995 requires the formulation of a written plan in pursuit of the achievement of air quality standards and objectives within the designated AQMA and has become known as the “Action Plan”. The City and County of Swansea have undertaken a considerable amount of feasibility and infrastructure work in formulating its Action Plan taking a few years to produce the completed Action Plan in December 2004.

In 2004, the authority commenced works on the second round of review and assessment. In accordance with the policy and technical guidance documents, the second round of review and assessment was carried out in two stages;

- An Updating and Screening Assessment (USA) - intended to identify aspects that have changed since the first round of review and assessment (from 1999 in Swansea's case) and identify those that require further assessment; namely
- A Detailed Assessment of those pollutants that have been identified as requiring further work and investigation

The Updating and Screening Assessment was submitted to the Welsh Assembly Government in July 2004 with a recommendation to proceed to a detailed assessment for nitrogen dioxide at identified narrow congested streets and busy junctions. The USA also concluded that particulate matter PM_{10} should also be investigated using real-time techniques at the identified narrow, congested streets and busy junctions, despite the then 2010 provisional objectives not being set in regulation.

A brief summary of the results and conclusions of the Detailed Assessment into NO_2 levels can also be found within the Progress Report 2004 – section 2.3.2.3 page 95. The Detailed Assessment itself was submitted to the Welsh Assembly Government during December 2005. This assessment concluded that there was no justification in declaring additional AQMA’s. At the time of submission, there was a debate with the auditors and Welsh assembly Government over the bias factor used to correct the nitrogen dioxide passive diffusion tube data. The authority used the bias factor quoted by Harwell Scientifics to correct for tube bias. Whilst the Detailed Assessment report was eventually accepted by the Welsh Assembly Government and the auditors as a result of the authority providing additional supporting information and justification for the use of the Harwell Scientific bias factor it was agreed that the authority would undertake co-location studies with its chemiluminescent analysers at 3 sites namely, the Swansea AURN on Carmarthen Road, and at the Morfa and Morriston Groundhog sites. This work commenced during December 2006 and was delayed until the Swansea AURN had been relocated and commissioned to prevent any additional uncertainties. The authority has now completed these co-location tasks at all three automatic sites within Swansea and has determined a local bias factor for the correction of the passive nitrogen dioxide diffusion tubes exposed within Swansea during 2008. Further details on this area of work can be found within section 2.1.13

The Progress Report for 2004/05 was submitted for consideration during July 2005

The infrastructure required for a real-time assessment of PM_{10} in Swansea, is still being developed. The authority have purchased ten Met One E-Type light scattering PM_{10} dust samplers and are in the process of deploying these at the identified narrow, congested roads and busy junctions mentioned within the USA submitted in July 2004 and the Detailed Assessment. Identification of suitable sites is now complete but what has proved time consuming are the practical considerations of the site location itself together with the provision of suitable services i.e. un-metered electricity feeds and suitable mounting points. Significant problems have been, and continue to be encountered with the operation of the EType samplers. It is recognised that these analysers do not have formal UK type approval but due to both the expense and considerable practical considerations of deploying Rupprecht & Patashnick Co., Inc. FDMS/TEOM's, these E Type samplers will provide a more accurate assessment than use of the DMRB screening tool would be able to provide. It is thought that if the technical difficulties being experienced with the equipment can be resolved that the modelling will supplement the data collected by the E Type samplers.

Additional works underway include the collection of real-time classified counts of traffic data via the Vodafone GPRS network together with the construction of an emissions database. It is these latter items, particularly communications problems with the GPRS system that have delayed the modelling capabilities to date. The USA dated April 2006 was submitted for consideration to the Welsh Assembly Government in July 2006.

The authority undertook a further Progress Report in 2007 which was submitted to the Welsh Assembly and the auditors during July 2007. The same issues arose from this report with the auditors – the rational behind the bias factor used to correct the passive diffusion tube was again raised despite the report clearly outlining the authorities' reasons for using the bias factor that was used to correct for tube bias. This issue as mentioned above should now have been resolved with the determination of a local Swansea bias factor

Progress Report 2008

The authority submitted its Updating and Screening Assessment 2009 to the Welsh Assembly Government during July 2009. The conclusions of this assessment were that exceedences of the nitrogen dioxide annual mean objective continued to be seen within the existing Hafod Air Quality Management Area along the Neath Road corridor, Cwm Level Road (Brynhyfryd Cross Roads) and Carmarthen Road (Dyfatty area). Additional monitoring within the then Hafod AQMA area around the High Street Railway Station highlighted the potential of exceedence of both the annual mean and 1-hour nitrogen dioxide objectives. Monitoring from outside of the then existing Hafod AQMA identified new areas that were failing the nitrogen dioxide annual mean objective. These areas are along Gower Road in Sketty, along Carmarthen Road within Fforestfach, and at numerous sites within the city centre. The city centre area was treated with caution as at the time of submission, only the minimum 9 months of data was available for analysis. An update on the city centre monitoring for nitrogen dioxide is presented below within section 2.1.2. The authority doubled its passive nitrogen dioxide tube survey during November 2009 from 134 to 274 sites, as a result of new LAQM Technical Guidance (LAQM.TG(09)) and the conclusions reached within the USA 2009 that used the new guidance, that additional initial screening of narrow/congested streets was required where the AADT flow was greater than 5000 vehicles. Monitoring data is presented for the periods available for the 140 additional sites within section 2.1.2.

Following the USA 2009, the authority intended to amend the existing Hafod Air Quality Management Area to include these newly identified areas (Sketty and Fforestfach) along with the renaming of the declared air quality management area. All declared areas are to be collectively known as The Swansea Air Quality Management Area 2010. However, considerable delays were encountered with the mechanisms of obtaining the necessary Council Order. Details were presented before Council during August 2010. Annexe 2 contains a map indicating the adopted Swansea Air Quality Management Area 2010

Progress Report 2010

The authorities Progress Report 2010 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Sketty and Fforestfach areas of Swansea. These areas have now been included within the Swansea Air Quality Management Area 2010.

Progress Report 2011

The authorities Progress Report 2011 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Sketty and Fforestfach areas of Swansea. Additionally, other sites outside of the Swansea Air Quality Management Area 2010 in the Mumbles, Uplands, Morriston, Llansamlet and Ynystawe areas were found to be exceeding the nitrogen dioxide annual mean objective. It was stated that further monitoring would be undertaken to confirm such exceedences before any additional AQMS were declared.

Details on the various stages completed by the authority in the Local Air Quality Management process are given below within table 2. Brynlliw Colliery remediation is shown for information purposes due to the delays in the LAQM process that this introduced. This was a long-term burning tip which required large scale monitoring and control.

Report	Date Completed	Internet URL
1st Stage Review	1999	http://www.swansea.gov.uk/index.cfm?articleid=5563
Brynlliw Colliery Remediation	1999-2000	N/A
2nd & 3rd Stage Review	2001	http://www.swansea.gov.uk/index.cfm?articleid=5565
Declaration of Hafod AQMA	September 2001	http://www.swansea.gov.uk/index.cfm?articleid=5557
Stage 4 Review	October 2003	http://www.swansea.gov.uk/index.cfm?articleid=5568
2nd Round Review USA	July 2004	http://www.swansea.gov.uk/index.cfm?articleid=5561
Hafod AQMA Action Plan	December 2004	http://www.swansea.gov.uk/index.cfm?articleid=9930
Progress Report 2004	July 2005	http://www.swansea.gov.uk/index.cfm?articleid=9929
Detailed Assessment	December 2005	http://www.swansea.gov.uk/index.cfm?articleid=5561
Progress Report 2006	July 2006	http://www.swansea.gov.uk/index.cfm?articleid=9929
USA 2006	April 2006	http://www.swansea.gov.uk/index.cfm?articleid=5561
Progress Report 2007	July 2007	http://www.swansea.gov.uk/index.cfm?articleid=9929
Progress Report 2008	May 2008	
USA 2009	July 2009	
Progress Report 2010	July 2010	
Progress Report 2011	September 2011	

Table 2 – Summary of Local Air Quality Management actions

The Internet addresses (URL's) that these reports can be downloaded from are given where appropriate.

2. New Monitoring Data

2.1 Summary of Continuous Real Time Monitoring Undertaken

The authority operates a network of monitoring stations, mainly located within the lower Swansea valley area. The network is a mixture of three, fixed point automatic stations, together with open path measurements from two DOAS (Differential Optical Absorption Spectroscopy) stations. Details of all automatic monitoring station are given below in table 3 with site by site operational details provided within section 2.1.1. Two of the fixed point stations (Morfa and Morriston) had datasets extending back to 2001. A summary of the commencement of measurement for each station is given below within section 2.1.8 as table 4.

Details of the Morfa Station are included for completeness but as explained below this station was decommissioned during May 2011.

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	IN AQMA	Relevant Exposure	Distance to kerb of nearest road	Worst-case Location
Swansea Roadside AURN	Roadside	X 265322 Y 194447	NO_2,PM_{10}, $PM_{2.5}$ CO, SO_2	Y	Y (12m)	4m	N
Morfa Groundhog	Roadside	X 266036 Y 195406	NO_2,PM_{10}, SO_2	Y	Y (34m)	5m	Y
Morriston Groundhog	Roadside	X 267210 Y 197676	NO_2,PM_{10}, CO, SO_2 and Ozone	N	Y (22m)	4m	N
Cwm Level Park	Urban Background	X 265915 Y 195895	NO_2 and Ozone	Y	N (100m)	78m	N
Hafod DOAS	Roadside	Transmitter X 265927 Y 194453 Receiver X 265991 Y 194706	NO_2 Ozone and Benzene	Y	Y (0.3m)	1.7m	N
St Thomas DOAS	Roadside	Transmitter X 266191 Y 193655 Receiver X 266263 Y 193370	NO_2 Ozone and Benzene	N	Y(2m) Varies along path length	1.7m	N

Table 3 Details of Automatic Monitoring Sites

2.1.1 Automatic Continuous Real Time Monitoring Sites

2.1.2 Swansea Roadside AURN, Carmarthen Road, Waun Wen

The Swansea AURN was located in the heart of the city centre on the pedestrian area of Princess Way. Due to the redevelopment of the David Evans complex, the monitoring station was scheduled for decommissioning on the 14th August 2006. The data logger failed on the 3rd August 2006 following a power surge at the site and in effect, data from the site ceased on this date as it was decided not to undertake any repairs to the data logger. Every effort had been made to re-establish the monitoring station within the city centre. However, DEFRA had amended the siting criterion which has resulted in a suitable site being unable to be identified. The station has now been relocated roadside on Carmarthen Road at Waun Wen. The ADDT for 2011 was approximately 21,200 vehicles. The relocated site is detailed and outlined below and is now sited within the boundary of the Swansea Air Quality Management Area 2010. The site has receptors close by with additional sensitive receptors in close proximity - a Nursing Home and a Primary School are within 100m of the monitoring location.

The AUN station at Princess Way had been affiliated onto the UK National Network during late 1994 and had been operational ever since until 3rd August 2006. The new roadside site has also been affiliated onto the UK National Network with data capture commencing on the 20th September 2006 at 13:00hrs. The station has been given a site classification Roadside[1]. Map 1 below is an aerial view of the site and the surrounding locations. The site is located in an open aspect approximately 55m above sea level with direct views over Swansea Bay. It is therefore more exposed to the prevailing south westerly winds than the monitoring sites located on the valley floor (Morfa, Morriston and Hafod DOAS). It is thought probable that this site may well sit above any inversions that form within the lower Swansea Valley and therefore, does not experience the elevated concentrations seen at the other monitoring stations during such conditions.

[1] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

Map 1 – Aerial view of Swansea Roadside AURN

All equipment is housed within an air-conditioned unit and operated continuously. The equipment comprises of an Advanced Pollution Instrument (API) real-time analyser measuring NO_x with Thermo FDMS units measuring PM_{10} and $PM_{2.5}$ until the 16th November 2011 when they were removed due to their unreliability and were replaced with Met One1020 BAM units on the 28th November 2011. The API gas analyser has been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the analyser. In addition officers from this authority performed routine monthly manual calibrations. The analyser is subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The analyser is also subjected to traceable calibration gases at a known concentration and the response of the analyser recorded. All manual calibration data is then forwarded to AEA Energy and Environment to perform data management procedures*.* The data is then further subjected to full network QA/QC procedure's undertaken by AEA Energy and Environment on behalf of the Department of Environment, Food and Rural Affairs (DEFRA). The station is serviced and maintained twice yearly by Enviro Technology Services Plc. In addition, the authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. All equipment on site is fully audited twice yearly by AEA Energy & Environment together with the calibration gases stored on site

Hourly ratified data for 2011 covering the pollutants Nitrogen Dioxide and Particulate Matter PM_{10} and $PM_{2.5}$ (FDMS and BAM 1020) has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector . These data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation.

During 2007, the UK Automatic Network underwent a review by DEFRA. During this review, numerous stations were either decommissioned from the network, or, as in the case of the Swansea AURN, a limited number of analysers from the station were kept within the UK monitoring framework. This review was undertaken by DEFRA in response to their changing EU commitments. Whilst data from the CO and SO_2 analysers are no longer collected (post 1st October 2007) or ratified by DEFRA (AEA Energy and Environment), this authority had decided to continue to fund their operation and data collection. However, due to budgetary constraints and the relatively low concentrations being recorded, this authority decided to cease measurements of during October 2010. The dataset from 1st October 2007 to 27th October 2010 for the above mentioned pollutants was therefore ratified by the authority. No presentation or analysis of CO and SO_2 since 2010 is made within this report as all objectives set in regulation had previously been met comfortably for several years. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, only NO_2 and PM_{10} (FDMS and BAM1020) data are reported here for 2011

The ozone analyser that was surplus to requirements at the site following the DEFRA review has been relocated at the Cwm Level Park urban background monitoring station during December 2008.

2.1.3 Morfa Groundhog

The Morfa station had been operational since August 2000 and was located in a fairly open area on a grass bank to the Morfa / Normandy roundabout which acts as a major intersection to the road network in the lower Swansea Valley. During May 2011 measurements ceased at this site due to the loss of the electricity supply to the station. The station was within the boundary of the Swansea Air Quality Management Area 2010 and had been given a site classification Roadside[2].

As with the majority of monitoring stations, the location finally chosen for monitoring has to be a compromise between the ideal desired location and the practicalities of siting a station of this size. It is recognised that this station having being sited adjacent to a roundabout is not ideally placed. However, in saying this, the station satisfied the majority of the monitoring criteria required by this authority with receptor locations (dwellings) being located within 35m. Due to its location in a fairly open aspect of the lower valley area, this station did not truly reflect the conditions experienced within the nearby narrow congested streets within the Neath Road corridor (see Hafod DOAS) that form part of the Swansea Air Quality Management Area 2010.

All equipment was housed within an air-conditioned unit and operated continuously. The equipment comprised of Advanced Pollution Instruments (API) real-time analysers measuring CO, SO_2 and $NO_{x,}$. The R&P TEOM measuring PM_{10} was upgraded to a Thermo FDMS unit again measuring PM_{10} on the 28th November 2006 with data capture for the FDMS unit commencing at 13:00. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser's are subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The analysers are also subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

[2] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

The station was operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data has been re-scaled by the authority according to the calibration factors (monthly span and overnight/monthly zeros). The station was serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the authority had a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site was fully audited yearly by AEA Energy & Environment together with the calibration gases stored on site. The L10 span gas cylinders are replaced on a regular basis and are to a certified and traceable standard.

A map showing the location of the Morfa Groundhog station is given below as map 2. The boundary of part of the existing Swansea Air Quality Management Area 2010 is shown as the black/yellow dashed line.

Map 2 Location of Morfa Groundhog Station

As mentioned above, measurements ceased at this site during May 2011. Prior to this, the CO and SO_2 measurements ceased during August 2010 due to budgetary restrictions. No presentation or analysis of 2011 data for these pollutants is made within this report as all objectives set in regulation had previously been met comfortably for several years. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, no data are reported here for 2011 and its inclusion here is for information only.

2.1.4 Morriston Groundhog

Morriston Groundhog has been operational since September 2000 and is located adjacent to the southbound slip road to the busy A4067 dual carriageway at Morriston Underpass. The Swansea Air Quality Management Area 2010 (former Hafod AQMA) boundary is approximately one mile south of this location. Receptor locations can be found to the right of the station in the form of terraced housing. To the left of the site and on the opposite side of the dual carriageway is Morriston Primary School. The school buildings abut the red brick retaining wall to the northbound Morriston slip road exit. The A4067 carries on for approximately one mile northbound where it meets the M4 motorway at junction 45. The station has been given a site classification Roadside[3]. Map 3 below is an aerial view of the site and the surrounding locations.

All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring O_3, and NO_x . The R&P PM_{10}TEOM was upgraded to a Thermo FDMS PM_{10} unit on the 27th October 2006 with data capture for the FDMS unit commencing at 17:00. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser’s are subjected to scrubbed internal generated zero air to assess the analyser’s response to zero air. The analysers are also subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data is re-scaled by the authority according to the

[3] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

calibration factors (monthly span and overnight/monthly zeros). The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site is fully audited yearly by AEA Energy & Environment together with the calibration gases stored on site. The L10 span gas cylinders are replaced on a regular basis and are to a certified and traceable standard.

Map 3 - Aerial view - Morriston Groundhog

However, due to budgetary constraints and the historically relatively low concentrations being recorded, this authority decided to cease measurements of CO during April 2010, and SO_2 during October 2010. The H_2S analyser had proved highly problematic and expensive to repair and measurements had already ceased some considerable time ago. No presentation or analysis of 2010 data for these pollutants is made within this report as all objectives set in regulation have previously been met comfortably for several years. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, only NO_2, Ozone and PM_{10} (FDMS) data are reported here for 2011.

2.1.5 Cwm Level Park, Landore

The authority established a NO_x and Ozone urban background monitoring station [4] at Cwm Level Park, Landore during late November/ early December 2008 within the compound of its 30m Meteorological monitoring mast. The details are reported here for information purposes only as the dataset collected to date does not provide the opportunity to meaningfully analyse any of the data collected.

All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring NO_x and Ozone. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser's are subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The NO_x analyser is subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. The internal span calibration is used with the ozone analyser. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data is re-scaled by the authority according to the calibration factors (monthly span and overnight/monthly zeros). The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the

[4] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

Map 4 Cwm Level Park Monitoring

authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to AEA Energy & Environment to run the Welsh Air Quality

Forum in April 2004, all equipment on site will be fully audited yearly by AEA Energy & Environment together with the calibration gases stored on site. The L10 span gas cylinders (NO and NO_2) will be replaced on a regular basis and are to a certified and traceable standard.

A map showing the location of the Cwm Level Park station is given below as map 4. The boundary of part of the Swansea Air Quality Management Area 2010 (former Hafod AQMA) is shown as the black/yellow dashed line.

There are no “major” sources close by as would be expected with the site classification, with the nearest road being nearly 80m away, having an AADT during 2010 of 14,370 vehicles. Some light industry / warehouse front the site but are insignificant as a source. Receptor dwellings are within 100m of the site.

2.1.6 The OPSIS Hafod Differential Optical Absorption Spectroscopy (DOAS) Monitoring Station

The OPSIS DOAS open path light source measures the pollutants Nitric Oxide, Nitrogen Dioxide, Ozone and Benzene along a 250-metre section of Neath Road, within the Hafod district of the lower valley area and within the Swansea Air Quality Management Area 2010 (former Hafod AQMA). These measurements take place at first floor level - a height of approximately 3 - 4 metres and less than 0.3m away from the front facade of the terraced dwellings. The DOAS transmitter ❶ is fixed externally to the front wall of a terraced dwelling that fronts onto Neath Road at one end of the open path measurement. The receiver module ❷ is located on the front wall of another dwelling that also fronts onto Neath Road at the other end of the open path measurement length. The receiver focuses the light received and transmits the light via fibre optic cable into a spectra analyser. Map 5 below shows an aerial photograph of the location of the transmitter and receiver heads. This section of Neath Road has an annual average daily traffic flow (AADT) during 2011 of 15,880 vehicles and forms the “traditional” route up/down the Swansea Valley. The whole length of Neath Road through the Lower valley area is characterised by slow moving traffic through the narrow, congested, B route corridor. Habits of a lifetime may prove difficult to break!

The transmitter emits a light beam from a xenon lamp and contains a range of wavelengths, from ultraviolet to visible. Different pollutant molecules absorb light at different wavelengths along the path between the emitter and receiver. The receiver is connected to the analyser that measures the intensity of the different wavelengths along the entire light path and converts this into concentrations for each of the gaseous pollutants being monitored.

Map 5 Hafod Opsis DOAS Monitoring

The monitoring location is allowing measurements' running parallel to the carriageway to be made of the above pollutants, as the carriageway is approximately 2 metres away from the front facade of these dwellings. The highway at this location can loosely be referred to as a "street canyon". Valid data capture commenced on the 8th January 2004 at 16:00hrs. The station has been given a site classification Roadside[5].

The DOAS system returns data in the form cyclonic means, not always of the same averaging period - the system has been configured to measure each pollutant for a set period of time: 1 minute each for NO and Benzene and 30 seconds each for nitrogen dioxide and ozone. This gives a cycle time of approximately 3 minutes. The system stores the information as a cycle period of measurement for each pollutant within a "logger value" dataset. During the QA/QC processes that have been completed, conditions were imposed on the minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for

[5] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

each pollutant. The validation process produces the same cyclonic means within a separate database. All individual measurement points that have not met the QA/QC conditions (detailed below) are replaced with null values within the new dataset. The user can then compile 5 minute means from the validated dataset and undertake analysis.

- **QA/QC for NO, Nitrogen Dioxide and Ozone**

  If (C1 >0 and C1 > 2 * C2 and C3 > 10) then result: = C1 else result: = C0

  C0 – Null value
  C1 – Pollutant Concentration
  C2 – Standard Deviation of pollutant
  C3 – Light Level of pollutant

- **QA/QC for Benzene**

  If (C1 >0 and C1 > 2 * C2 and C3 > 40) then result: = C1 else result: = C0

  C0 – Null value
  C1 – Pollutant Concentration
  C2 – Standard Deviation of pollutant
  C3 – Light Level of pollutant

It should be noted that the data presented here represents the spatial average over the whole of the 250-meter measurement path and not a "point measurement" as seen within other "traditional or conventional" monitoring equipment/locations. It should also be noted that the DOAS methodology of monitoring does not comply with the EU Directive methods of measurement (chemiluminescent for NO_2, UV fluorescence for SO_2 etc) at present but the system has recently achieved MCERTS certification and TUV certification.

Monitoring data from the site has been subject to interruption as the property owner at the transmitter site ❶ undertook extensive renovation works to the property. The transmitter head was removed from the front façade during these works to prevent damage. The equipment was removed from the façade of the property at 11:00 on the 22nd April 2005 and was replaced at 10:00 16th May 2006. There is therefore significant data loss for both 2005 and 2006 with in total just over a years worth of monitoring data being lost. This is frustrating and regrettable but the loss is outside of the control of this authority.

To compound and frustrate matters further an Area Renewals Project commenced during January 2008 to properties at the receiving end ❷ of the open path measurement. This renewal project resulted in scaffolding erected to the front facades of the terrace properties blocking the light path to the receiver between the 3rd January 2008 and July 2008. Full functionality was not restored until the site had been serviced and calibrated on the 26th August 2008.

The station is now subject to Xenon lamp changes on a quarterly basis, with zero and span calibrations now taking place on an annual basis. These works are undertaken by Enviro Technology Plc, the UK distributor for Opsis of Sweden. The frequency of zero/span calibration has been subject to discussions with Opsis as noticeable drop of lamp intensity was noticed for the NO channel (which is deep down in the spectrum) during the 5th and 6th months after renewal. Changing the Xenon lamps every 4 months has resolved this data issue concern.

2.1.7 The Opsis St.Thomas Differential Optical Absorption Spectroscopy (DOAS) Monitoring Station

The St.Thomas OPSIS Differential Optical Absorption Spectroscopy (DOAS) has been installed during September 2005 along a 280m path length of Pentreguinea Road within the St.Thomas area to measure the pollutants sulphur dioxide, nitrogen dioxide, and ozone. Valid data capture commenced on the 12th September 2005 at 09:30am. This section of Pentreguinea Road had an annual average daily traffic flow (AADT) during 2011 of 19,440 vehicles and forms the eastside link up/down the Swansea Valley from Whiterock bridge to Quay Parade bridges. This route is intended for use within the Action Plan to attempt traffic management during forecast pollution episodes by diverting traffic from the central Neath Road corridor

Measurements take place at a height of approximately 3-4 metres and less than 2m away from the front facade of the majority of terraced dwellings. The DOAS transmitter ❶ is fixed on top of a concrete column located north of the junction of Kilvey Terrace and Pentreguinea Road as shown in photo 1 below. The receiver module ❷ is located on top of a concrete column and site housing at the other end of the open path measurement length as shown in photo 2 below.

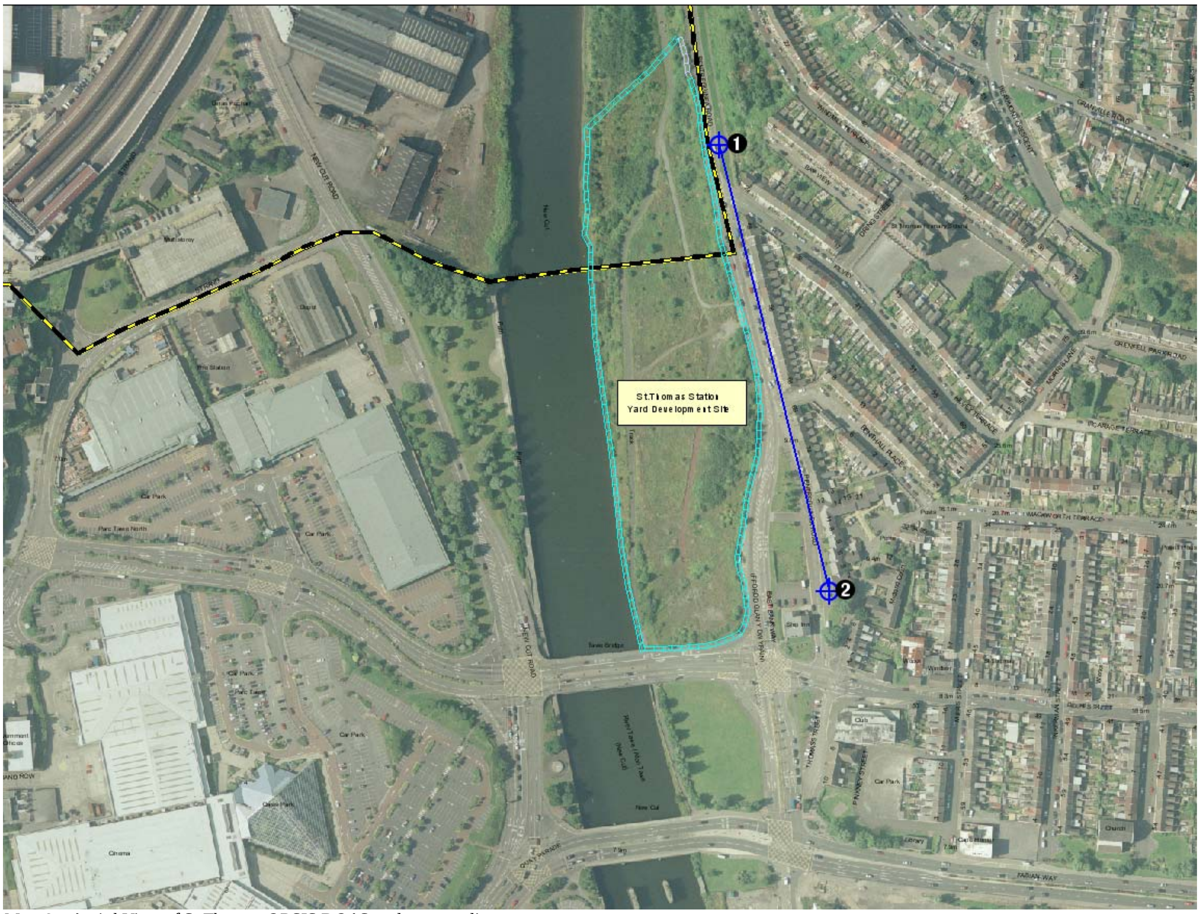
Photo 1 - St Thomas DOAS Transmitter

Photo 2 - St Thomas DOAS Receiver Station

The transmitter emits a light beam from a xenon lamp that contains a range of wavelengths, from ultraviolet to visible. Different pollutant molecules absorb light at different wavelengths along the path between the emitter and receiver. The receiver is connected to the analyser that measures the intensity of the different wavelengths along the entire light path and converts this into concentrations for each of the gaseous pollutants being monitored. The station has been given a site classification Roadside[6].

The monitoring location is allowing measurements' running parallel to the carriageway to be made of the above pollutants. The location of the open path monitoring can be seen within map 6 below. The site of the transmitter lies just outside of the southern boundary of the Swansea Air Quality Management Area 2010 (former Hafod AQMA). The extent of the existing order can be seen within map 6.

[6] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*



Map 6 – Aerial View of St.Thomas OPSIS DOAS and surrounding area

Quay Parade Bridges are to the south of this location. Congestion extends from Quay Parade bridges up Pentreguinea Road with congestion being seen as far north as the Morfa Shopping Parc in Landore. There are numerous dwellings located along this section of Pentreguinea Road with an application already received for residential development on the former St.Thomas Station Yard Site located between Pentreguinea Road and the River Tawe (see map 6 above). An application for formal planning consent was received during 2005 but was rejected due to the intensity of the development. It is thought that a modified scheme will be resubmitted shortly to include an element of social housing as a result of the appeal process. The WAG Planning Panel are yet to issue its formal decision.

The DOAS system returns data in the form cyclonic means, not always of the same averaging period - the system has been configured to measure each pollutant for a set period of time: 1 minute each for NO and Benzene and 30 seconds each for nitrogen dioxide and ozone. This gives a cycle time of approximately 3 minutes. The system stores the information as a cycle period of measurement for each pollutant within a “logger value” dataset. During the QA/QC processes that have been completed by this authority, conditions were imposed on the minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for each pollutant. The validation process produces the same cyclonic means within a separate database. All individual measurement points that have not met the QA/QC conditions (detailed below) are replaced with null values within the new dataset. The user can then compile 5 minute means from the validated dataset and undertake analysis.

- **QA/QC for NO, Nitrogen Dioxide and Ozone**

  If (C1 >0 and C1 > 2 * C2 and C3 > 10) then result: = C1 else result: = C0

  C0 – Null value
  C1 – Pollutant Concentration
  C2 – Standard Deviation of pollutant
  C3 – Light Level of pollutant

- **QA/QC for Benzene**

  If (C1 >0 and C1 > 2 * C2 and C3 > 40) then result: = C1 else result: = C0

  C0 – Null value
  C1 – Pollutant Concentration
  C2 – Standard Deviation of pollutant
  C3 – Light Level of pollutant

The station is subject to Xenon lamp changes on a 6 monthly basis with zero and span calibrations now taking place on a yearly basis. These works are undertaken by Enviro Technology Plc, the UK distributor for Opsis of Sweden. The frequency of lamp change differs to that of the Hafod DOAS as this station does not measure the NO channel and as such does not suffer the drop of lamp intensity during the 5th and 6th months of operation. Changing the Xenon lamps every 6 months does not invoke any data issue concerns at this site.

It should be noted that the data presented here represents the spatial average over the whole of the 280-meter measurement path and not a "point measurement" as seen within other "traditional or conventional" monitoring equipment/locations. It should also be noted that the DOAS methodology of monitoring does not comply with the EU

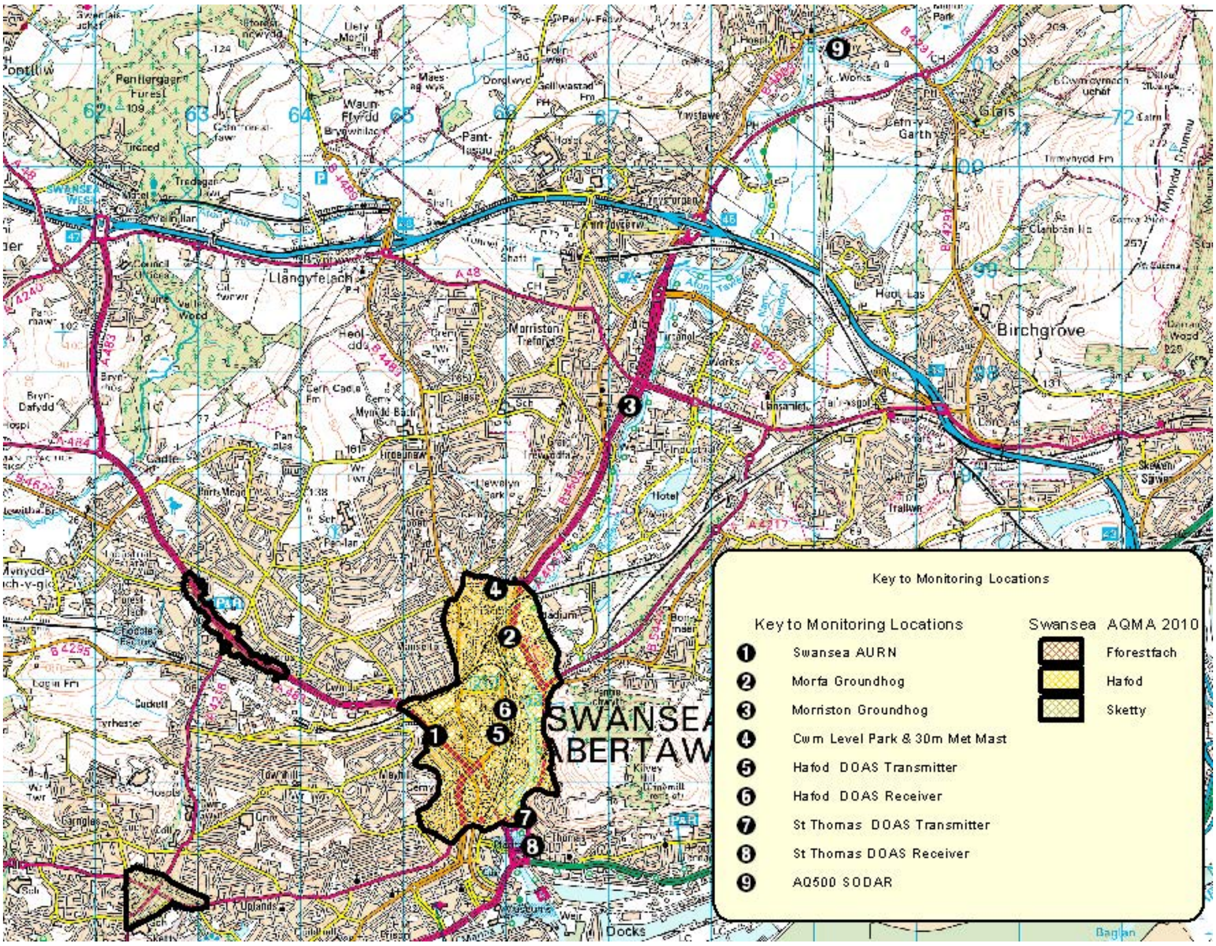
Directive methods of measurement (chemiluminescent for NO_2, UV fluorescence for SO_2 etc) at present but the system has recently achieved MCERTS certification and TUV certification.

2.1.8 Summary of Automatic Continuous Real-Time Monitoring Locations.

For ease of reference and in order for the reader to familiarise themselves spatially with the locations that the City and County of Swansea undertake automatic continuous monitoring, all such sites are presented below within map 7. Also included within map 7 is the extent of the Swansea Air Quality Management Area 2010 which was declared during August 2010.

Included with this spatial view is the meteorological monitoring that is currently being undertaken within the lower Swansea Valley area. This currently includes a dedicated 30m mast at Cwm Level Park and a SODAR remote sensing instrument capable of wind speed/direction measurements every 15m up to its maximum height range of 300m located within the Vale nickel refinery in Glais further north and up the Swansea Valley. It is envisaged that this meteorological monitoring will provide the datasets required by the air quality modelling that is currently under development, with sufficient details of the meteorological conditions experienced within the complex topographical area that exists in the lower valley area.

From map 7, the reader will no doubt realise that no continuous and automatic monitoring has been, or is currently being undertaken within the Sketty and Fforestfach areas of the Swansea Air Quality Management Area 2010. This is unlikely to change for a considerable period of time given the current budgetary restraints. Monitoring within these areas has been, and will continue to be undertaken, via passive nitrogen dioxide diffusion tubes.



Map 7 – Overview of continuous monitoring locations

Table 2 below details the commencement date of monitoring at each of the automatic sites, pollutants monitored and other site criteria details.

Site Name	Site ID	Site Type	Date of Commencement Measurements	Pollutants Monitored	IN AQMA	Relevant Exposure	Distance to kerb of nearest road	Worst-case Location
Swansea Roadside AURN	**1**	Roadside	**20th September 2006**	NO_2, PM_{10}, $PM_{2.5}$	Y	Y (12m)	4m	N
Morfa Groundhog	**2**	Roadside	**24th July 2000**	NO_2, PM_{10},	Y	Y (34m)	5m	Y
Morriston Groundhog	**3**	Roadside	**11th October 2000**	NO_2, PM_{10}, and Ozone	N	Y (22m)	4m	N
Cwm Level Park	**4**	Urban Background	**(O_3) 28th November 2008** **(NOx) 21st January 2009**	NO_2 and Ozone	Y	N (100m)	78m	N/A
Hafod DOAS	**5**	Roadside	**8th January 2004**	NO_2 Ozone and Benzene	Y	Y (0.2m)	1.7m	Y
St Thomas DOAS	**6**	Roadside	**4th May 2005**	NO_2 Ozone and Benzene	N	Y(2m) Varies along path	1.7m	N

Table 2 Automatic Continuous Measurements Commencement Dates

2.1.9 Additional Continuous Monitoring

2.1.10 Heavy Metals Monitoring

The Department of the Environment, Transport and the Regions (DETR) is funding a monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes.

The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale INCO (now Vale) being located within the authority's area at Clydach.

On the 16th July 2003 the European Commission adopted a proposal for a Directive relating to arsenic, cadmium, nickel, mercury and ploycyclic hydrocarbons (PAH) in ambient air[7]. The target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of Best Available Technique (BAT). There are therefore, as yet, no binding obligations to reduce these pollutants. Ambient air concentrations of these substances only have to be monitored once emissions have passed a critical threshold.

Annexe 1 of the Directive details the target values for arsenic, cadmium, nickel and bezo(a)pyrene and these are reproduced below as table 3.

Pollutant	Target value ng/m^{-3}
Arsenic	6
Cadmium	5
Nickel	20
Benzo(a)pyrene	1

Table 3 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Glais Primary School, School Road, ❷ was chosen as the initial monitoring location due to its proximity to the refinery ❶ and for additional security issues with the equipment at the time. A Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling unit, fitted with a PM_{10} sampling inlet with a flow rate of 16.7 l/min, has been installed on a flat roof at Glais Primary School.

During July 2006, two additional monitoring locations were added: one at Coed-Gwilym Cemetery ❸ upwind of the high level stack release and one at the Morriston Groundhog ❺ some 4.1 kilometres downwind of the stack release point (see section 2.1.4 for site location of the Morriston Groundhog and section 2.1.8 for spatial location). Both additional units were Partisol 2025 units with automatic filter cartridge exchange and are fitted with PM_{10} sampling inlets with flow rates of 16.7 l/min. Four filters are housed in the main exchange drum and the unit automatically regulates weekly exposure of each filter.

During July 2007, the building that the Partisol 2000 unit was located on at Glais Primary School was demolished due to subsidence. The site was therefore decommissioned and did not become operational again until December 2007. Whilst

[7] *COM 2003 (423)*

the site was recommissioned during 2007 it ceased to form part of the UK Heavy metals monitoring Network from the 1st January 2008. However, this authority will continue to fund heavy metals monitoring at this site for the foreseeable future and have contracted NPL to undertake all analysis work.

A further site has been established to the north of the high level stack release point during November 2007 at YGG Gellionnen ❹ (Welsh Primary School). The site is located on top of a flat roof within the school complex and has an uninterrupted view down to the refinery complex. This authority will continue to fund heavy metals monitoring at this site for the foreseeable future and have contracted NPL to undertake all analysis work.

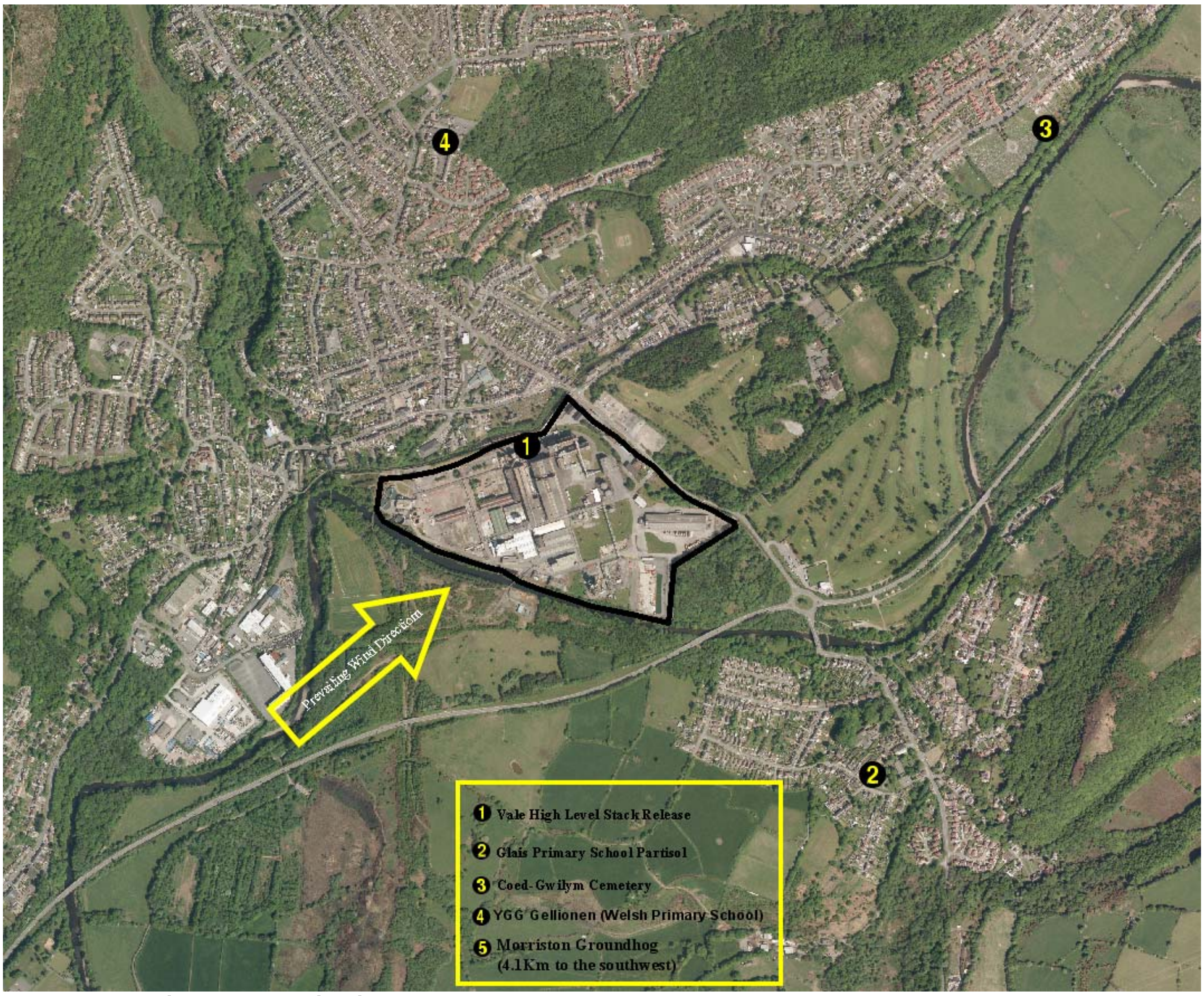
During December 2007, there were changes made to those sites that form part of the UK Heavy Metals Monitoring Network – these changes took effect on the 1st January 2008. Two monitoring locations now form part of the UK network within Swansea – these are the site upwind of the high level stack release at Coed-Gwilym Cemetery ❸ and the site located downwind of the release point at the Morriston Groundhog❺. Both the sample units deployed at these sites are Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling units.

The authority as stated above will continue to fund heavy metals monitoring at the Glais Primary School ❷ and at the YGG Gellionnen ❹ (Welsh Primary School) sites. Monitoring is undertaken using Partisol 2025 units with automatic filter cartridge exchange. NPL will continue to undertake all analysis from filters exposed at these sites to maintain comparability with the analysis undertaken from the two sites that form part of the UK heavy Metals Monitoring Network.

All monitoring locations (both UK Network sites and the two Swansea funded sites) have an Industrial classification [8]. Data continues to be captured covering the four compass points around the high level stack release point.

The location of Vale and the sampling locations can be seen within map 8.

[8] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*



Map 8 Heavy Metals Monitoring, Vale, Glais

Filters are exposed on a weekly basis and sent to the National Physics Laboratory (NPL) for analysis. The analysed parameters are: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Magnesium (Mn), Nickel (Ni), Lead (Pb), Platinum (Pt), Vanadium (V), Zinc (Zn) and Mercury(Hg). Analysis for particulate-phase metals took place at NPL using a PerkinElmer Elan DRC II ICP-MS, following NPL's UKAS accredited procedure, which is fully complaint with the requirements of EN 14902:2005.

Upon arrival at NPL, the filters were cut accurately in half, and each portion digested at temperatures up to 220°C using a CEM Mars X microwave. The digestion mixtures used were:

- Hg & Pt: 5 ml of nitric acid and 5 ml hydrochloric acid.
- All other metals: 8 ml of nitric acid and 2 ml hydrogen peroxide.

ICP-MS analysis of the digested solutions took place using at least four gravimetrically-prepared calibration solutions. A QA standard was repeatedly analysed (after every two solutions), and the change in response of the QA standard was mathematically modeled to correct for the long-term drift of the instrument. The short-term drift of the ICP-MS was corrected for by use of an internal standards mixture (containing Y, In, Bi, Sc, Ga & Rh) continuously added to the all samples via a mixing block. Each sample is analysed in triplicate, each analysis consisting of five replicates.

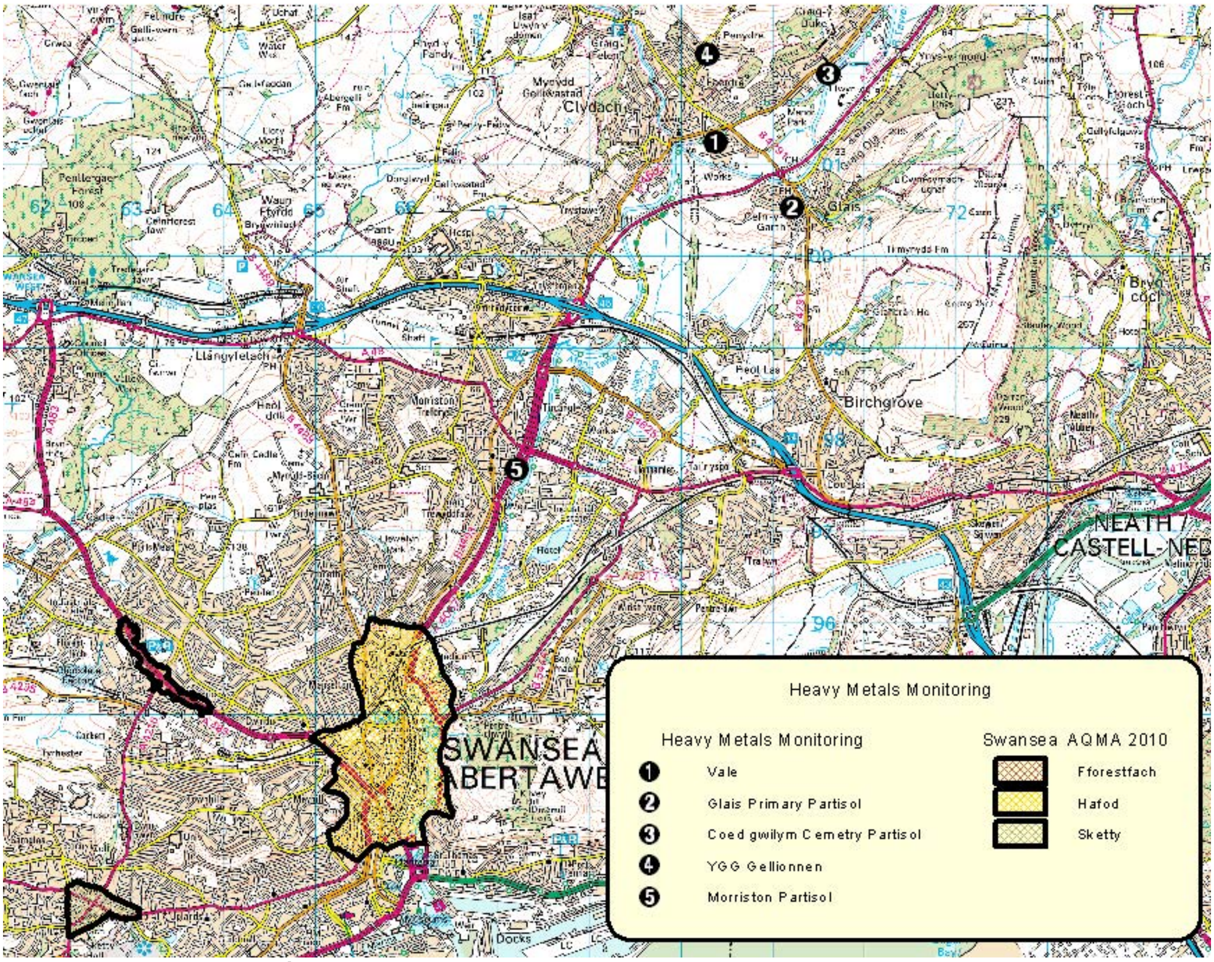
The amount of each metal in solution (and its uncertainty) was then determined by a method of generalised least squares using XGenline (an NPL-developed program) to construct a calibration curve[9].

The uncertainty weighted mean for a series of N measurements, where the i^{th} measurement produces a value, x_i, with a measurement uncertainty, u_i, the uncertainty-weighted mean of the measurement, $\bar{x}_u$, would be given by:

$$\bar{x}_u = \frac{\sum_{i=1}^{i=N} \left(x_i / u_i^2 \right)}{\sum_{i=1}^{i=N} \left(1 / u_i^2 \right)}$$

Again, in order for the reader to be aware spatially of the UK Heavy Metal Monitoring sites within Swansea, the monitoring locations are presented below within map 9, with the Swansea Air Quality Management Area 2010 (former Hafod AQMA) indicated for reference purposes.

9 2008 NPL Report-AS 34 (March 2009) Annual Report for 2008 on the UK Heavy Metals Monitoring Network



Map 9 Swansea *UK Heavy Metal Monitoring Sites*

2.1.11 Continuous PAH Monitoring

The authority operate a continuous PAH monitoring site at the Cwm Level Park station (see 2.1.8 for location) on behalf of DEFRA and the Welsh Assembly Government using a Digitel DHA-80 Air sampling System with PM_{10} inlet. This network has been upgraded during 2007 to provide fully complaint data for assessment of PAH under the 4th Daughter Directive and the National Assembly for Wales Statutory Instrument 2007 W 63 Environmental Protection Wales and the Air Quality Standards (Wales) Regulations 2007. The site has been designated as urban background, [10] with the purpose of the site to assess the levels of PAH before / as a consequence of, the influence of industry to the east and North of the Swansea area.

[10] *Source LAQM.TG(09) Appendix A page A1-20 Table A1.4*

2.1.12 Non-Automatic Monitoring

The authority has operated a network of passive nitrogen dioxide diffusion tubes for several years. Some sites have provided data to the UK Non-Automatic (NO_2) Network until this network ceased to operate on a weekly and monthly basis in December 2005. The remainder of the sites form part of specific studies within areas of concern. The datasets from these studies may therefore be for a limited time frame whilst conditions are assessed.

The authority expanded the coverage of monthly exposure of passive NO_2 tubes from 71 sites to 134 sites during July 2008 with a further doubling of the survey during November 2009 from 134 to 274 sites and eventually to 291 sites during late 2009 and early 2010. This new commitment to yet more additional monitoring was as a direct result of the new LAQM Technical Guidance (LAQM.TG(09)) and the conclusions reached within the USA 2009 that additional initial screening of narrow/congested streets was required where the AADT flow was greater than 5000 vehicles. However, due to budgetary constraints introduced within the authority during April 2011 a decision was made to cease monitoring at all sites that have consistently returned a bias corrected annual mean below 30ug/m^3. Monitoring ceased at these sites during May 2011 and for completeness, these sites are annotated within table 3.

Monitoring is focused primarily on roadside locations with particular emphasis in determining NO_2 levels around several busy junctions and busy/narrow/congested roads. Wherever possible, passive diffusion tubes are located directly on receptor locations – typically front façade of dwellings, mainly on front down pipes etc. Where this has not been possible, the tubes have been located on the nearest lamppost etc to the dwelling and concentrations corrected to facade. Full details of the sites chosen are presented below within table 3 and a map showing the monitoring locations is included below as map 10. Due to the number of passive diffusion tube locations, it is not possible to label the site numbers within map10. For clarity and completeness, the additional areas that make up The Swansea Air Quality Management Area 2010 (presented to Council in August 2010) are shown within map 10.

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location?
1		262046	196420	Roadside	NO_2		Y (0.1m)	3m	
2	Y	262095	196500	Roadside	NO_2		Y (0.1m)	12m	
3	Y	262161	196513	Roadside	NO_2		Y (0.1m)	6m	
4		262497	192857	Roadside	NO_2	Y	Y (0.1m)	4m	
5		262548	192943	Roadside	NO_2	Y	Y (0.1m)	3m	
6		262612	192995	Roadside	NO_2	Y	Y (0.1m)	4.5m	
7		262691	192852	Roadside	NO_2	Y	Y (0.1m)	2m	
8		262990	195820	Roadside	NO_2	Y	Y (0.1m)	3m	
9		263190	195205	Roadside	NO_2		Y (0.1m)	6m	
10		263219	195513	Roadside	NO_2	Y	Y (0.1m)	5m	
11		263344	195474	Roadside	NO_2	Y	Y (0.1m)	2m	
12		263680	195103	Roadside	NO_2	Y	Y (0.1m)	2m	
13		264830	193066	Roadside	NO_2		Y (0.1m)	8m	
14		265285	192696	Roadside	NO_2		Y (0.1m)	2.5m	
15		265334	192608	Roadside	NO_2		Y (0.1m)	12m	
16		265339	192534	Roadside	NO_2		Y (0.1m)	11m	
17		265496	192408	Roadside	NO_2		Y (0.1m)	5m	
18		265526	195807	Roadside	NO_2	Y	Y (0.1m)	2m	
19		265597	194061	Roadside	NO_2	Y	Y (0.1m)	5m	
20		265594	194175	Roadside	NO_2	Y	Y (0.1m)	1.5m	
21		265634	195316	Roadside	NO_2	Y	Y (0.1m)	2m	
22		265682	195374	Roadside	NO_2	Y	Y (0.1m)	2m	
23		265728	195494	Roadside	NO_2	Y	Y (0.1m)	2m	
24	Y	265760	192420	Roadside	NO_2		Y (0.1m)	5m	
25		265845	195547	Roadside	NO_2	Y	Y (0.1m)	3.5m	
26		265876	194318	Roadside	NO_2	Y	Y (0.1m)	2m	
27		265922	194428	Roadside	NO_2	Y	Y (0.1m)	2m	
28		265949	194891	Roadside	NO_2	Y	Y (0.1m)	14m	
29		265973	195222	Roadside	NO_2	Y	Y (0.1m)	3.5m	
30	Y	266080	192516	Roadside	NO_2		Y (0.1m)	5m	
31		266153	196003	Roadside	NO_2		Y (0.1m)	2.5m	
32		266209	193867	Roadside	NO_2		Y (0.1m)	5m	
33		266236	193488	Roadside	NO_2		Y (0.1m)	5m	
34		266272	196168	Roadside	NO_2		Y (0.1m)	1.5m	
35		266314	193298	Roadside	NO_2		Y (0.1m)	2m	
36		266455	193300	Roadside	NO_2		Y (0.1m)	2m	
37	Y	266515	193213	Roadside	NO_2		Y (0.1m)	2m	
38		266662	193181	Roadside	NO_2		Y (0.1m)	6m	
39	Y	266905	193271	Roadside	NO_2		Y (0.1m)	5m	
40		266951	198278	Roadside	NO_2		Y (0.1m)	8m	
41		266953	198085	Roadside	NO_2		Y (0.1m)	2m	
42	Y	267084	198274	Roadside	NO_2		Y (0.1m)	5m	
43		267093	198063	Roadside	NO_2		Y (0.1m)	2m	
44		267639	199543	Roadside	NO_2		Y (0.1m)	23m (M4)	
45		267661	199451	Roadside	NO_2		Y (0.1m)	10m (M4)	
46	Y	267752	193218	Roadside	NO_2		Y (0.1m)	5m	
47	Y	267908	199773	Roadside	NO_2		Y (0.1m)	16m	
48		268011	193101	Roadside	NO_2		Y (0.1m)	9m	
49		268501	197329	Roadside	NO_2		Y (0.1m)	6m	
50		268530	197419	Roadside	NO_2		Y (0.1m)	6m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
51		268593	197434	Roadside	NO_2		Y (0.1m)	5m	
52	Y	268643	197245	Roadside	NO_2		Y (0.1m)	4m	
53	Y	268652	197508	Roadside	NO_2		Y (0.1m)	5m	
54		268693	197416	Roadside	NO_2		Y (0.1m)	9m	
55		268789	197420	Roadside	NO_2		Y (0.1m)	4m	
56 *		269306	198661	Roadside	NO_2		Y (166m)	2m	Y
57	Y	269395	199042	Roadside	NO_2		Y (0.1m)	3m	
58		264052	192884	Roadside	NO_2		Y (8m)	2m	Y
59		265918	194463	Roadside	NO_2	Y	Y (0.2m)	1.5m	
60		265036	192931	Roadside	NO_2		Y (0.1m)	2m	
61		264959	192878	Roadside	NO_2		Y (0.1m)	2m	
62	Y	266698	195335	Roadside	NO_2		Y (10m)	1m	Y
63		262675	192775	Roadside	NO_2	Y	Y (6.0m)	1.5m	Y
64		262719	192840	Roadside	NO_2	Y	Y (3.0m)	1m	Y
65		262735	192855	Roadside	NO_2	Y	Y (0.1m)	5m	
66		262802	192829	Roadside	NO_2	Y	Y (0.1m)	8m	
67		265903	193683	Roadside	NO_2	Y	Y (5.0m)	1m	Y
68		265573	193432	Roadside	NO_2		Y (0.1m)	6m	
69		265543	193450	Roadside	NO_2		Y (4m)	3m	Y
70		266649	195435	Roadside	NO_2		Y (7m)	1m	Y
71 **		266514	195485	Roadside	NO_2		Y (138m)	2m	Y
72		264091	192900	Roadside	NO_2		Y (0.1m)	18m	
73		264138	192868	Roadside	NO_2		Y (0.1m)	9m	
74		264163	192853	Roadside	NO_2		Y (0.1m)	12m	
75		264072	192869	Roadside	NO_2		Y (0.1m)	8m	
76		263968	192880	Roadside	NO_2		Y (0.1m)	9m	
77	Y	263856	192931	Roadside	NO_2		Y (0.1m)	7m	
78		263819	192948	Roadside	NO_2		Y (0.1m)	7m	
79		263842	192896	Roadside	NO_2		Y (0.1m)	10m	
80	Y	263558	192833	Roadside	NO_2		Y (0.1m)	12m	
81	Y	262940	192775	Roadside	NO_2	Y	Y (0.1m)	8m	
82	Y	262851	192805	Roadside	NO_2	Y	Y (0.1m)	8m	
83		262785	192838	Roadside	NO_2	Y	Y (0.1m)	7.5m	
84		262714	192839	Roadside	NO_2	Y	Y (0.1m)	6.5m	
85		262702	192847	Roadside	NO_2	Y	Y (0.1m)	6.5m	
86		262704	192865	Roadside	NO_2	Y	Y (0.1m)	4.5m	
87		262697	192798	Roadside	NO_2	Y	Y (0.1m)	6m	
88		262605	192916	Roadside	NO_2	Y	Y (0.1m)	4m	
89		262587	192956	Roadside	NO_2	Y	Y (0.1m)	4.5m	
90		262631	192996	Roadside	NO_2	Y	Y (0.1m)	4.5m	
91		262534	192950	Roadside	NO_2	Y	Y (0.1m)	3m	
92		262545	192869	Roadside	NO_2	Y	Y (3.0m)	4.5m	
93		263406	195534	Roadside	NO_2		Y (0.1m)	2m	
94		263444	195572	Roadside	NO_2		Y (0.1m)	2m	
95		262815	196090	Roadside	NO_2		Y (0.1m)	8m	
96		262922	195950	Roadside	NO_2		Y (0.1m)	3m	
97		262946	195902	Roadside	NO_2	Y	Y (0.1m)	4m	

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98		263142	195548	Roadside	NO_2	Y	Y (0.1m)	4m	
99		263387	195332	Roadside	NO_2	Y	Y (0.1m)	2m	
100		263470	195250	Roadside	NO_2	Y	Y (0.1m)	4m	
101		263843	195047	Roadside	NO_2	Y	Y (0.1m)	4m	
102		266379	193307	Roadside	NO_2		Y (0.1m)	2m	
103		268526	197359	Roadside	NO_2		Y (0.1m)	3m	
104		268538	197389	Roadside	NO_2		Y (0.1m)	8m	
105		268562	197472	Roadside	NO_2		Y (0.1m)	6.5m	
106		268496	197476	Roadside	NO_2		Y (0.1m)	5m	
107		268765	197420	Roadside	NO_2		Y (0.1m)	5m	
108		267608	199461	Roadside	NO_2		Y (0.1m)	15m (M4)	
109		267510	199487	Roadside	NO_2		Y (0.1m)	16.5 (M4)	
110		267369	199521	Roadside	NO_2		Y (0.1m)	35m (M4)	
111		267705	199426	Roadside	NO_2		Y (0.1M)	17m (M4)	
112		264868	192814	Roadside	NO_2		Y (6.0M)	0.5m	Y
113		264654	192662	Roadside	NO_2		Y (0.1m)	5.5m	
114		264622	192971	Roadside	NO_2		Y (0.1m)	7m	
115		265031	193097	Roadside	NO_2		Y (0.1m)	5m	
116		265192	193138	Roadside	NO_2		Y (0.1m)	4m	
117		265288	193211	Roadside	NO_2		Y (0.1m)	5.5m	
⊗118		265483	193385	Roadside	NO_2		Y (17M)	7m	
119		265522	193390	Roadside	NO_2		Y (0.1M)	2m	
120		265570	193366	Roadside	NO_2		N (6.0M)	2m	Y
121		265706	193662	Roadside	NO_2	Y	Y (0.1M)	3m	
122		265694	193505	Roadside	NO_2		Y (0.5M)	3m	
123		265655	193423	Roadside	NO_2		Y (0.1M)	4m	
⊗124		265651	193253	Roadside	NO_2		Y (2M)	4m	
⊗125		265641	193162	Roadside	NO_2		Y (3m)	1m	Y
⊗126		265475	193144	Roadside	NO_2		Y (10m)	5m	
⊗127		265348	193110	Roadside	NO_2		Y(10m)	1m	
⊗128		265297	193085	Roadside	NO_2		N (>50m)	4.5m	
⊗129		265153	193098	Roadside	NO_2		Y (5m)	7m	
⊗130		265139	192912	Roadside	NO_2		Y (27m)	3.5m	Y
131		265137	192846	Roadside	NO_2		Y(30m)	5m	
132		265229	192753	Roadside	NO_2		Y (5M)	2m	Y
133		265350	192566	Roadside	NO_2		Y (0.1m)	2m	
⊗134		265113	192903	Roadside	NO_2		Y(0.1m)	4m	
^135		262605	192916	Roadside	NO_2	Y	Y(0.1m)	4m	
^136		262612	192995	Roadside	NO_2	Y	Y(0.1m)	4.5m	
^137		262631	192996	Roadside	NO_2	Y	Y(0.1m)	4.5m	
138		266779	199246	Roadside	NO_2		Y(0.1m)	3m	
139		266867	199030	Roadside	NO_2		Y(0.1m)	1.5m	
140		266863	199009	Roadside	NO_2		Y(0.1m)	1.5m	
141		266979	198772	Roadside	NO_2		Y(0.1m)	2m	
142		267017	198710	Roadside	NO_2		Y(0.1m)	2m	
143		267089	198608	Roadside	NO_2		Y(0.1m)	2m	
144		267141	198591	Roadside	NO_2		Y(0.1m)	2m	
145		267139	198578	Roadside	NO_2		Y(0.1m)	2m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
146		267156	198571	Roadside	NO_2		Y(0.1m)	2m	
147		267165	198580	Roadside	NO_2		Y(0.1m)	2m	
148		267170	198564	Roadside	NO_2		Y(0.1m)	2m	
149		267204	198561	Roadside	NO_2		Y(0.1m)	4m	
150		267205	198545	Roadside	NO_2		Y(0.1m)	3m	
151		267192	198518	Roadside	NO_2		Y(0.1m)	3m	
152	Y	267081	198268	Roadside	NO_2		Y(0.1m)	6m	
153	Y	268845	201137	Roadside	NO_2		Y(0.1m)	2m	
154	Y	268870	201267	Roadside	NO_2		Y(0.1m)	2m	
155		269009	201280	Roadside	NO_2		Y(0.1m)	2.5m	
156		269059	201296	Roadside	NO_2		Y(0.1m)	4m	
157	Y	269173	201355	Roadside	NO_2		Y(0.1m)	4m	
158		269480	201441	Roadside	NO_2		Y(0.1m)	3m	
159		269171	201620	Roadside	NO_2		Y(0.1m)	5m	
160		269049	201744	Roadside	NO_2		Y(0.1m)	3m	
161	Y	268938	201929	Roadside	NO_2		Y(0.1m)	6.5m	
162		259553	203379	Roadside	NO_2		Y(0.1m)	1m	
163		259287	203556	Roadside	NO_2		Y(0.1m)	2m	
164		259195	203667	Roadside	NO_2		Y(0.1m)	2m	
165		259149	203675	Roadside	NO_2		Y(0.1m)	2m	
166		259148	203690	Roadside	NO_2		Y(0.1m)	2.5m	
167		259126	203700	Roadside	NO_2		Y(0.1m)	4.5m	
168		259115	203705	Roadside	NO_2		Y(0.1m)	4.5m	
169		259013	203747	Roadside	NO_2		Y(0.1m)	4.5m	
170		258971	203797	Roadside	NO_2		Y(0.1m)	4.5m	
171		258917	203826	Roadside	NO_2		Y(0.1m)	4.5m	
172		258887	203859	Roadside	NO_2		Y(0.1m)	4.5m	
173		259250	203708	Roadside	NO_2		Y(0.1m)	5.5m	
174		259253	203660	Roadside	NO_2		Y(0.1m)	6m	
175		259251	203638	Roadside	NO_2		Y(0.1m)	8.5m	
176		258872	203691	Roadside	NO_2		Y(0.1m)	5m	
177		258896	203697	Roadside	NO_2		Y(0.1m)	1m	
178		258986	203684	Roadside	NO_2		Y(0.1m)	1m	
179	Y	259059	197831	Roadside	NO_2		Y(0.1m)	2.5m	
180		259064	197781	Roadside	NO_2		Y(0.1m)	1.5m	
181	Y	259010	197817	Roadside	NO_2		Y(0.1m)	3.5m	
182		259050	197790	Roadside	NO_2		Y(0.1m)	2m	
183		259036	197795	Roadside	NO_2		Y(0.1m)	2.5m	
184	Y	259014	197797	Roadside	NO_2		Y(0.1m)	5m	
185	Y	258919	197820	Roadside	NO_2		Y(0.1m)	4.5m	
186	Y	258711	197868	Roadside	NO_2		Y(0.1m)	4m	
187	Y	258206	198239	Roadside	NO_2		Y(0.1m)	2.5m	
188	Y	258197	198219	Roadside	NO_2		Y(0.1m)	6.5m	
189	Y	258270	198257	Roadside	NO_2		Y(0.1m)	7.5m	
190	Y	258260	198237	Roadside	NO_2		Y(0.1m)	2.5m	
191	Y	258338	198270	Roadside	NO_2		Y(0.1m)	4.5m	
192	Y	257422	198542	Roadside	NO_2		Y(0.1m)	5m	
193	Y	257371	198522	Roadside	NO_2		Y(0.1m)	3.5m	
194	Y	257958	198581	Roadside	NO_2		Y(0.1m)	4.5m	

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195	Y	257972	198563	Roadside	NO_2		Y(0.1m)	5m	
196	Y	258046	198558	Roadside	NO_2		Y(0.1m)	5m	
197		258797	198701	Roadside	NO_2		Y(0.1m)	2m	
198		258811	198701	Roadside	NO_2		Y(0.1m)	2m	
199		254703	195764	Roadside	NO_2		Y(0.1m)	2m	
200	Y	254582	195821	Roadside	NO_2		Y(0.1m)	2m	
201		254522	195859	Roadside	NO_2		Y(0.1m)	2m	
202	Y	254437	195879	Roadside	NO_2		Y(0.1m)	4m	
203	Y	254294	195885	Roadside	NO_2		Y(0.1m)	3.5m	
204	Y	253777	195926	Roadside	NO_2		Y(0.1m)	4m	
205	Y	253758	195939	Roadside	NO_2		Y(0.1m)	2.5m	
206		261565	188211	Roadside	NO_2		Y(0.1m)	1.5m	
207		261561	188222	Roadside	NO_2		Y(0.1m)	2.5m	
208		261541	188215	Roadside	NO_2		Y(0.1m)	2.5m	
209		261534	188198	Roadside	NO_2		Y(0.1m)	1.5m	
210		261516	188207	Roadside	NO_2		Y(0.1m)	2.5m	
211		261501	188188	Roadside	NO_2		Y(0.1m)	1.5m	
212		261486	188200	Roadside	NO_2		Y(0.1m)	2.5m	
213		261490	188186	Roadside	NO_2		Y(0.1m)	1.5m	
214		261315	188193	Roadside	NO_2		Y(0.1m)	4m	
215		261299	188191	Roadside	NO_2		Y(0.1m)	4m	
216		261276	188190	Roadside	NO_2		Y(0.1m)	4m	
217	Y	260357	188240	Roadside	NO_2		Y(0.1m)	4.5m	
218	Y	260384	188206	Roadside	NO_2		Y(0.1m)	1m	
219	Y	260419	188172	Roadside	NO_2		Y(0.1m)	2.5m	
220	Y	261194	188163	Roadside	NO_2		Y(0.1m)	4m	
221	Y	260454	188171	Roadside	NO_2		Y(0.1m)	4m	
222	Y	260469	188182	Roadside	NO_2		Y(0.1m)	5m	
223	Y	266899	197354	Roadside	NO_2		Y(0.1m)	3m	
224	Y	266881	197389	Roadside	NO_2		Y(0.1m)	2m	
225	Y	266861	197432	Roadside	NO_2		Y(0.1m)	2m	
226	Y	266829	197472	Roadside	NO_2		Y(0.1m)	5m	
227	Y	266836	197484	Roadside	NO_2		Y(0.1m)	2m	
228	Y	266779	197578	Roadside	NO_2		Y(0.1m)	5m	
229	Y	266772	197621	Roadside	NO_2		Y(0.1m)	2m	
230	Y	266777	197651	Roadside	NO_2		Y(0.1m)	2m	
231	Y	268802	197666	Roadside	NO_2		Y(0.1m)	4m	
232	Y	266825	197654	Roadside	NO_2		Y(0.1m)	2m	
233	Y	266823	197668	Roadside	NO_2		Y(0.1m)	4m	
234	Y	266858	197671	Roadside	NO_2		Y(0.1m)	3m	
235	Y	266874	197657	Roadside	NO_2		Y(0.1m)	3.5m	
236	Y	266886	197658	Roadside	NO_2		Y(0.1m)	4m	
237	Y	266885	197676	Roadside	NO_2		Y(0.1m)	3.5m	
238		266902	197660	Roadside	NO_2		Y(0.1m)	3.5m	
239		266181	196022	Roadside	NO_2		Y(0.1m)	1.5m	
240		266169	195995	Roadside	NO_2		Y(0.1m)	1.5m	
241		266159	196013	Roadside	NO_2		Y(0.1m)	1.5m	
242		265655	193423	Roadside	NO_2		Y(0.1m)	4m	
243		265474	194949	Roadside	NO_2		Y(0.1m)	4m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
244		265466	194930	Roadside	NO_2	Y	Y(0.1m)	2m	
245		265448	194922	Roadside	NO_2	Y	Y(0.1m)	2m	
246		265425	194927	Roadside	NO_2		Y(0.1m)	4m	
247		265394	194899	Roadside	NO_2	Y	Y(0.1m)	2m	
248		265342	194894	Roadside	NO_2		Y(0.1m)	4m	
249		265326	194871	Roadside	NO_2	Y	Y(0.1m)	2m	
250		265274	194867	Roadside	NO_2		Y(0.1m)	4m	
251		265263	194845	Roadside	NO_2	Y	Y(0.1m)	2m	
252		265226	194830	Roadside	NO_2	Y	Y(0.1m)	2m	
253		265194	194833	Roadside	NO_2		Y(0.1m)	4m	
254		265142	194816	Roadside	NO_2		Y(0.1m)	2m	
255		265098	194825	Roadside	NO_2		Y(0.1m)	2m	
256		264995	194777	Roadside	NO_2		Y(0.1m)	2m	
257	Y	254817	189135	Roadside	NO_2		Y(0.1m)	1.5m	
258		254906	189110	Roadside	NO_2		Y(0.1m)	1.5m	
259	Y	254949	189113	Roadside	NO_2		Y(0.1m)	5.5m	
260	Y	254970	189116	Roadside	NO_2		Y(0.1m)	4m	
261	Y	254991	189115	Roadside	NO_2		Y(0.1m)	1m	
263	Y	262444	193447	Roadside	NO_2		Y(0.1m)	6m	
264	Y	262251	193293	Roadside	NO_2		Y(0.1m)	5m	
265		266375	198023	Roadside	NO_2		Y(0.1m)	2m	
266	Y	266380	198043	Roadside	NO_2		Y(0.1m)	4m	
267		266382	198028	Roadside	NO_2		Y(0.1m)	2m	
268		266419	198053	Roadside	NO_2		Y(0.1m)	3m	
269	Y	266458	198111	Roadside	NO_2		Y(0.1m)	4m	
270	Y	266896	198084	Roadside	NO_2		Y(0.1m)	2m	
271		266879	198078	Roadside	NO_2		Y(0.1m)	1.5m	
272		266888	198074	Roadside	NO_2		Y(0.1m)	1.5m	
273	Y	267060	198234	Roadside	NO_2		Y(0.1m)	6m	
274		269487	201451	Roadside	NO_2		Y(0.1m)	6m	
275		265658	194856	Roadside	NO_2	Y	Y(2.0m)	1.5m	
276		265610	194871	Roadside	NO_2	Y	Y(0.1m)	3m	
277		265596	194875	Roadside	NO_2	Y	Y(0.1m)	3m	
278		265573	194882	Roadside	NO_2	Y	Y(0.1m)	3m	
279		265555	194926	Roadside	NO_2	Y	Y(0.1m)	1.5m	
280		265542	194980	Roadside	NO_2	Y	Y(2.0m)	1m	
281		265542	194872	Roadside	NO_2	Y	Y(3.0m)	1m	
282		265540	194840	Roadside	NO_2	Y	Y(3.0m)	1m	
283		265436	195937	Roadside	NO_2		Y(0.1m)	2m	
284		265452	195899	Roadside	NO_2		Y(0.1m)	2m	
285		266955	197415	Roadside	NO_2		Y(0.1m)	2m	
286		266938	197377	Roadside	NO_2		Y(0.1m)	4m	
287		265715	193902	Roadside	NO_2	Y	Y(0.1m)	2m	
288		265698	193878	Roadside	NO_2	Y	Y(0.1m)	2m	
289		265702	193842	Roadside	NO_2	Y	Y(0.1m)	2m	
290		263014	195737	Roadside	NO_2	Y	Y(0.1m)	2m	
291		267952	193121	Roadside	NO_2		Y(0.1m)	5m	

Table 3 Passive NO_2 Diffusion Tube Monitoring Locations

*** Site 56** is located on Ynysallan Road, Ynystawe to the frontage of a potential housing development site that would be 10-15m from the eastbound carriageways of the M4. Relevant exposure is given at present to the nearest existing dwelling within a separate development setback from the monitoring location.
**** Site 71** Copper Quarter 3 is on the frontage of an existing housing development site (construction ceased at present due to economic downturn) that will see dwellings fronting onto the access road to Morfa Retail Park and the Liberty Stadium. Relevant exposure is given at present to the nearest existing dwelling on the development site. The nearest potential dwelling within the development (setback from the monitoring location) will be within 10m of the monitoring location when construction is complete.
***** Site 125** Army Careers Centre, City Centre – Relevant exposure is given to a block of flats over commercial premises
⊗ City centre sites along busy roads – relevant exposure is given to either restaurants where there is a Café environment or to blocks of flats. Assessment where Café environment exists is for 1 hour NO_2 objective
^Sites 135-137 are located at first floor level of properties in addition to exposure at 2.5 on the same dwelling to assess if concentrations change with height

The contract for the supply and analysis of all passive diffusion tubes has been awarded to Harwell Scientifics of 551 South Becquerel Avenue, Harwell International Business Centre, Didcott, Oxon.

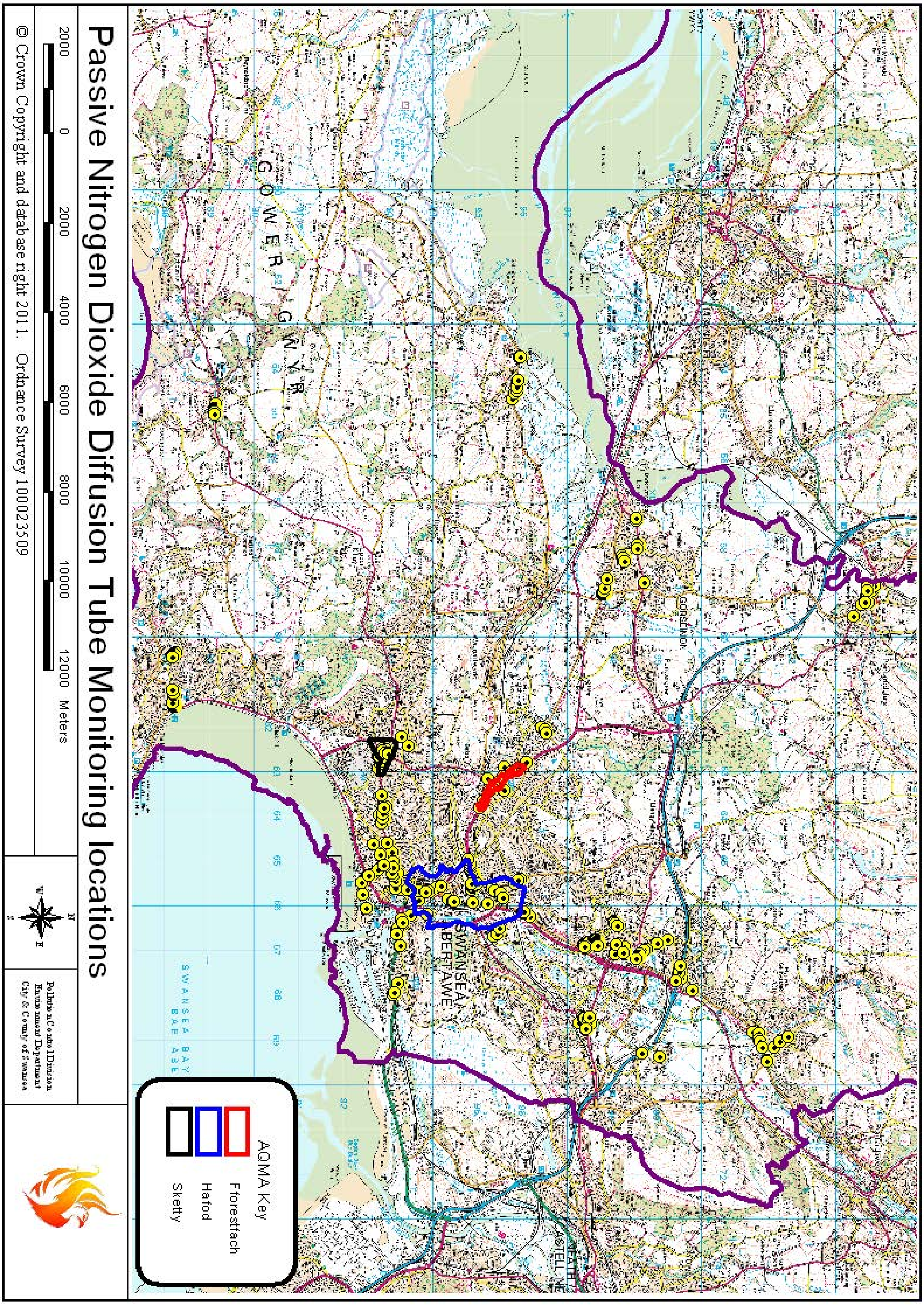
This contract laboratory has been operating for over 20 years and has extensive UKAS accreditation. In addition, all work is accredited to BS EN ISO 9001. Its predecessor the EMS Division, Harwell, carried out Swansea's original NO_2 mapping in 1985/86.

All samples have been analysed in accordance with the Harwell Scientifics standard operating procedure HS/GWI/1015 issue14. This method meets the guidelines set out in DEFRA's "Diffusion Tubes for Ambient NO2 Monitoring:Practical Guidance". All tubes are prepared by spiking acetone:triethanolamine (50:50) onto grids prior to the tubes being assembled. The tubes were desorbed with distilled water and the extract analysed using a segmented flow autoanalyser with ultraviolet detection. The analytical methods employed by Harwell Scientifics follow the procedures set out in the Harmonisation Practical Guidance.

Harwell Scientifics take part in the Workplace Analysis Scheme for Proficiency (WASP) operated by HSL. The WASP scheme is an independent proficiency testing scheme operated by the Health and Safety Laboratory (HSL). Each month a diffusion tube doped with nitrite is distributed to each participating laboratory; participants then analyse the tube and report the results to HSL. The nominal mass of nitrite on the doped tubes is different each month, and is intended to reflect the range encountered in actual monitoring. The latest results from Harwell Scientifics participation in the

WASP scheme are enclosed as Annexe 3. For the purpose of diffusion tube QA/QC in the context of Local Air Quality Management, NETCEN carry out an assessment of laboratory performance for each full calendar year. This was based on the following criteria, which were agreed with DEFRA and HSL:

1. Participating laboratories must complete at least 10 of the 12 monthly WASP rounds.
2. The year's single worst result is ignored: this makes some limited allowance for one-off problems with analytical equipment etc.
3. Each laboratory's monthly standardised results are then combined to give a standard uncertainty for the full year, expressed as a relative standard deviation (%RSD)
4. The RSD must be within 15%Non-Automatic Monitoring



Map 10 – Location of passive Nitrogen Dioxide Diffusion Tubes

2.1.13 Determination of a "Swansea" bias factor

There has been great debate surrounding the use of a locally derived bias factor when correcting diffusion tubes for bias. Indeed, previous auditor's comments have indicated that such a local derived correction factor should be obtained for Swansea. The auditor's comments have been taken on board and for the last several years tri located diffusion tubes have been located on the sample intake at each of the authority's chemiluminescent analyser sites at the Swansea Roadside AURN, Morfa and Morriston Groundhog sites. These co-location studies were extended during 2009 to include the urban background site at Cwm Level Park. All co-location sites will operate for the foreseeable future. This co-location work is required to be repeated yearly given the advice within section 6.3.1 of the report prepared by AEA Energy and Environment on behalf of DEFRA and the Devolved Administrations: NO_2 Diffusion Tubes for LAQM: Guidance note for Local Authorities[11].

Following on from previous auditors comments dated 9th September 2010 where it was highlighted that the bias adjustment factors from the four monitoring stations mentioned above should not have been averaged to produce a "Swansea Bias Factor" it has been decided to use the result of the co-location study undertaken at the Swansea AURN to correct passive NO_2 tubes exposed during 2011.

The ratified data has been obtained for the Swansea Roadside AURN via the UK Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector. AEA Energy and Environment undertake the QA/QC work on behalf of DEFRA at the Swansea AURN site.

The bias correction to be used for diffusion tube exposure during 2012 in Swansea is therefore 0.89. A spreadsheets containing the automatic real-time data and the passive diffusion tube data used to derived the bias factor is shown within Annexe 4

[11] http://www.airquality.co.uk/archive/reports/cat13/0604061218_Diffusion_Tube_GN_approved.pdf

2.2 Comparison of Monitoring Results with Air Quality Objectives

This section has been divided by pollutant and also whether the automatic monitoring location is either within, or outside of an existing AQMA as recommended in Box 5.2 of Chapter 5 of LAQM.TG(09).

2.2.1 Nitrogen Dioxide

2.2.2 Automatic Real-Time Nitrogen Dioxide Data

Measurements are undertaken with Advanced Pollution Instrumentation (API) real-time NO_x analysers and also by the DOAS systems at Hafod and St Thomas. The logged 15-minute means have been compiled into hourly averages by the software package OPSIS Enviman Reporter. In order to compile a valid hourly mean, a minimum of 3, 15-minute means were specified[12]. Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to calculate the annual mean.

Following rescaling works using the factors derived from the routine calibration of the API analyser, NO_2 is determined by $NO_x - NO = NO_2$. All existing stored NO_2 data is overwritten (within the working ASCII file only) with the rescaled derived NO_2 data.

All results are presented in $\mu g/m^3$ by multiplying the logged result in ppb by the conversion factor of 1.91[13] to produce results expressed in $\mu g/m^3$.

In the case of the Swansea AURN, the QA/QC procedures undertaken by NETCEN have resulted in ratified hourly data expressed in $\mu g/m^3$ being provided. The ratified hourly means have been used to calculate the objectives for the hourly and annual means. Hourly ratified data has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector. These data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation. Sections 2.1.6 and section 2.1.7 refer to the data collection methodology for the Hafod

[12] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47
[13] *LAQM.TG(09) Appendix A1 - Data Processing- Box A1.5 page A1-36*

and St.Thomas DOAS systems. Annual means derived for 2011 are given below within table 4 along with those for previous years 2007-2010.

Site ID (see table2 above)	Location	Within AQMA	Data Capture 2011 %	Annual mean (ug/m³)				
				2007	2008	2009	2010	2011
1	Swansea AURN ** (12m)	Y	99.1%	**26.7** (31.0)	**25.6** (31.8)	**26.3** (33.2)	**27.8** (36.1)	**25.6** (32.38)
2	Morfa Groundhog ** (34m)	Y	N/A	**24.3** (36.1)	**23.2** (36.5)	**22.5** (36.38)	**22.3** (37.7)	N/A
3	Morriston Groundhog ** (22m)	N	91.7%	**27.6** (36.1)	**23.6** (29.0)	**22.3** (29.34)	**22.6** (30.5)	**21.1** (27.25)
4	Cwm Level Park ** (100m)	Y	98.2%	**-**	**-**	**18.72**	**23.38**	**20.87**
5	Hafod DOAS	Y	96.4%	**52.19**	**58.64**	**53.44**	**58.60**	**57.61**
6	St.Thomas DOAS	N	98.8%	37	34.94	34.71	**45.88**	**40.89**

Table 4 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

** The distance to the nearest receptor location is given in brackets after the site name in the above table. The NO_2 annual mean at the nearest receptor location has been derived following guidance within TG.09 box 5.2(2) page 5-5 and also box 2.3 page2-6. The supporting simple calculator Excel spreadsheet (Issue 4) has been downloaded from http://laqm.defra.gov.uk/documents/NO2withDistancefromRoadsCalculatorIssue4.xls

The resulting calculated NO_2 annual mean at the receptor location due to fall off in concentration with distance from the road is given in bold for the year of consideration. The measured roadside concentration is given in brackets. Background 1k by 1k NO_2 concentrations were downloaded from http://laqm.defra.gov.uk/maps/maps2010.html and overlain on a GIS background map within ArcView3.3. The background concentration required for the calculation was obtained from the nearest 1k grid square to the monitoring station. The background concentrations shown in table 5 below were used:

Site ID (see table 4 above)	Location	Background NO_2 Concentrations (ug/m^3)				
		2007	2008	2009	2010	2011
1	Swansea AURN)	16.9	16.9	15.9	16.3	16.3
2	Morfa Groundhog)	16.4	16.3	15.5	16.1	N/A
3	Morriston Groundhog	18.2	17.6	16.8	17.8	17.8

Table 5 NO_2 background concentrations

As the site at Cwm Level Park has an Urban Background classification, with the nearest receptor being 100m away, the annual mean is presented and has not been corrected to the nearest receptor as guidance within LAQM.TG(09) (within box 2.3) indicates that the correction method within the simple calculator is setup to work at a distance of 0.1 to 50m form the kerb.

From table 4 it can be seen that the Hafod DOAS continues to experience annual mean NO_2 concentrations above the objective level. The St Thomas DOAS, whilst marginally exceeding the annual mean objective during 2011 has seen a 10.8% improvement on the returned annual mean to that of 2010 – possibly due to the improvements made around Quay Parade bridges during November/December 2011. All other sites have also seen a marginal decrease in annual mean concentrations. Interestingly for 2011, the Hafod DOAS, whilst continuing to see 16 exceedences of the 1 hour objective during 2011, has also seen an improvement on 2010 where 20 exceedences of the 1-hour objective were seen.

The data obtained from the Hafod DOAS is an open path, spatial measurement along a 250m path length within 0.2m of the terrace facades, running parallel to the terraced housing. On the opposite side of the road to the measurement path is a passive diffusion tube measurement site located at the Hafod Post Office (site 59 in table 7 of NO_2 tube results within section 2.3 below). The bias corrected annual mean of 53.98ug/m^3 from this site also indicates exceedence of the annual mean objective within this street canyon.

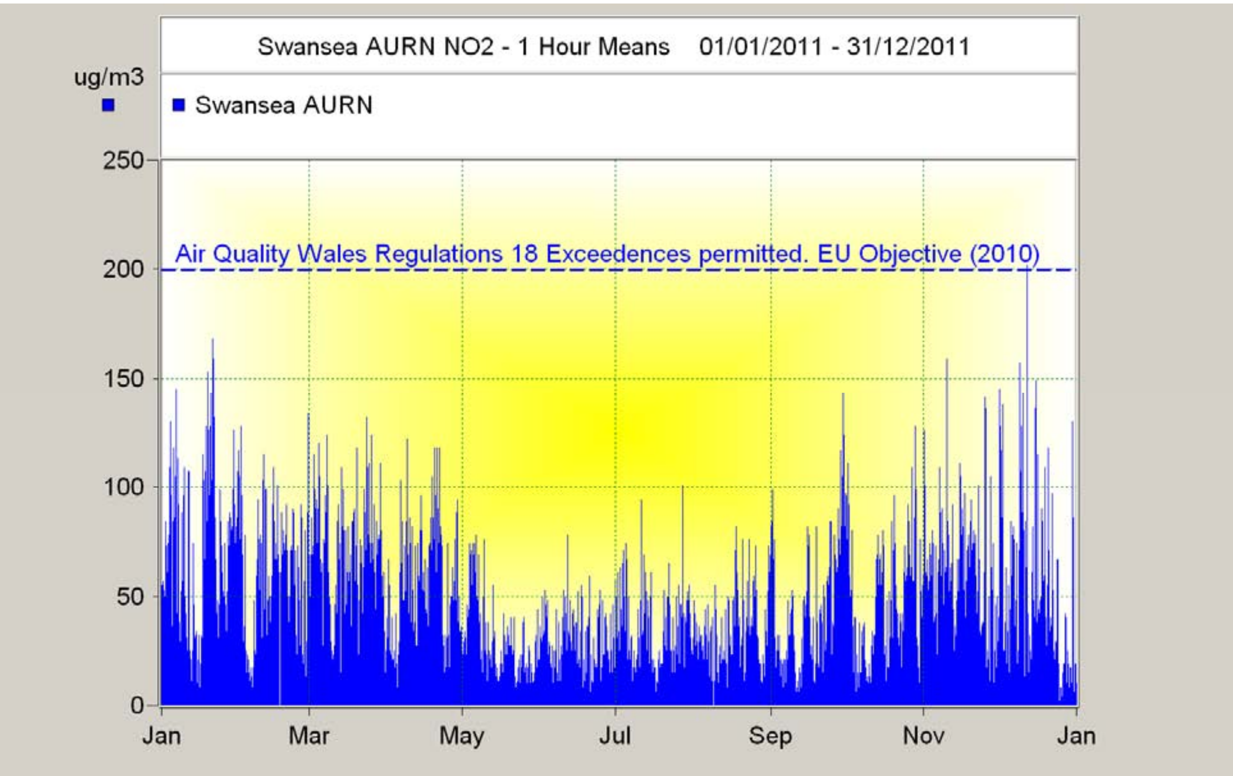
Table 5 below indicates assessments from all stations in respect of the number of exceedences of the 1-hour NO_2 objective. Where data capture rates are below 90% the 99.8th percentile is presented in brackets.

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2011 %	Number of Exceedences of hourly mean (200 μg/m³)				
				2007	2008	2009	2010	2011
1	Swansea AURN	**Y**	99.1%	0	0	0	0	1
2	Morfa Groundhog	**Y**	N/A	2	1	0 **(149.0)	1	N/A
3	Morriston Groundhog	**N**	91.7%	1	1 **(123.95)	0	0	0
4	Cwm Level Park	**Y**	98.2%	-	-	0 **(92.0)	0	0
5	Hafod DOAS	**Y**	96.4%	7	7 **(199.54)	11	20 **(203.13)	16
6	St.Thomas DOAS	**N**	98.8%	0	0	0	0	0

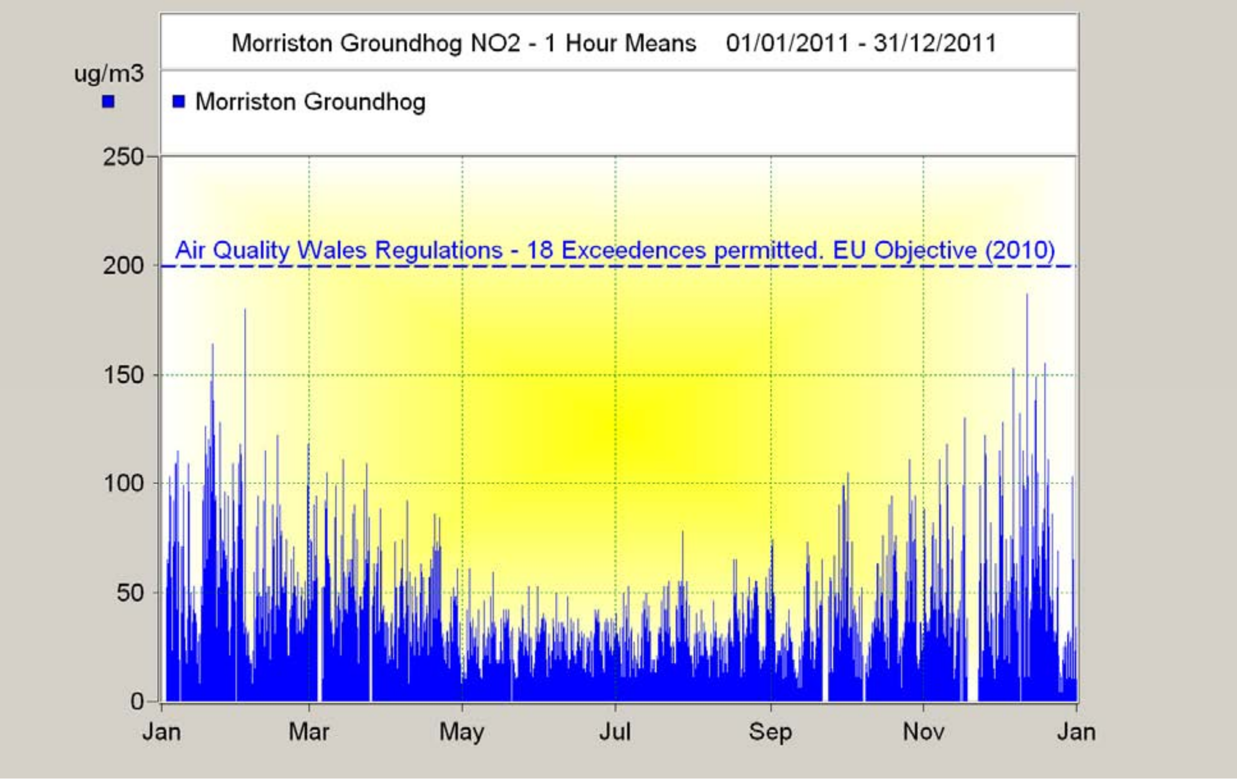
Table5 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

** Data capture rate below 90% 99.8th percentile presented in brackets

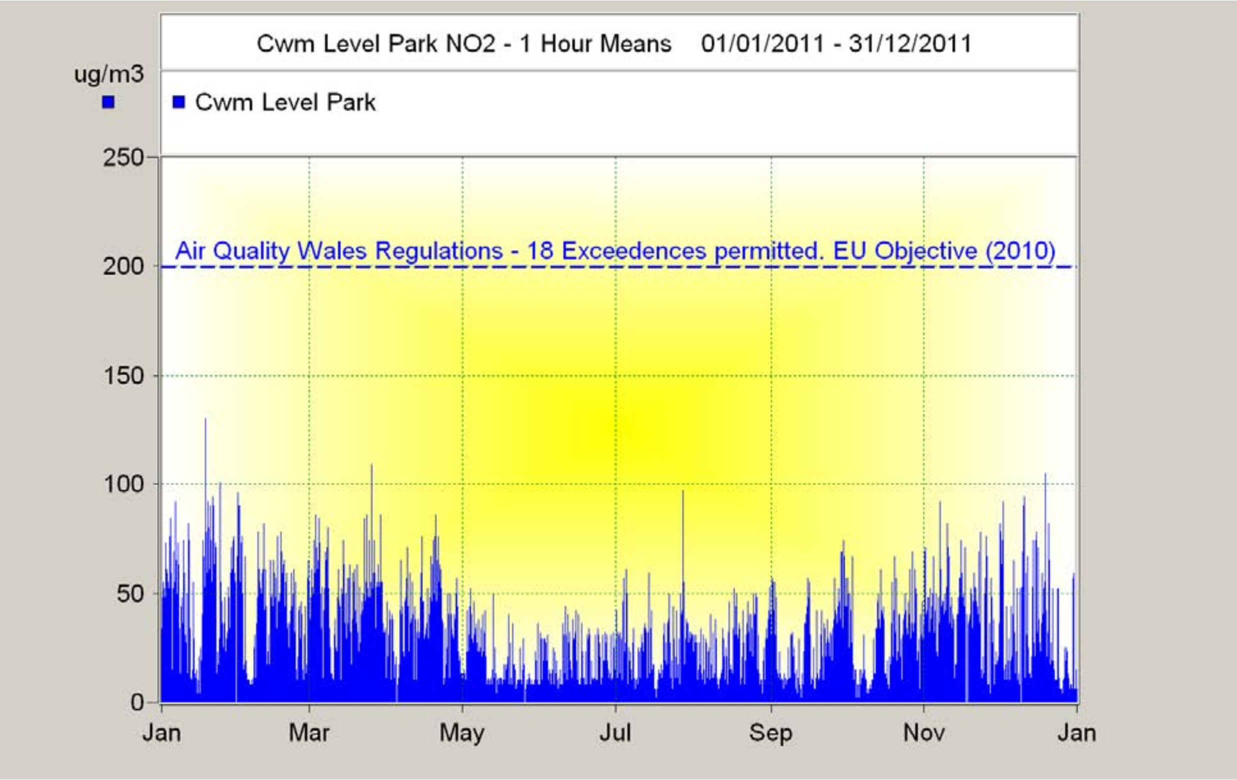
Graphs 1-5 below show the NO_2 1-hour means for 2011 from the 5 automatic and continuous sites now within Swansea.



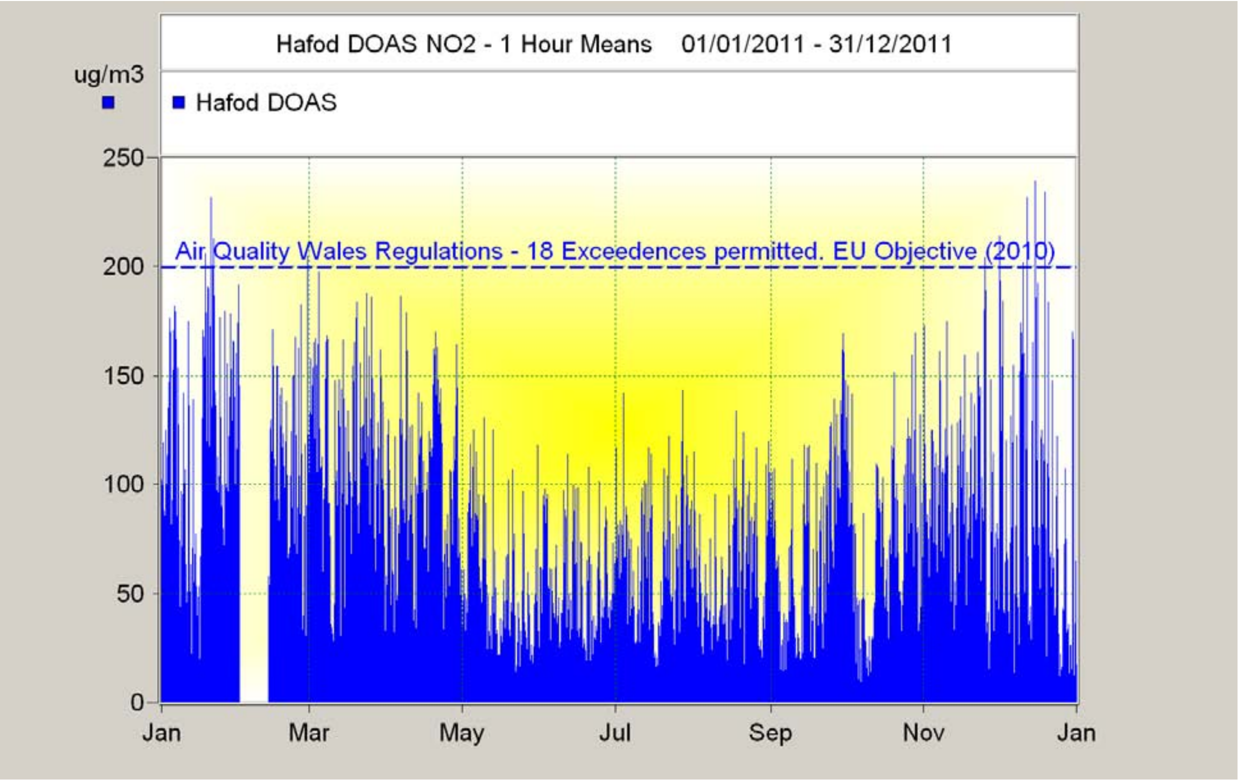
Graph 1 – NO_2 1- hour means Swansea AURN 2011



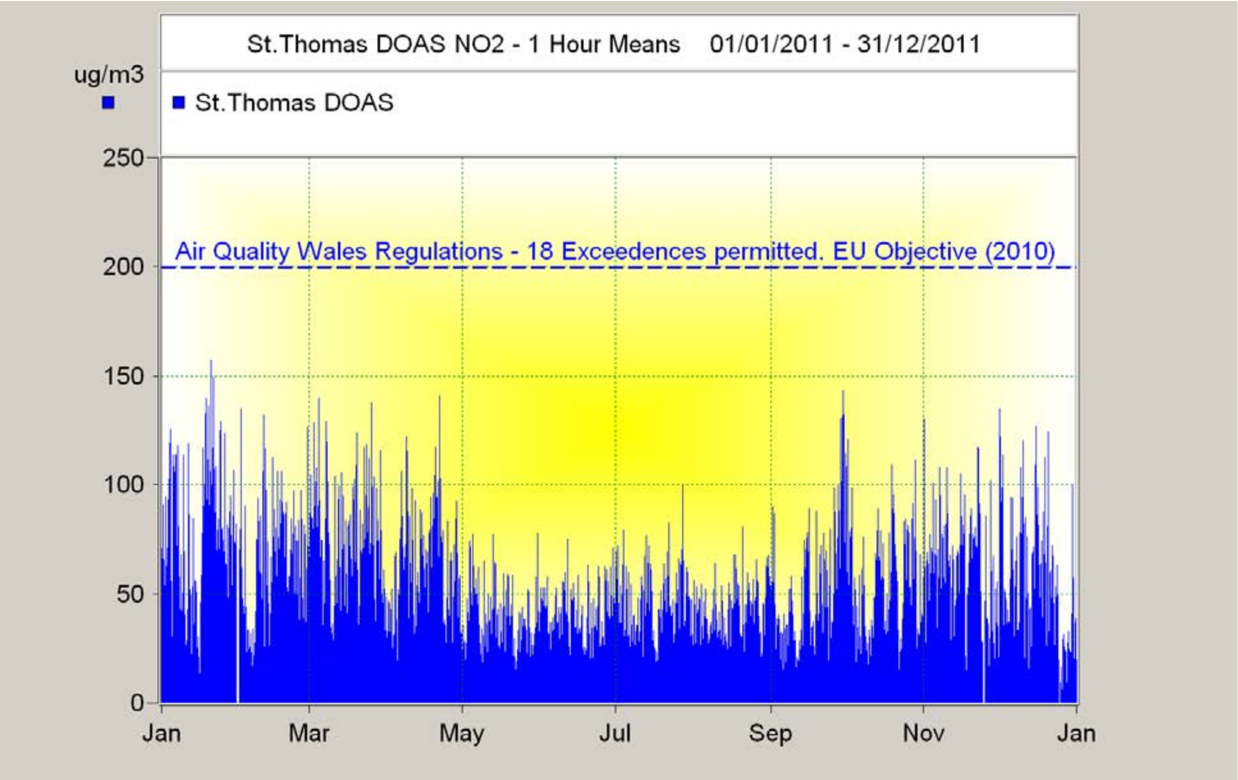
Graph 2 - NO_2 1- hour means Morriston Groundhog 2011



Graph 3 - NO_2 1- hour means Cwm Level Park 2011



Graph 4 - NO_2 1- hour means Hafod DOAS 2011

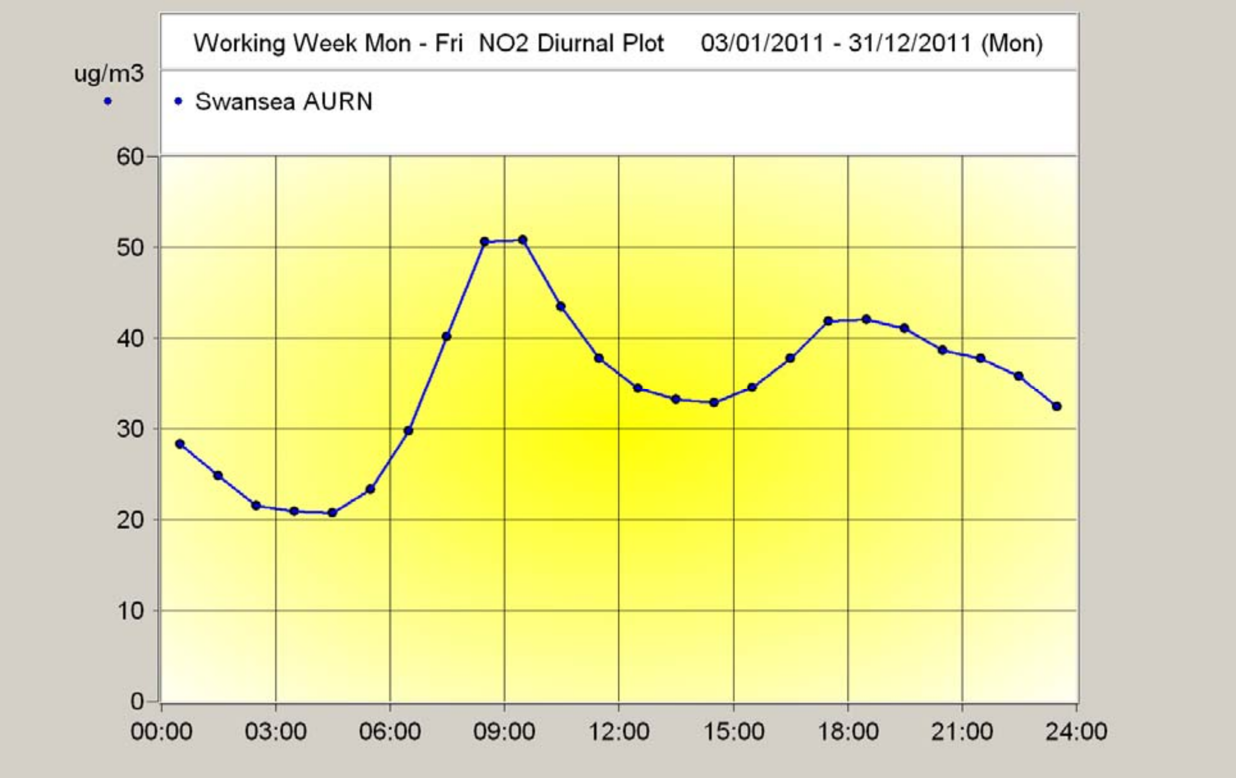


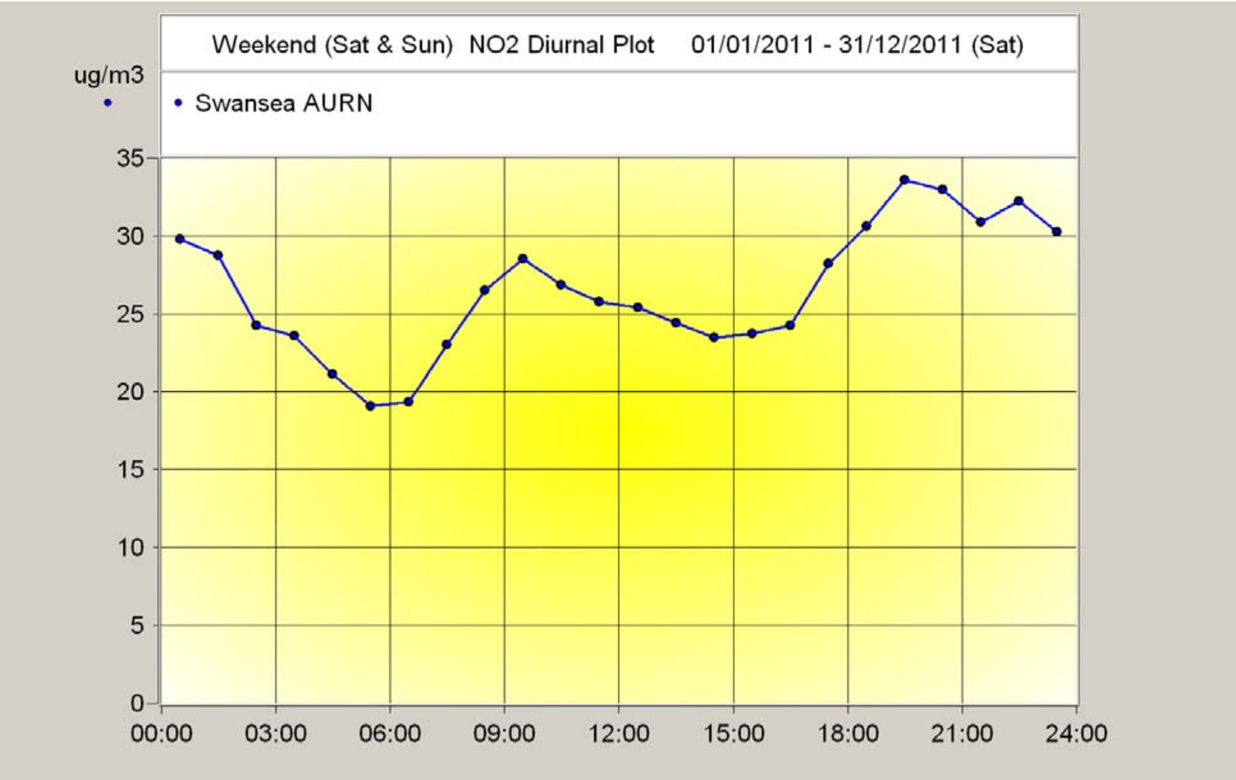
Graph 5 - NO_2 1- hour means St.Thomas DOAS 2011

Graph 4 above shows that the majority of exceedences of the 1-hour NO_2 objective seen at the Hafod DOAS occurred during the period 25th November to 20th December 2011. Winds during this period were predominantly from a north-westerly direction but were interspersed with short periods from the north-east with low wind speeds.

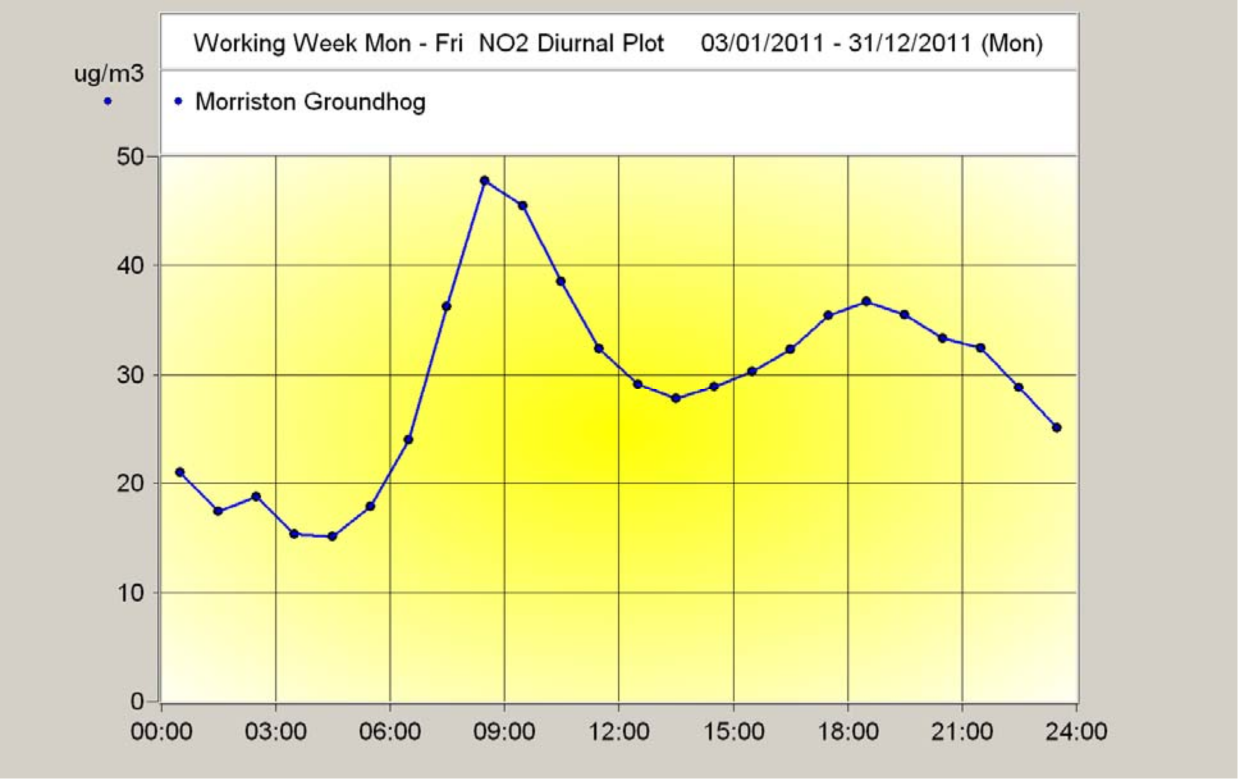
Diurnal NO_2 profiles for each site are provided below within diurnal plots 1-5. Again, as would be expected, the weekday peak concentrations are seen at each site during the am period with the pm period being much smoother. The am peak is thought likely to be influenced more by the prevailing meteorological conditions during the morning period which are then dispersed before the pm period i.e. wintertime inversions. A completely different profile is obtained for the weekend period.

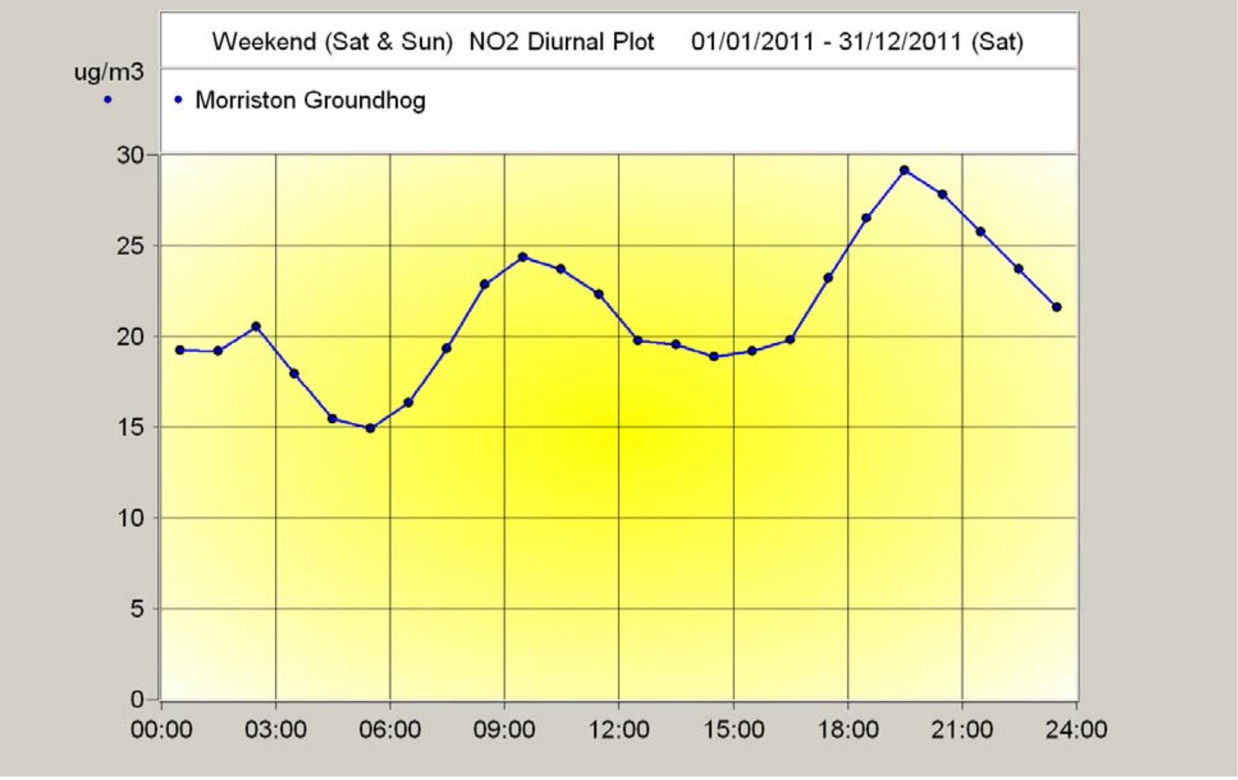
The weekday profiles raise the question whether the authority should, as part of its Air Quality Action Plan, concentrate efforts on reducing the NO_2 impact solely around the am peak traffic period of 7-10am. A view is still being investigated as to what effect this may have on the overall NO_2 annual mean and 1 hour objectives and what practical traffic management measures can be introduced into the Nowcaster forecast system being developed for such situations to achieve widespread compliance with the objective.



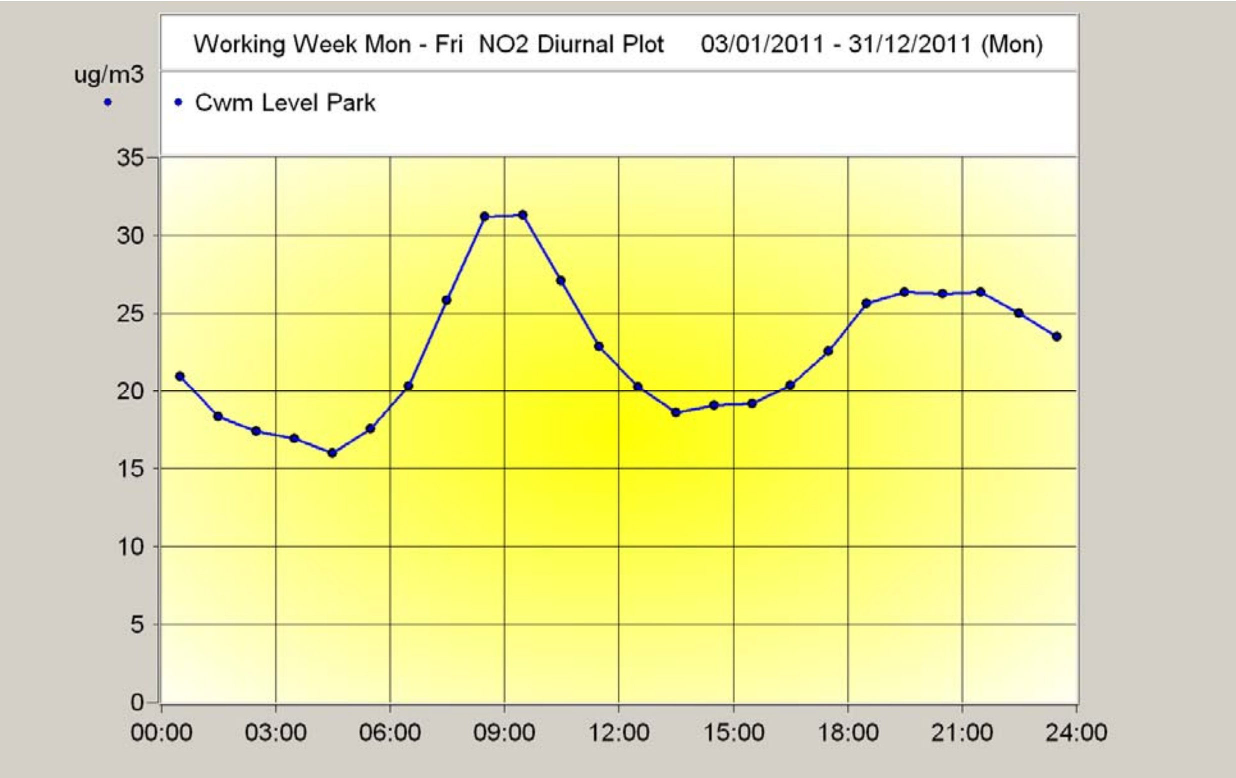


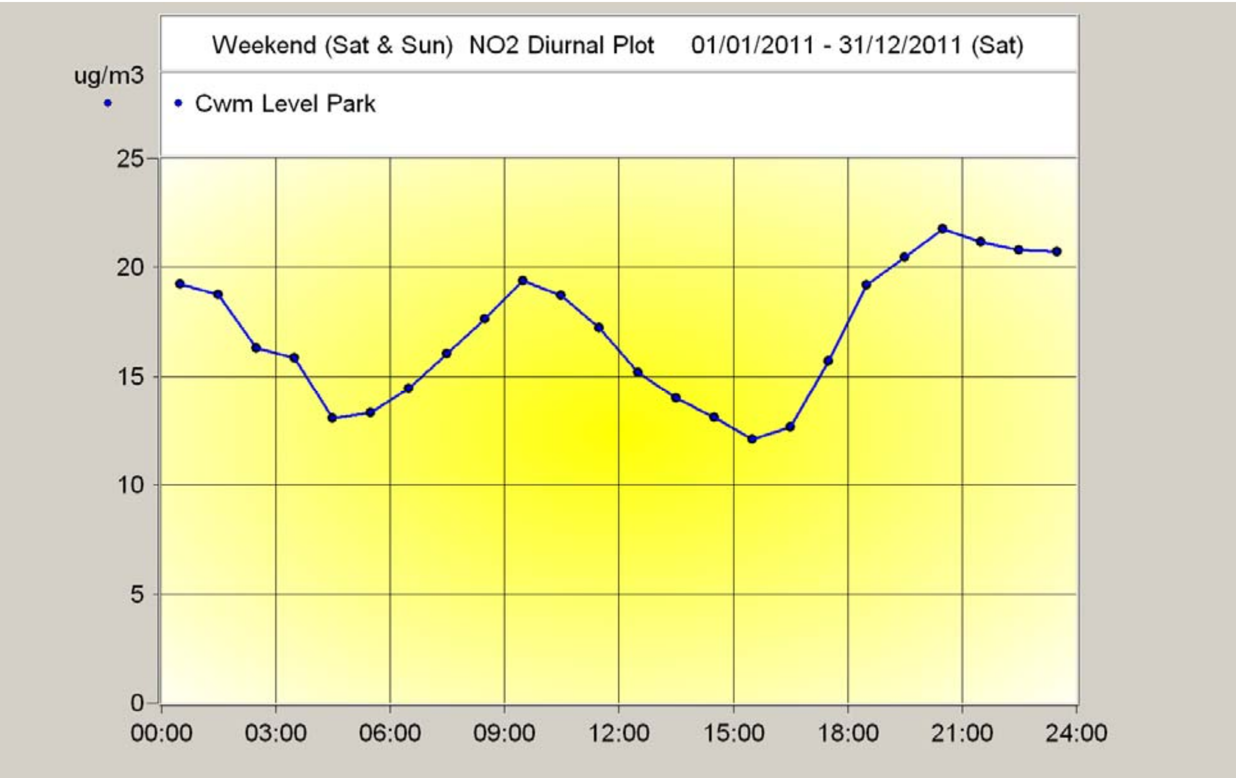
NO_2 Diurnal Profile 1 – Swansea AURN 2011 (top weekday profile, bottom weekend profile)



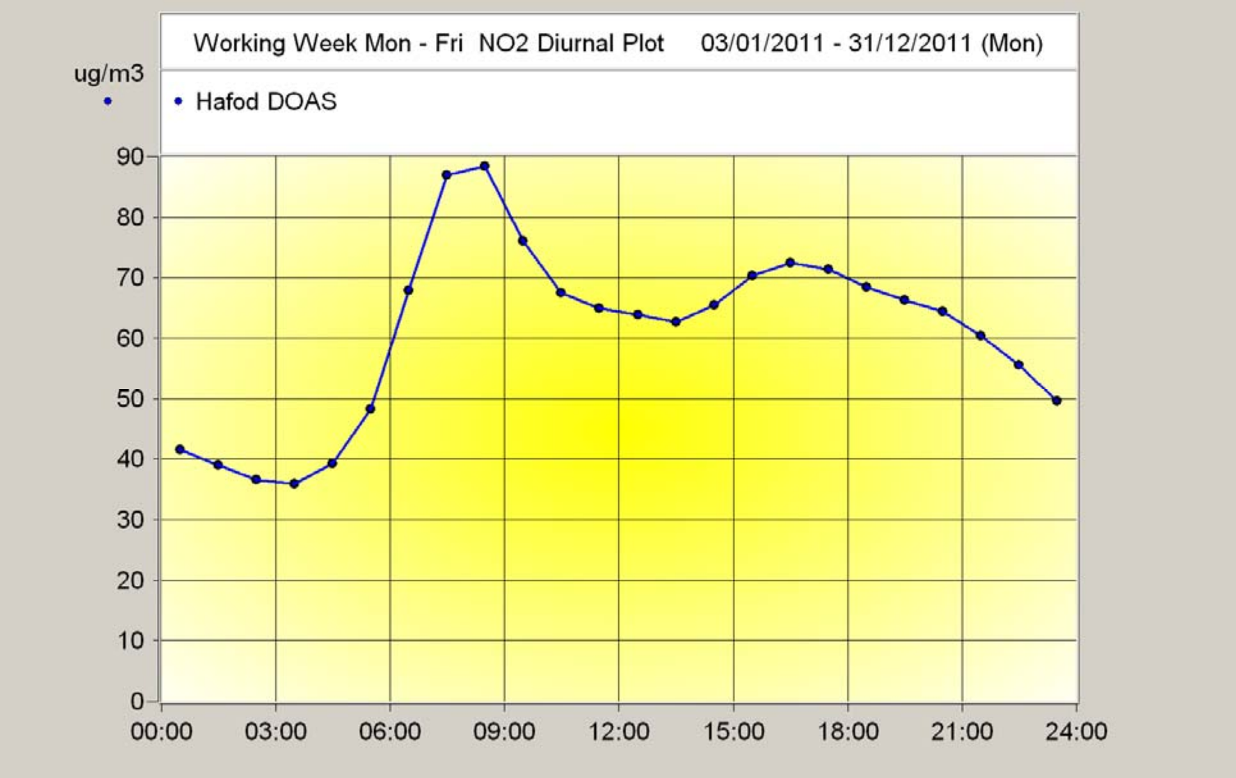


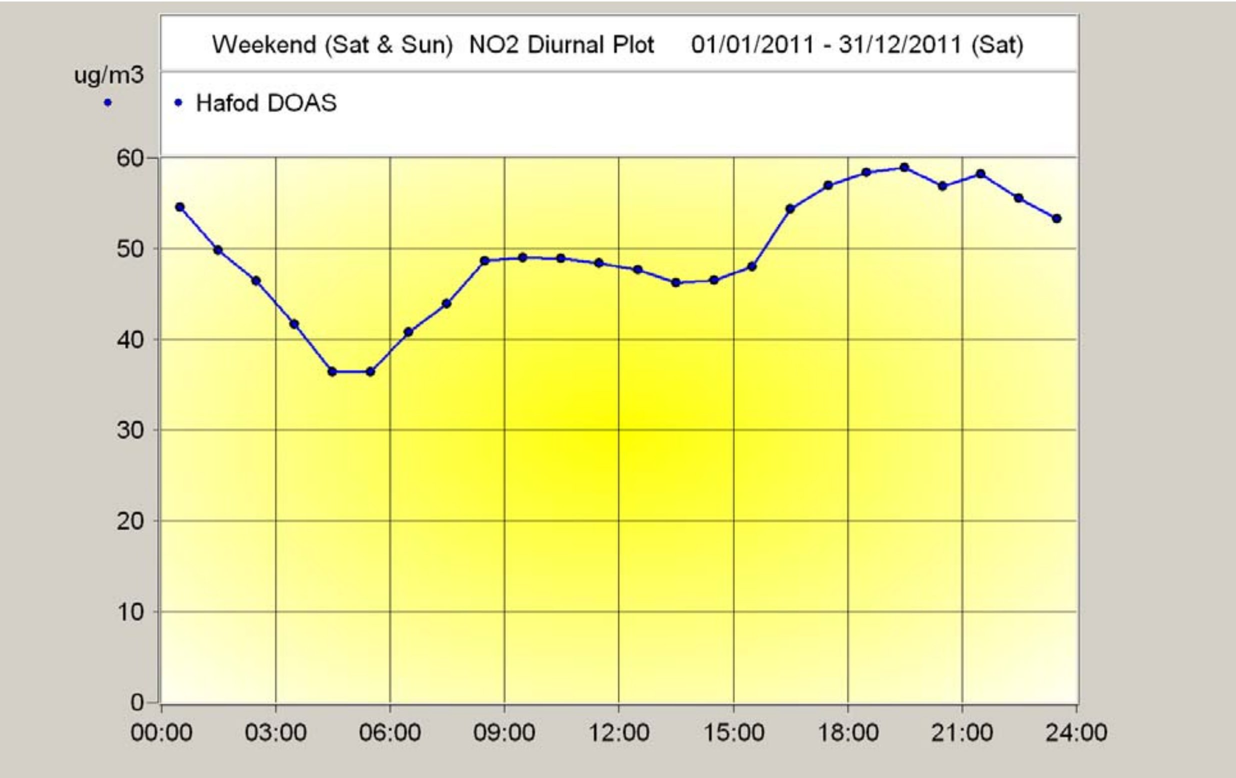
NO_2 Diurnal Profile 2 – Morriston Groundhog 2011 (top weekday profile, bottom weekend profile)



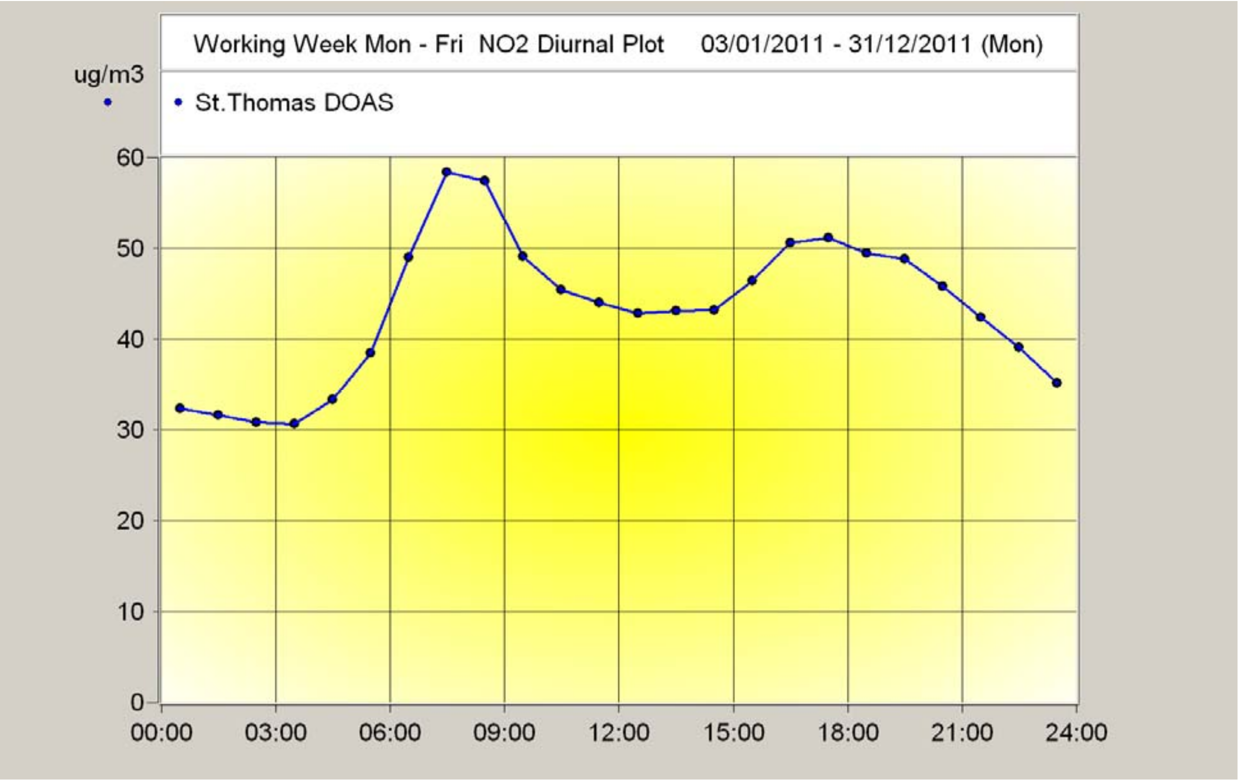


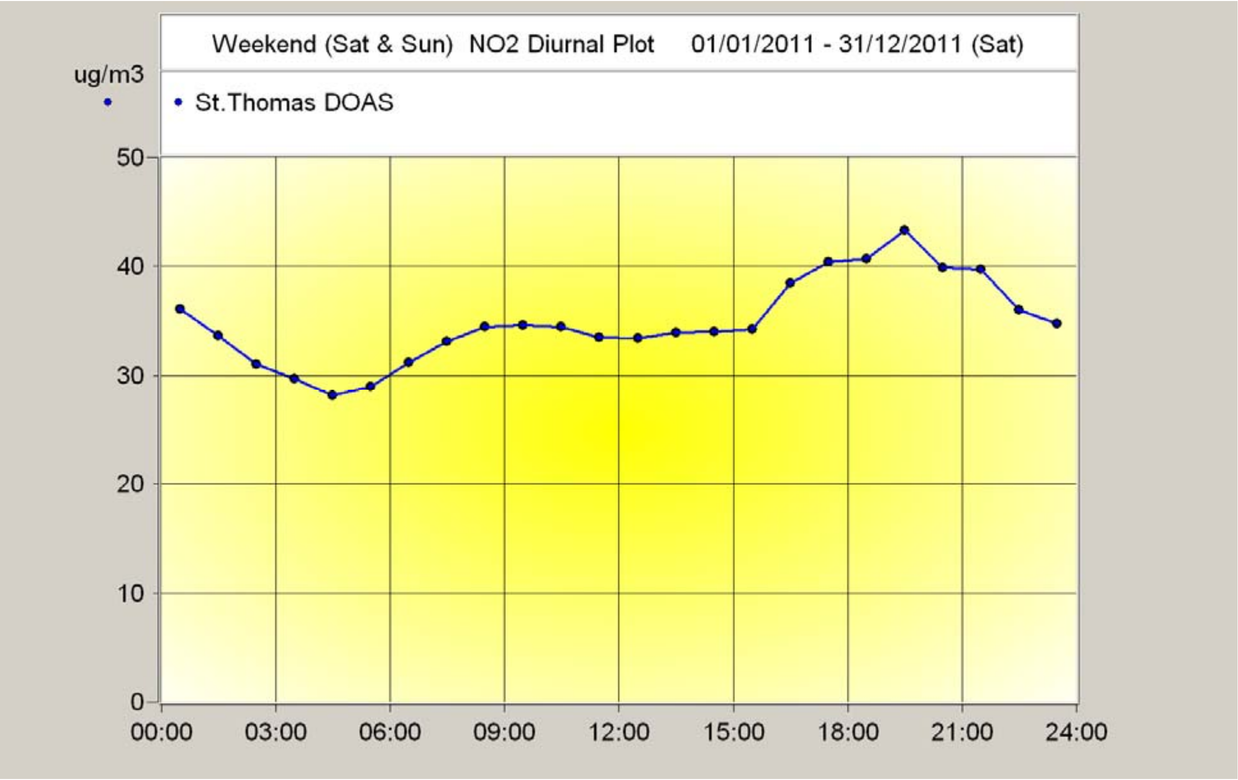
NO_2 Diurnal Profile 3 – Cwm Level Park 2011 (Urban background site) (top weekday profile, bottom weekend profile)





NO_2 Diurnal Profile 4 –Hafod DOAS 2011 (top weekday profile, bottom weekend profile)





NO_2 Diurnal Profile 5 – St Thomas DOAS 2011 (top weekday profile, bottom weekend profile)

Detailed traffic flow data for the authorities GPRS network of 44 ATC's is presented in subsequent chapters.

LAQM.TG (09) provides a method within box 2.1 page 2-4 to project measured annual mean roadside nitrogen dioxide concentrations to future years. The supporting adjustment factor table was updated during January 2012 in view of the release of updated vehicle emission factors and is obtainable from
http://laqm.defra.gov.uk/documents/Is_the_example_in_Box_2.1_TG09_correct.pdf

It is noted that in addition to the above, from http://laqm.defra.gov.uk/whatsnew.html that Defra have produced another update to the previously revised future year projection guidance by way of a further note entitled "Note on Projecting NO2 concentrations" [14] dated April 2012. This note sets out additional alternative methods to project measured NO_2 concentrations to future years. As a result, this authority is considering the implications raised with some of the alternative methods mentioned within this note but have decided to undertake within this USA the more simplistic revised approach detailed within section 2.4. This alternative projection method assumes an average national reduction trend in NO_2 concentrations of 0.68% per year at roadside stations and 0.87% reduction per year at background stations. The adjustment factors presented within table 2 of the April 2012 update are presented as the UK averages of the site classifications i.e. roadside. This newly adopted method allows the comparison of the LAQM.TG(09) revised guidance future year projections issued during January 2010 to the additional revised note dated April 2012. This method produces a range of predicted future year concentrations as to where the NO_2 concentration is likely to lie. (no pun intended)

Using the above rational, Table 6 indicates the range of predicted NO_2 concentrations in 2012 - 2020 at the 4 automatic roadside sites and the urban background site in Swansea. Where applicable, the correction derived for distance from the roadside measurement location to the nearest receptor location is given in bold within table 6. It is this figure in bold that has been used to calculate the future year projections. The actual measured roadside concentration is given in brackets for information.

[14] http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note and
http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

Site ID	Location	Within AQMA?	Annual mean adjusted for distance from road to nearest receptor where applicable	Future Years Projection Ranges expressed in ug/m^3 (* at nearest receptor location) LAQM.TG(09) method first, Revised April 2012 method last Predicted exceedence of annual mean objected highlighted in **bold red** Prediction within 3ug/m^3 of annual mean objected highlighted in **bold blue**								
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	*Swansea AURN	Y	**25.6** (32.38)	24 to 25.41	22.5 to 25.26	20.9 to 25.07	19.3 to 24.91	18.2 to 24.75	17.1 to 24.57	16 to 24.41	14.8 to 24.25	13.7 to 24.09
2	*Morfa Groundhog	Y	N/A	-	-	-	-	-	-	-	-	-
3	*Morriston Groundhog	N	**21.1** (27.25)	19.8 to 20.95	18.5 to 20.82	17.2 to 20.66	15.9 to 20.53	15 to 20.40	14.1 to 20.25	13.2 to 20.12	12.2 to 19.99	11.3 to 19.86
4	** Cwm Level Park (Urban Background)	Y	**20.87**	19.6 to 20.70	18.3 to 20.52	17 to 20.35	15.8 to 20.17	14.8 to 20	13.9 to 19.82	13 to 19.65	12.1 to 19.47	11.2 to 19.30
5	Hafod DOAS	Y	**57.61**	**54.1** **to** **57.19**	**50.5** **to** **56.84**	**47** to **56.42**	**43.5** to **56.06**	**41** to **55.7**	**38.5** to **55.29**	36 to **54.93**	33.4 to **54.57**	30.9 to **54.21**
6	St.Thomas DOAS	N	**40.89**	**38.4** **to** **40.59**	35.9 **to** **40.34**	33.4 to **40.04**	30.9 to **39.79**	29.1 to **39.54**	27.3 to **39.24**	25.5 to **38.99**	23.7 to **38.73**	21.9 to **38.48**

Table 6 – Predicted Future Years Roadside NO_2

*** Urban background site included for sake of completeness. Revised April 2012 method includes background factors.*

It is thought that table 6 above now indicates a more realistic range of predicted NO_2 concentrations in future years. In light of past experience with LAQM work and projecting future year concentrations of roadside NO_2 it would seem wise to look to the higher threshold of the range indicated as this appears to be more “real world”.

From table 6, the realistic view can be taken that the Hafod DOAS will continue to experience exceedences of the annual mean until at least 2020 given current thinking, with the St Thomas DOAS remaining at risk of exceedence of the annual mean objective as well in 2020. All other stations exhibit existing full compliance with the annual mean objective.

2.2.3 Nitrogen Dioxide Diffusion Tube Monitoring

All data presented within table 7 below has been corrected for tube bias only. No correction for tube chemistry has been applied as a result of the tri-location study carried out at the Swansea Roadside AURN chemiluminescent analyser[15]. In any event, all passive diffusion tubes are located roadside and no correction has been made using a roadside tri-location study derived bias correction to a passive diffusion tube with an urban background classification.

The authority has steadily increased it passive diffusion tube network over the years with the biggest increases being seen in the last 3 years. The total number of sites operational during 2011 was 291, exposed on a monthly basis**.** Sites 1 to 274 are reported below and form the additional monitoring outlined within the Updating and Screening Assessment 2009, with an update being made within the Progress Report 2010. These additional sites became necessary as a result of the revised guidance within LAQM.TG(09) requiring assessment of narrow/congested streets that have an annual daily flow greater than 5000 vehicles. Sites 275 to 291 represent yet more additional monitoring partly in direct response to local residents concerns following alteration of road junctions. Please not that following budgetary restraints during April 2011 a decision was made to cease monitoring at all sites that have consistently returned a bias corrected annual mean below 30ug/m^3. Monitoring ceased at these sites during May 2011 and for completeness, these sites are annotated within table 3 and highlighted within the results table 7 below.

Sites with data capture greater than 75% i.e. those that have the minimum 9 months exposure period and which exceed the annual mean are highlighted in bold red. Those sites that are close to exceeding the annual mean (between 37-40ug/m^3) are highlighted in bold blue. **Table 7 indicates the bias corrected annual means including any correction necessary for distance to nearest receptor from the sampling location - see table 3 for distance to nearest receptor. The relevant distance correction (where applicable) is given within table 8 for sake of completeness**. Box-Whisker Plots are provided for all sites within Annexe 5. Please note that RAW uncorrected for bias data is presented within the box-whisker plots

[15] http://laqm.defra.gov.uk/bias-adjustment-factors/local-bias.html

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
1	262046	196420		91.67	27.35
2	262095	196500		41.67	20.52
3	262161	196513		41.67	25.43
4	262497	192857	Y	91.67	29.97
5	262548	192943	Y	91.67	33.42
6	262612	192995	Y	91.67	29.29
7	262691	192852	Y	91.67	**50.93**
8	262990	195820	Y	83.33	**41.81**
9	263190	195205		91.67	27.65
10	263219	195513	Y	83.33	25.28
11	263344	195474	Y	91.67	**37.21**
12	263680	195103	Y	91.67	**43.96**
13	264830	193066		91.67	28.03
14	265285	192696		91.67	26.99
15	265334	192608		91.67	27.33
16	265339	192534		83.33	30.85
17	265496	192408		50.00	33.16
18	265526	195807	Y	91.67	**49.10**
19	265597	194061	Y	83.33	**45.84**
20	265594	194175	Y	91.67	**37.41**
21	265634	195316	Y	91.67	30.62
22	265682	195374	Y	91.67	33.73
23	265728	195494	Y	91.67	33.97
24	265760	192420		50.00	23.49
25	265845	195547	Y	83.33	28.91
26	265876	194318	Y	91.67	**40.78**
27	265922	194428	Y	91.67	**39.95**
28	265949	194891	Y	91.67	30.29
29	265973	195222	Y	91.67	**53.48**
30	266080	192516		50.00	21.45
31	266153	196003		91.67	31.70
32	266209	193867		91.67	33.24
33	266236	193488		91.67	32.11
34	266272	196168		91.67	34.47
35	266314	193298		83.33	**40.39**
36	266455	193300		83.33	33.58
37	266515	193213		41.67	22.68
38	266662	193181		91.67	**37.23**
39	266905	193271		41.67	25.92
40	266951	198278		91.67	27.77
41	266953	198085		91.67	**40.54**
42	267084	198274		0.00	
43	267093	198063		91.67	34.88
44	267639	199543		91.67	30.01
45	267661	199451		91.67	33.82
46	267752	193218		41.67	20.05
47	267908	199773		41.67	29.29
48	268011	193101		91.67	23.98
49	268501	197329		91.67	28.28
50	268530	197419		91.67	35.38
51	268593	197434		91.67	30.31

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
52	268643	197245		41.67	26.33
53	268652	197508		41.67	29.07
54	268693	197416		91.67	36.31
55	268789	197420		91.67	36.10
^56 *	269306	198661		91.67	21.70
57	269395	199042		41.67	17.26
^58	264052	192884		83.33	32.50
59	265918	194463	Y	83.33	**53.98**
60	265036	192931		91.67	**39.62**
61	264959	192878		91.67	**38.82**
62	266698	195335		0.00	-
^63	262675	192775	Y	83.33	23.20
^64	262719	192840	Y	**66.67**	**39.01**
65	262735	192855	Y	91.67	25.49
66	262802	192829	Y	83.33	30.52
^67	265903	193683	Y	83.33	**39.40**
68	265573	193432		91.67	**39.26**
^69	265543	193450		83.33	**40.80**
^70	266649	195435		83.33	24.40
^71 **	266514	195485		91.67	20.10
72	264091	192900		83.33	25.52
73	264138	192868		91.67	33.17
74	264163	192853		91.67	28.19
75	264072	192869		91.67	**42.01**
76	263968	192880		91.67	27.01
77	263856	192931		33.33	29.63
78	263819	192948		91.67	29.09
79	263842	192896		91.67	36.77
80	263558	192833		41.67	28.57
81	262940	192775	Y	41.67	27.67
82	262851	192805	Y	33.33	25.56
83	262785	192838	Y	91.67	30.58
84	262714	192839	Y	91.67	36.44
85	262702	192847	Y	91.67	**38.05**
86	262704	192865	Y	91.67	27.94
87	262697	192798	Y	91.67	22.23
88	262605	192916	Y	91.67	32.19
89	262587	192956	Y	91.67	23.12
90	262631	192996	Y	83.33	34.43
91	262534	192950	Y	75.00	32.73
^92	262545	192869	Y	91.67	28.70
93	263406	195534		91.67	31.39
94	263444	195572		91.67	29.38
95	262815	196090		91.67	28.64
96	262922	195950		91.67	29.46
97	262946	195902	Y	66.67	35.00
98	263142	195548	Y	91.67	**37.29**
99	263387	195332	Y	91.67	30.58
100	263470	195250	Y	91.67	26.06
101	263843	195047	Y	91.67	27.26
102	266379	193307		83.33	29.54

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
103	268526	197359		91.67	32.42
104	268538	197389		91.67	28.55
105	268562	197472		91.67	28.90
106	268496	197476		91.67	33.38
107	268765	197420		83.33	33.53
108	267608	199461		91.67	30.58
109	267510	199487		91.67	25.12
110	267369	199521		91.67	26.34
111	267705	199426		91.67	28.70
^112	264868	192814		75.00	27.90
113	264654	192662		91.67	31.18
114	264622	192971		91.67	29.99
115	265031	193097		91.67	**41.44**
116	265192	193138		91.67	**41.92**
117	265288	193211		91.67	**39.71**
⊗118	265483	193385		91.67	32.96
119	265522	193390		91.67	36.56
⊗120	265570	193366		91.67	**51.29**
121	265706	193662	**Y**	83.33	**52.71**
122	265694	193505		83.33	**37.12**
123	265655	193423		91.67	**50.96**
⊗124	265651	193253		83.33	**45.58**
⊗125	265641	193162		91.67	**42.10**
⊗126	265475	193144		91.67	**41.96**
⊗127	265348	193110		**66.67**	**56.19**
⊗128	265297	193085		91.67	**42.37**
⊗129	265153	193098		91.67	35.42
⊗130	265139	192912		91.67	**43.32**
⊗131	265137	192846		91.67	**46.62**
132	265229	192753		83.33	36.82
133	265350	192566		83.33	30.34
⊗134	265113	192903		91.67	**49.41**
^135	262605	192916	**Y**	91.67	29.29
^136	262612	192995	**Y**	91.67	28.09
^137	262631	192996	**Y**	91.67	34.46
138	266779	199246		83.33	24.16
139	266867	199030		75.00	28.29
140	266863	199009		91.67	35.01
141	266979	198772		91.67	28.55
142	267017	198710		91.67	30.65
143	267089	198608		91.67	32.94
144	267141	198591		91.67	27.30
145	267139	198578		91.67	33.47
146	267156	198571		91.67	34.62
147	267165	198580		91.67	28.21
148	267170	198564		91.67	31.33
149	267204	198561		83.33	27.11
150	267205	198545		91.67	29.50
151	267192	198518		75.00	27.01
152	267081	198268		41.67	30.44
153	268845	201137		41.67	29.59

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
154	268870	201267		41.67	26.75
155	269009	201280		91.67	28.36
156	269059	201296		91.67	29.51
157	269173	201355		41.67	29.02
158	269480	201441		91.67	28.37
159	269171	201620		91.67	30.26
160	269049	201744		91.67	34.35
161	268938	201929		41.67	20.57
162	259553	203379		91.67	26.12
163	259287	203556		91.67	22.72
164	259195	203667		91.67	28.99
165	259149	203675		83.33	23.86
166	259148	203690		75.00	23.99
167	259126	203700		91.67	23.83
168	259115	203705		83.33	22.49
169	259013	203747		91.67	26.06
170	258971	203797		91.67	18.43
171	258917	203826		91.67	28.14
172	258887	203859		91.67	28.36
173	259250	203708		91.67	19.35
174	259253	203660		91.67	16.46
175	259251	203638		91.67	20.68
176	258872	203691		91.67	12.98
177	258896	203697		91.67	13.29
178	258986	203684		91.67	14.74
179	259059	197831		41.67	27.02
180	259064	197781		91.67	32.49
181	259010	197817		41.67	23.47
182	259050	197790		91.67	29.37
183	259036	197795		91.67	32.08
184	259014	197797		41.67	27.83
185	258919	197820		41.67	24.88
186	258711	197868		41.67	24.26
187	258206	198239		41.67	19.31
188	258197	198219		41.67	26.96
189	258270	198257		41.67	20.72
190	258260	198237		41.67	21.13
191	258338	198270		41.67	18.00
192	257422	198542		41.67	17.96
193	257371	198522		41.67	18.65
194	257958	198581		41.67	18.25
195	257972	198563		41.67	25.56
196	258046	198558		41.67	22.14
197	258797	198701		83.33	33.73
198	258811	198701		91.67	36.97
199	254703	195764		91.67	29.05
200	254582	195821		41.67	24.62
201	254522	195859		83.33	28.39
202	254437	195879		41.67	23.96
203	254294	195885		41.67	19.40
204	253777	195926		41.67	17.91
205	253758	195939		41.67	21.08

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
206	261565	188211		91.67	**47.05**
207	261561	188222		83.33	34.51
208	261541	188215		91.67	**37.59**
209	261534	188198		91.67	**44.72**
210	261516	188207		91.67	31.66
211	261501	188188		91.67	34.34
212	261486	188200		83.33	27.04
213	261490	188186		91.67	**37.79**
214	261315	188193		91.67	25.36
215	261299	188191		83.33	22.93
216	261276	188190		91.67	25.94
217	260357	188240		41.67	20.07
218	260384	188206		41.67	28.17
219	260419	188172		41.67	25.68
220	261194	188163		41.67	24.59
221	260454	188171		41.67	18.79
222	260469	188182		41.67	26.62
223	266899	197354		41.67	24.71
224	266881	197389		41.67	24.73
225	266861	197432		41.67	25.99
226	266829	197472		41.67	29.11
227	266836	197484		41.67	27.92
228	266779	197578		41.67	26.10
229	266772	197621		41.67	21.73
230	266777	197651		41.67	25.85
231	268802	197666		41.67	22.81
232	266825	197654		41.67	29.81
233	266823	197668		41.67	23.72
234	266858	197671		41.67	24.52
235	266874	197657		41.67	25.76
236	266886	197658		41.67	31.41
237	266885	197676		41.67	23.98
238	266902	197660		91.67	32.78
239	266181	196022		91.67	33.64
240	266169	195995		91.67	36.36
241	266159	196013		91.67	31.39
242	265655	193423		91.67	**46.01**
243	265474	194949		91.67	33.82
244	265466	194930	Y	91.67	**38.33**
245	265448	194922	Y	91.67	**41.03**
246	265425	194927		91.67	26.92
247	265394	194899	Y	91.67	35.47
248	265342	194894		91.67	25.22
249	265326	194871	Y	91.67	33.94
250	265274	194867		91.67	28.20
251	265263	194845	Y	91.67	30.76
252	265226	194830	Y	91.67	31.94
253	265194	194833		91.67	24.59
254	265142	194816		91.67	23.45
255	265098	194825		91.67	24.86
256	264995	194777		91.67	**39.81**
257	254817	189135		33.33	18.92

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2011 %	Annual Mean concentrations 2011 (ug/m3) Adjusted for tube bias and distance to receptor
258	254906	189110		91.67	26.30
259	254949	189113		41.67	26.06
260	254970	189116		41.67	17.51
261	254991	189115		41.67	19.69
262	255056	189118		41.67	12.62
263	262444	193447		41.67	19.30
264	262251	193293		41.67	19.22
265	266375	198023		91.67	31.81
266	266380	198043		41.67	22.46
267	266382	198028		91.67	30.76
268	266419	198053		91.67	29.00
269	266458	198111		41.67	26.08
270	266896	198084		41.67	28.85
271	266879	198078		91.67	32.38
272	266888	198074		91.67	28.91
273	267060	198234		41.67	32.02
274	269487	201451		41.67	22.56
^275	265658	194856	Y	**58.33**	26.00
276	265610	194871	Y	91.67	36.03
277	265596	194875	Y	91.67	**37.05**
278	265573	194882	Y	91.67	**39.11**
279	265555	194926	Y	91.67	**50.24**
^280	265542	194980	Y	75.00	**37.90**
^281	265542	194872	Y	91.67	36.00
^282	265540	194840	Y	91.67	33.80
283	265436	195937		91.67	30.35
284	265452	195899		91.67	33.28
285	266955	197415		91.67	**37.51**
286	266938	197377		83.33	36.68
287	265715	193902	Y	91.67	30.76
288	265698	193878	Y	83.33	33.38
289	265702	193842	Y	91.67	**37.33**
290	263014	195737	Y	83.33	27.86
291	267952	193121		91.67	**41.79**

Table 7- Nitrogen Dioxide Passive Diffusion Tube Results 2010

*** Site 56** is located on Ynysallan Road, Ynystawe to the frontage of a potential housing development site that would be 10-15m from the eastbound carriageways of the M4. Relevant exposure is given at present to the nearest existing dwelling within a separate development setback from the monitoring location.
**** Site 71** Copper Quarter 3 is on the frontage of an existing housing development site that will see dwellings fronting onto the access road to Morfa Retail Park and the Liberty Stadium. Relevant exposure is given at present to the nearest existing dwelling on the development site. The nearest potential dwelling within the development (setback from the monitoring location) will be within 10m of the monitoring location when construction is complete.
^Sites 135-137 are located at first floor level of properties in addition to exposure at 2.5 on the same dwelling to assess if concentrations change with height

⊗ City centre sites along busy roads – relevant exposure is given to either restaurants where there is a Café environment or to blocks of flats. Assessment where Café environment exists is for 1 hour NO_2 objective. Site 125 now corrected to relevant exposure to flats development above commercial premises.
^ See table 8 below for Correction of NO_2 for distance from road

Sites 64, 127 and 275 have not met the required minimum 75% data capture for 2011 and the derived annual mean should be treated with caution. It is worth explanation that the maximum possible data capture rate for 2011 was 91.67% due to **all** staff within Pollution Control participating in an EU funded study into the bathing water quality within Swansea Bay. All staff were diverted from their normal duties to participate within this study for significant periods of 2011. As such it is remarkable that only one period of exposure was left to merge into what turned out to be a 2 month sample period (August-September2011).

The distance to the nearest receptor location is given in brackets after the site name in table 3. The NO_2 annual mean at the nearest receptor location has been derived following guidance within TG.09 box 2.3 page 2-6 and use of the spreadsheet at http://laqm.defra.gov.uk/documents/NO2withDistancefromRoadsCalculatorIssue4.xls

The spreadsheet calculator has been setup to work from 0.1 to 50m only. As can be seen from table 7, the authority is aware of, and planning for future proposed domestic housing developments, by making measurements at the current nearest possible monitoring position to those developments. Unfortunately, an indication can at present only be gained to a distance of 50m from the measurement point due to the setup of the provided spreadsheet tool. Table 3 and table 7 indicate two monitoring sites (site 56 and 71) that are utilised to provide an indicative annual mean to the **nearest existing dwelling** within the development sites. Receptor locations when additional dwellings are constructed to the remainder/potential sites will be considerably closer. It could be argued that at present there is no relevant exposure at present in LAQM terms from these two monitoring locations but it is anticipated due to the developments underway that these receptor locations will be realised at some stage in the near future. Both of these locations are at a distance greater than the spreadsheet will produce corrections for. These two sites are therefore presented with corrected annuals means as if they were 50m away.

The resulting calculated NO_2 annual mean at the receptor location due to fall off in concentration with distance from the road is given below within table 8. Background 1k by 1k NO_2 concentrations were downloaded from http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html and overlain on a GIS background map within ArcView 3.3. The background concentration required for the calculation was obtained from the nearest 1k grid square to the monitoring site. The final derived predicted annual mean concentration at the receptor location has been included within table 7 above.

Site ID	Distance of Measurement Site from Kerb	Distance of Receptor from Kerb	NO_2 Background Concentration ug/m^3	Measured 2011 Annual Mean ug/m^3 Corrected for bias	Predicted Annual Mean at Receptor ug/m^3
56	2	*166	17.62	34.35	21.7
58	4	8	14.93	36.67	32.5
63	2	6	11.27	27.40	23.2
**64	1	3	11.27	**47.06**	**39.01**
67	2	5	17.75	**45.29**	**39.40**
69	2	4	17.75	**49.24**	**40.80**
70	2	7	16.18	27.86	24.4
*71	2	*138	16.18	32.29	20.1
92	1	3	11.27	33.64	28.7
112	1	6	14.93	35.20	27.9
125	1	3	17.75	**49.03**	**42.1**
**275	1	3	16.32	28.77	26
280	1	2	16.32	**41.35**	**37.9**
281	1	3	16.32	**41.59**	36.0
282	1	3	16.32	**38.77**	33.8

Table 8 – Correction of NO_2 for distance from road

* Calculated as if 50m

**Data capture below 75%

Sites 118,120,124,125,126,127,128,129,130 and 134 were sited with the main intention of assessing concentrations against the NO_2 1-hour objective within the city centre. As discussed later, Swansea city centre has seen significant change in the road network to accommodate the Metro Service. It is thought reasonable to access exposure to the 1 hour objective to the general population within the city centre area especially where this exposure can be related to an external café area type environment. These café environments are not set back at a distance from the kerb/road where the measurement has been made but are on the same road, at the same distance from the kerb as the measurement site, albeit at a distance either right or left from the monitoring point. Due to some siting issues, measurements were not always directly possible at the café environment. It is not thought that the method within box 2.3 of TG(09) is relevant or applicable to these locations as the café environments are at an identical distance from the kerb of the same road.

From the advice on using passive diffusion tube annual mean results[16] to assess compliance with the 1 hour objective for NO_2 it is clear from the above results that it is unlikely that the 1 hour objective has been exceeded at any site during 2011 as all bias corrected means are below 60ug/m^3. Previously (see Progress Report 2010 and 2011) sites 59, 121, 125, 126 and 127 indicated a possible exceedence of the 1-hour objective. Of these sites, site 127 has returned the highest bias corrected annual mean of 56.19ug/m^3 and is outlined below for completeness.

Site 59 (annual bias corrected mean of 53.98 ug/m^3) is located façade between the Hafod Post Office and a terraced property and as mentioned above (within sec 2.2) is directly opposite the Hafod DOAS transmitter station. The annual mean returned from the real-time DOAS is 57.61ug/m^3 with 16 exceedences of the hourly objective being seen within the 250m open path measurement length during 2011. Whilst there has been no exceedence of the 18 permitted 1-hour exceedences during 2011, the results observed from year to year from the both real-time and passive methods are highly variable in their extent, but both methods continue to confirm exceedence of the annual mean objective. It is thought that the likelihood of a combination of conditions i.e. meteorological and/or traffic flow, leading to exceedences of the 1-hour objective occurring within this street canyon remain and can not be ignored, therefore monitoring will continue for the foreseeable future especially in light of the continued exceedence of the annual mean objective being seen.

Site 121 is located within the existing Swansea AQMA 2010 on High Street and is shown below in photo 3. This site is situated façade at approximately 2.5m high on a block of flats opposite Swansea High Street Railway Station and outside bus stop bays. Numerous bus services operate outbound and inbound along this section of High Street. Data from the GPRS Automatic Traffic Counter (GPRS ATC site 22) located to the northern section of High Street (approx 150 yards north of photo location) is valid for this monitoring location and indicates a bus composition of 5.6% of the flow during 2011. If the total LDV composition is taken into consideration, the figure rises to 11.7%. These figures however exhibit a continued downward trend not

[16] http://www.airquality.co.uk/archive/reports/cat18/0806261511_TG_NO2relationship_report_draft1.pdf

only in terms of traffic composition but also in terms of the returned bias corrected annual means from previous years for this site.

Year	Bias Corrected Mean ug/m^3	Bus % Composition	Total % LDV
2008	79.3	8.7	16
2009	61.19	7.4	14.3
2010	52.33	6.5	13
2011	52.71	5.6	11.7

Whilst this site lies within the existing Air Quality Management Area, changes to the road infrastructure outside High Street Railway station and subsequent relocation of bus stops etc appear, given the data above to have impacted upon NO_2 concentrations seen in the area. This trend evident in the data shown above is surprising given past thinking and local knowledge of the area but none the less is a welcome trend.

Photo 3 – Northern section of High Street showing passive diffusion tube site 121 and surrounding locale

Full details on all GPRS ATC's operated by the authority can be found below within section 3.

The authority were actively considering locating a continuous chemiluminescent analyser into this section of High street (see photo 4) as concerns now exist for sections of High Street that fall outside of the existing AQMA exceeding the NO_2 annual mean objective with the distinct possibility of the 1-hour objective also being exceeded. Discussions have commenced with the Housing Association that manage a sheltered youth residence which forms the frontage to passive diffusion tube site 123 on High Street. The intention was to locate a continuous NO_x chemiluminescent analyser to the frontage of the property at pavement level. Agreement had been reached to acquire electrical and telemetry feeds from within the premises but due to the budget restraints currently being imposed, there is no budget to purchase either the required enclosure or Teledyne NO_x analyser.

Photo 4 – Middle section of High Street showing passive diffusion tube site 123 and surrounding locale.

The authority is aware of preliminary proposals for redevelopment of old commercial premises at several locations in this vicinity as well as being aware of the development along the lower section of High Street. One such scheme within the middle section of High Street can be see in photo 4 opposite passive diffusion tube site 123 - the Urban Village development has commenced along High Street during early 2011 and is a mix of commercial and residential dwellings. Passive diffusion tube site123 is opposite the development and is exhibiting a bias corrected annual mean of 50.96ug/m^3 for 2011.

Details of this scheme can be found in section 5.2.10 of te Progress Report 2011 but recent alterations to the approved scheme following discussions with the developers, has seen the proposals to site residential elements along the High Street frontage removed from the scheme and replaced with commercial use.

Whilst again the returned annual mean for 2011 confirms an exceedence of the annual mean NO_2 objective, the trend is similar to that described above with a downward reduction in concentrations albeit a levelling off of concentration that still remain above the objective level.

Site 125 is located in the section of Castle Street that leads into the lower section of High Street. The authority is aware of preliminary proposals for redevelopment of old commercial premises at several locations in this vicinity. One such development has commenced at the junction of High Street/Castle Street and College Street to convert and extend a former nightclub into residential accommodation / flats.

Photo 5 - Residential Development (right) opposite existing receptors over commercial premises (left)

The nightclub extended over existing commercial premises at ground floor level, including the Army Careers centre which forms passive diffusion tube site 125. Site 125 returned a bias corrected annual mean / corrected for distance during 2011 of 49.03ug/m^3. Again, this monitoring location is located façade to the commercial premises at ground floor and is once again outside a row of bus stops. Receptors exist at present at a block of flats over commercial premises on the opposite site of the road. For 2010 and 2011, the distance to receptor correction has been taken to be at the residential development under construction. It is thought that during 2012 the residential accommodation will begin to see occupation. All bus traffic then feed into the lower section of High Street and passed site 123 and eventually site 121 in the upper section of High Street. As commented above with other sites, the results observed from year to year with the passive diffusion tube method employed are highly variable in their extent of exceedence, but nevertheless continue to confirm exceedence of the annual mean objective. It is not possible to determine definitively if this variability is due solely to meteorological conditions or changes in traffic flow or to a combination of both. Previous work would indicate that the more likely explanation is a combination of the two.

Sites 206 – 213 are located around the junction of Newton Road, Mumbles with the A483 Mumbles Road, with the majority indicating a breach of the annual mean objective during 2010. These sites were identified during the USA 2009 as Newton Road at this location forms a narrow, congested street (mainly in summertime due to indiscriminate parking etc) with an AADT flow greater than 5000 vehicles.

Photo 6 – View looking south down Newton Road towards junction with A483 Mumbles Road and Swansea Bay

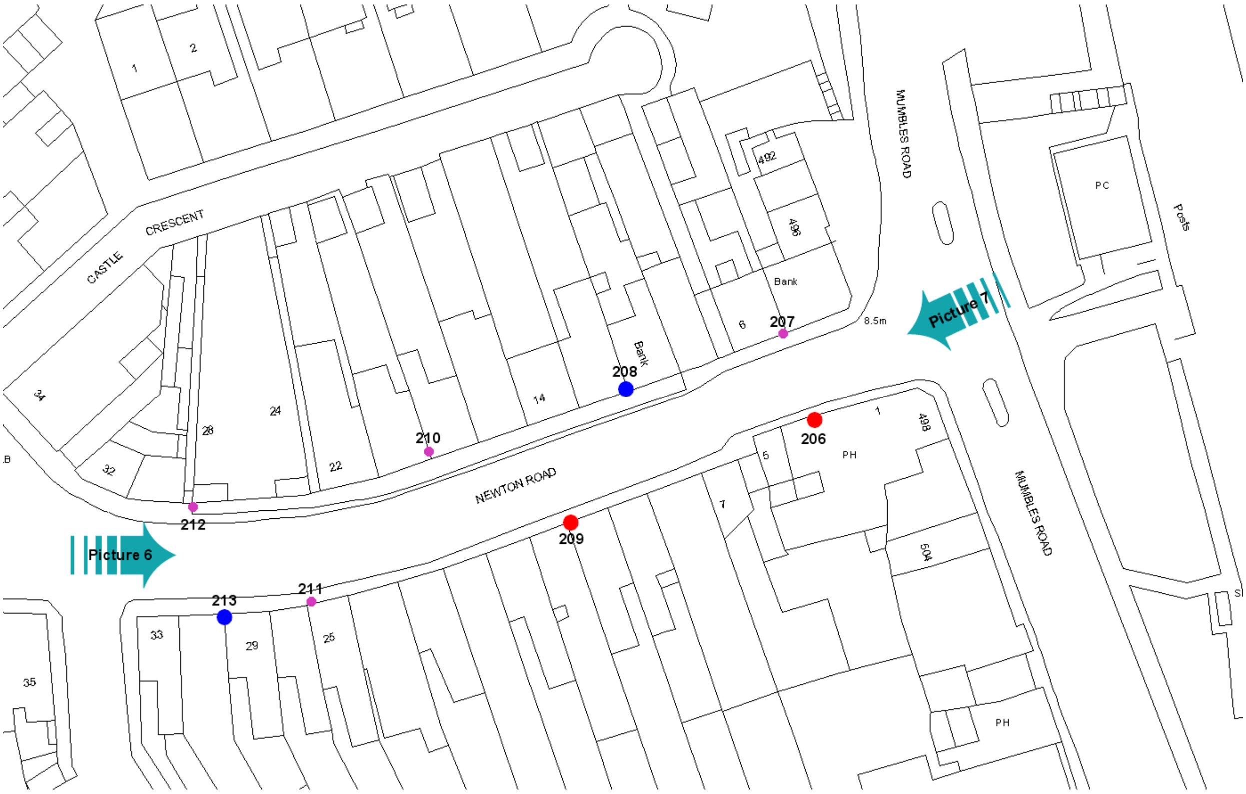
The junction suffers congestion mainly during the summer months due to the influx of tourists visiting both the Mumbles area and the shopping facilities along Newton Road.

Receptor locations exist at first floor level above commercial premises. However, whilst passive diffusion tube sites are located facade to the entrance doors to the flats in between the commercial premises, on one side of the lower section of Newton Road a canopy extends along the commercial premises at first floor level. Dispersion around passive diffusion tube sites 207, 208, and 210 may be hindered under these circumstances with the returned annual means at sites painting a false picture. Whilst this may be true for the monitoring undertaken facade underneath the canopy, sites on the opposite side of the road (left of photo 7) do not suffer from a similar situation, with sites 206, 209 and 211 and 213.

Photo 7 – View looking north up Newton Road

During 2011 the authority reported within its Progress Report that exceedences of the NO_2 annual mean objective had been observed at monitoring points under the canopy at sites 207, 208 and 210. It was further reported that exceedences observed at sites on the opposite side of the road (left of photo 7above) do not suffer from a similar situation of poor dispersion/circulation, with sites 206, 209 and 213 exceeding the annual mean objective. Site 211 was within 0.55ug/m^3 of exceeding the annual mean objective so in practical terms it was also be taken to exhibit probable exceedence of the annual mean objective. It was stated within section 10.1 Conclusions from New Monitoring Data that additional monitoring would be undertaken at 1st floor level above the canopy at façade of the flats above the commercial premise. This has not been implemented as during the risk assessment undertaken it was determined that to change the diffusion tubes would present staff with unacceptable risks both from traffic and the height of working. The monitoring sites have, and will therefore remain, he same as described above.

Results from 2011 indicate that only sites 206 and 209 exceed the annual mean objective with sites 208 and 213 being within 3ug/m^3 of exceeding the annual mean objective so in practical terms they can also be taken to exhibit probable exceedence of the annual mean objective. It is interesting to note that only sites not directly under the commercial premises canopy have exceeded the annual mean objective during 2011.



Plan 1 – Newton Road Passive diffusion Tube Monitoring Sites 2011

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Photo 8 below shows site 75 Uplands Crescent. This site is just up from the junction of Bryn-y-Mor Crescent and sees congestion on both lanes during peak times with traffic queing from the lights within Uplands. The EBam PM_{10} analyser and Automatic Traffic Counting site 33 can bee see to the left of photo 8 and opposite the passive diffusion tube site 75.

Photo 8 – Uplands Crescent, Uplands - Passive NO_2 site 75

Photo 9 below depicts conditions within Woodfield Street, Morriston around passive NO_2 tube site 41 (right of Church). Morriston is a busy shopping centre, mixed in with domestic dwellings which are a legacy from a former period in the history of Morriston. Congestion albeit not directly evident within photo 9 occurs every day, and is compounded by HGV vehicle deliveries, indiscriminate parking and the signal phased Morriston Cross junction approx 30 meters to the south of photo 9.

Photo 9 – Woodfield Street, Morriston – NO_2 Tube Site 41

Photo 10 below is a view up Martin Street where NO_2 tube site 285 (located at the terraced properties north of the public house) exhibits the potential to exceed the annual mean objective. Martin Street leads to/from a busy roundabout junction with the A4067 directly into the lower end of Woodfield Street. Queuing traffic is evident the majority of peak periods trying to enter the roundabout junction.

Photo 10 – Martin Street, Morriston – NO_2 Tube Site 285

Photo 11 below indicates the locale surrounding NO_2 tube site 35 (the property to the left of the photo) which is indicating a breach of the nitrogen dioxide annual mean objective during 2011. Bus stops are adjacent to and opposite the site. The bus stop to the right of photo 11 forces traffic to pass on the other side of the road when passengers are alighting. The site is within 75 meters of the St.Thomas DOAS receiver along Pentreguineau Road which has also indicated a breach of the annual mean objective during 2011. Shown within photo 11 is the gyratory system formed between the Quay Parade bridges. Delhi Street leads onto/from this signal controlled junction with resulting traffic queuing back along the length of Delhi Street at peak times.

Photo 11 – Delhi Street, St Thomas – NO_2 Tube Site 35

Photo 12 below indicates the locale surrounding NO_2 tube site 38 at Port Tennant Road which is indicating the potential to exceed the NO_2 annual mean objective. Site 38 is located alongside the main A483 at the newly formed SA1 junction. The A483 at this location leads directly into the city centre and to junction 42 of the M4 motorway. Queuing traffic forms at peak times directly outside the row of terraced properties within the photo. Also seen within the photo is the location of the EBam PM_{10} particulate monitoring site (within the grassed area behind the small white van and within 2.5 meters of the façade of the terraced properties).


Photo 12 – Port Tennant Road, St Thomas – NO_2 tube site 38

Site 291 is located to the east of site 38 above, again, on the outbound A483 towards junction 42 of the M4. The site is located front faced of a terraced property that is within 4 meters of the A483 and close to a bus stop. It should be noted that few scheduled services stop and use the pull in lay bye style bus stop and that , at this location, the outbound flow of traffic is free flowing. There is a signal controlled junction with the Swansea Docks and the A483 entrance 200 meters westwards towards the city centre. This signal controlled junction results in queuing traffic on the opposite dual carriageway of the A483 past NO_2 site 48 at Bevans Row. It is curious that free flow conditions outside site 291 result in an exceedence of the annual mean objective whilst queuing traffic past site 48 Bevans Row results in compliance with the objective. This is worth further investigation but initial thoughts are that this is an effect of traffic accelerating away from the signal controlled junction..

Table 9 below details the annual NO_2 bias corrected annual means for sites 1-291 between the period 2005-2011. Those sites that have been decommissioned have been removed from the 2011 dataset reported (see also table 3). Whilst there is evidence of a slight overall downward trend with annual mean concentrations between 2005 and 2011, numerous sites still exhibit a breach of the annual mean objective with numerous other also showing the potential to breach the annual mean objective.

A map of those sites failing the annual mean objective and those with the potential to fail the annual mean objective from the 2011 passive diffusion tube data is given below as map 11.

As numerous sites have continued to exhibit bias corrected concentrations below 30ug/m3 for several years, a decision has been made to cease measurements at these sites to both ease the workload and costs associated with this work. The exception to the above is where those sites are within, or near to, the Swansea Air Quality Management Area where these sites may prove useful in assessing the benefit if any of measures taken within the AQMA.

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m³) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
1	262046	196420		29.0	25.7	26.7	24.2	25.42	30.83	27.35
2	262095	196500		24.8	17.6	18.1	16.3	17.73	20.08	-
3	262161	196513		29.9	21.3	22.2	20.1	22.79	23.95	-
4	262497	192857	Y	**39.2**	33.7	33.9	30.8	33.25	35.07	29.97
5	262548	192943	Y	**43.5**	34.0	35.1	32.2	34.22	**42.06**	33.42
6	262612	192995	Y	35.3	31.9	32.0	29.8	28.71	34.62	29.29
7	262691	192852	Y	**56.1**	**51.1**	**50.0**	**48.5**	**53.02**	**58.76**	**50.93**
8	262990	195820	Y	**47.9**	**42.2**	**46.0**	**42.4**	**44.59**	**46.81**	**41.81**
9	263190	195205		**37.6**	29.9	30.3	28.6	29.00	31.41	27.65
10	263219	195513	Y	33.3	25.6	24.8	24.2	26.03	29.98	25.28
11	263344	195474	Y	**45.2**	**40.8**	**39.1**	**37.8**	**37.08**	**43.92**	**37.21**
12	263680	195103	Y	**49.7**	**41.8**	**42.3**	**40.7**	**43.92**	**48.15**	**43.96**
13	264830	193066		34.7	29.8	30.8	28.9	29.90	32.83	28.03
14	265285	192696		34.5	25.2	30.0	25.2	25.23	32.66	26.99
15	265334	192608		36.6	25.7	27.7	26.1	25.73	32.76	27.33
16	265339	192534		36.9	30.8	34.5	30.7	30.73	**38.61**	30.85
17	265496	192408		28.1	22.4	26.0	22.8	21.22	30.40	-
18	265526	195807	Y	**52.4**	**43.1**	**46.4**	**44.9**	**47.87**	**51.23**	**49.10**
19	265597	194061	Y	**56.1**	**44.9**	**48.2**	**42.6**	**44.92**	**52.20**	**45.84**
20	265594	194175	Y	**52.0**	**40.7**	**40.7**	**39.9**	**42.42**	**45.51**	**37.41**
21	265634	195316	Y	**38.3**	32.4	32.8	31.7	32.04	33.65	30.62
22	265682	195374	Y	**44.3**	36.6	36.6	35.7	34.57	**37.93**	33.73
23	265728	195494	Y	**40.1**	32.6	36.0	34.1	33.57	36.53	33.97
24	265760	192420		28.3	21.7	23.6	20.6	19.65	27.50	-
25	265845	195547	Y	**37.1**	29.6	28.9	27.7	29.82	31.43	28.91
26	265876	194318	Y	**42.4**	**43.7**	**42.1**	**41.7**	**40.20**	**45.81**	**40.78**
27	265922	194428	Y	**55.4**	**43.5**	**41.3**	**37.8**	**43.14**	**45.39**	**39.95**
28	265949	194891	Y	**39.9**	28.5	31.6	29.4	30.18	33.48	30.29
29	265973	195222	Y	**70.9**	**58.4**	**58.4**	**56.3**	**52.00**	**53.38**	**53.48**
30	266080	192516		31.4	22.3	24.6	20.1	21.35	25.92	-
31	266153	196003		**40.0**	33.9	33.4	32.4	32.39	**37.79**	31.70
32	266209	193867		**39.1**	32.6	34.0	31.3	32.11	**38.82**	33.24
33	266236	193488		**42.8**	32.4	32.7	31.0	30.86	**38.09**	32.11
34	266272	196168		**38.7**	35.1	36.1	32.7	31.18	**39.60**	34.47
35	266314	193298		**49.3**	**39.0**	**38.6**	35.9	36.23	**40.67**	**40.39**
36	266455	193300		**42.7**	33.0	34.0	31.0	30.03	34.42	33.58
37	266515	193213		35.7	26.1	26.5	24.2	23.88	28.33	-
38	266662	193181		**42.2**	33.7	35.5	33.1	35.34	**39.05**	**37.23**
39	266905	193271		**38.5**	27.4	26.7	25.2	25.70	28.35	-
40	266951	198278		34.8	28.1	29.7	28.2	28.71	31.80	27.77
41	266953	198085		**47.3**	**39.7**	33.4	**37.3**	**41.59**	**41.38**	**40.54**
42	267084	198274		34.1	28.4	31.3	34.8	**43.17**	**38.59**	-
43	267093	198063		**40.4**	35.8	35.1	34.4	36.19	**42.60**	34.88
44	267639	199543		32.8	29.9	28.3	29.0	29.71	28.37	30.01
45	267661	199451		**42.9**	34.6	**39.4**	35.5	**37.79**	**43.87**	33.82
46	267752	193218		23.1	17.0	16.7	16.0	15.91	17.71	-
47	267908	199773		26.9	24.4	24.1	23.9	25.19	26.83	-
48	268011	193101		31.3	24.8	24.3	25.2	23.88	27.08	23.98
49	268501	197329		32.8	28.7	29.9	29.6	29.43	32.35	28.28
50	268530	197419		**48.4**	**39.4**	**39.7**	35.3	**37.99**	**41.14**	35.38
51	268593	197434		36.9	32.3	30.7	32.2	30.98	34.19	30.31

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m^3) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
52	268643	197245		26.0	27.3	20.9	22.5	24.20	24.42	-
53	268652	197508		30.0	23.7	23.4	22.9	23.67	25.93	-
54	268693	197416		**40.1**	**38.6**	34.3	34.6	35.44	33.14	36.31
55	268789	197420		**39.9**	**37.1**	36.2	35.3	33.50	36.93	36.10
56	269306	198661		**42.4**	**39.4**	**39.1**	**23**	22.80	22.4	21.70
57	269395	199042		21.3	16.3	15.9	15.4	15.51	15.73	-
58	264052	192884		**52.0**	**41.3**	**41.7**	**33.6**	34.90	**41.7**	32.50
59	265918	194463	Y	**69.0**	**56.8**	**60.5**	**53.9**	**49.76**	**60.33**	**53.98**
60	265036	192931		-	**37.4**	**38.7**	**37.1**	35.30	**42.75**	**39.62**
61	264959	192878		-	**38.3**	**38.2**	**38.0**	**38.24**	**40.21**	**38.82**
62	266698	195335		-	-	**38.4**	29.0	17.82	26.83	-
63	262675	192775	Y	-	-	35.4	**21.6**	22.00	25.9	23.20
64	262719	192840	Y	-	-	**65.1**	**42.4**	**40.10**	**44.9**	**39.01**
65	262735	192855	Y	-	-	**37.1**	27.0	26.47	29.59	25.49
66	262802	192829	Y	-	-	**44.3**	32.8	30.98	36.04	30.52
67	265903	193683	Y	-	-	**69.3**	**38.2**	**39.80**	**46.3**	**39.40**
68	265573	193432		-	-	**42.0**	34.4	34.64	**41.51**	**39.26**
69	265543	193450		-	-	**60.8**	**42.1**	**43.60**	**50.9**	**40.80**
70	266649	195435		-	-	**38.1**	23.3	22.90	25.7	24.40
71	266514	195485		-	-	**41.8**	19.9	19.80	20.9	20.10
72	264091	192900		-	-	-	25.1	23.86	31.40	25.52
73	264138	192868		-	-	-	34.0	34.62	35.36	33.17
74	264163	192853		-	-	-	28.9	28.76	32.85	28.19
75	264072	192869		-	-	-	35.1	**42.09**	**45.19**	**42.01**
76	263968	192880		-	-	-	26.1	26.30	31.70	27.01
77	263856	192931		-	-	-	22.8	23.14	26.89	-
78	263819	192948		-	-	-	27.5	27.83	33.17	29.09
79	263842	192896		-	-	-	33.0	33.95	**37.13**	36.77
80	263558	192833		-	-	-	24.8	24.34	26.53	-
81	262940	192775	Y	-	-	-	23.3	23.30	27.79	-
82	262851	192805	Y	-	-	-	26.0	24.60	28.32	25.56
83	262785	192838	Y	-	-	-	29.8	28.60	35.51	30.58
84	262714	192839	Y	-	-	-	**37.3**	**37.57**	**39.42**	36.44
85	262702	192847	Y	-	-	-	**38.6**	**39.58**	**41.89**	**38.05**
86	262704	192865	Y	-	-	-	30.8	28.90	33.25	27.94
87	262697	192798	Y	-	-	-	21.3	21.16	23.93	22.23
88	262605	192916	Y	-	-	-	**37.3**	35.21	**38.27**	32.19
89	262587	192956	Y	-	-	-	22.4	24.17	25.99	23.12
90	262631	192996	Y	-	-	-	34.2	35.74	**37.93**	34.43
91	262534	192950	Y	-	-	-	31.7	30.62	**37.50**	32.73
92	262545	192869	Y	-	-	-	32.0	34.62	33.7	28.70
93	263406	195534		-	-	-	29.9	30.94	33.38	31.39
94	263444	195572		-	-	-	29.6	31.05	30.34	29.38
95	262815	196090		-	-	-	29.1	28.88	34.29	28.64
96	262922	195950		-	-	-	27.9	28.99	31.05	29.46
97	262946	195902	Y	-	-	-	36.6	33.84	**39.95**	35.00
98	263142	195548	Y	-	-	-	**40.5**	**40.62**	**41.01**	**37.29**
99	263387	195332	Y	-	-	-	32.5	29.16	**37.64**	30.58
100	263470	195250	Y	-	-	-	28.7	28.13	31.78	26.06
101	263843	195047	Y	-	-	-	29.8	28.27	30.97	27.26
102	266379	193307		-	-	-	29.4	29.99	33.13	29.54

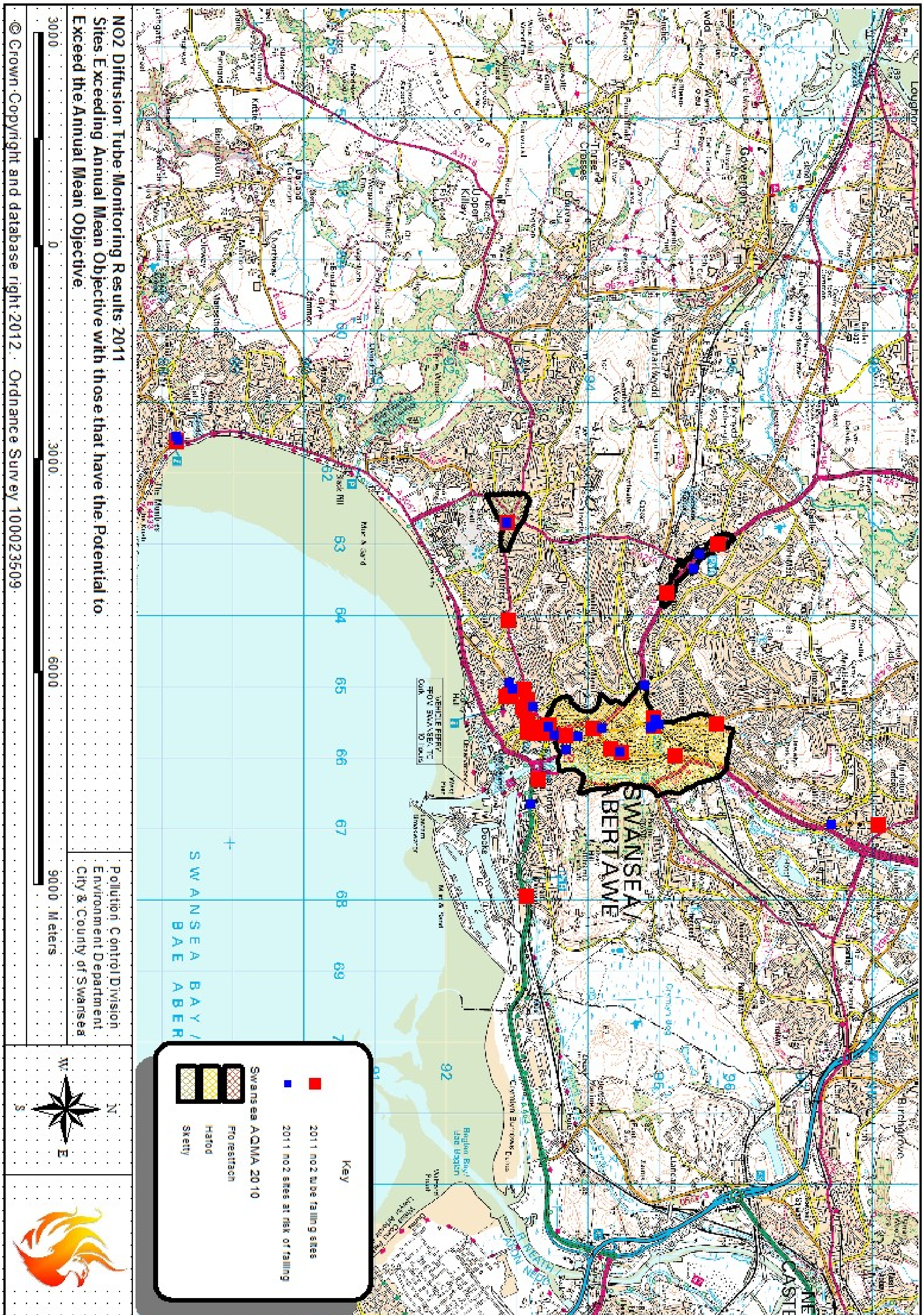
Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m³) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
103	268526	197359		-	-	-	33.4	31.06	35.11	32.42
104	268538	197389		-	-	-	29.4	28.41	31.70	28.55
105	268562	197472		-	-	-	32.3	30.11	30.33	28.90
106	268496	197476		-	-	-	33.8	33.64	34.66	33.38
107	268765	197420		-	-	-	35.0	34.27	36.16	33.53
108	267608	199461		-	-	-	31.4	30.10	35.76	30.58
109	267510	199487		-	-	-	28.1	27.06	32.44	25.12
110	267369	199521		-	-	-	27.7	26.18	30.46	26.34
111	267705	199426		-	-	-	32.9	30.63	34.62	28.70
112	264868	192814		-	-	-	26.0	26.20	30.3	27.90
113	264654	192662		-	-	-	21.8	28.76	36.16	31.18
114	264622	192971		-	-	-	32.5	33.19	33.92	29.99
115	265031	193097		-	-	-	**38.8**	**40.48**	**45.67**	**41.44**
116	265192	193138		-	-	-	**41.5**	**42.87**	**48.73**	**41.92**
117	265288	193211		-	-	-	**39.4**	**38.32**	**47.27**	**39.71**
118	265483	193385		-	-	-	29.3	32.02	**38.58**	32.96
119	265522	193390		-	-	-	32.2	35.43	**40.81**	36.56
120	265570	193366		-	-	-	**46.5**	**44.16**	**57.75**	**51.29**
121	265706	193662	Y	-	-	-	**79.3**	**61.19**	**52.33**	**52.71**
122	265694	193505		-	-	-	**39.5**	**37.21**	**47.39**	**37.12**
123	265655	193423		-	-	-	**54.4**	**51.27**	**51.80**	**50.96**
124	265651	193253		-	-	-	**44.1**	**46.68**	**51.72**	**45.58**
125	265641	193162		-	-	-	**51.4**	**59.48**	**50.5**	**42.10**
126	265475	193144		-	-	-	**38.9**	**48.41**	**62.03**	**41.96**
127	265348	193110		-	-	-	**40.9**	**37.71**	**61.83**	**56.19**
128	265297	193085		-	-	-	**41.1**	**42.82**	**51.71**	**42.37**
129	265153	193098		-	-	-	36.1	35.34	**40.51**	35.42
130	265139	192912		-	-	-	**53.5**	**42.92**	**43.92**	**43.32**
131	265137	192846		-	-	-	**58.3**	**46.69**	**50.19**	**46.62**
132	265229	192753		-	-	-	32.7	32.39	**39.43**	36.82
133	265350	192566		-	-	-	26.8	27.05	33.15	30.34
134	265113	192903		-	-	-	**50.5**	**45.02**	**47.74**	**49.41**
135	262605	192916	Y	-	-	-	-	-	35.60	29.29
136	262612	192995	Y	-	-	-	-	-	33.32	28.09
137	262631	192996	Y	-	-	-	-	-	**37.13**	34.46
138	266779	199246		-	-	-	-	-	26.22	24.16
139	266867	199030		-	-	-	-	-	31.87	28.29
140	266863	199009		-	-	-	-	-	**39.36**	35.01
141	266979	198772		-	-	-	-	-	30.00	28.55
142	267017	198710		-	-	-	-	-	33.45	30.65
143	267089	198608		-	-	-	-	-	**37.32**	32.94
144	267141	198591		-	-	-	-	-	30.26	27.30
145	267139	198578		-	-	-	-	-	33.83	33.47
146	267156	198571		-	-	-	-	-	35.76	34.62
147	267165	198580		-	-	-	-	-	32.97	28.21
148	267170	198564		-	-	-	-	-	33.86	31.33
149	267204	198561		-	-	-	-	-	31.17	27.11
150	267205	198545		-	-	-	-	-	31.42	29.50
151	267192	198518		-	-	-	-	-	30.92	27.01
152	267081	198268		-	-	-	-	-	29.60	-
153	268845	201137		-	-	-	-	-	28.20	-

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations ($\mu g/m^3$) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
154	268870	201267		-	-	-	-	-	27.98	-
155	269009	201280		-	-	-	-	-	30.76	28.36
156	269059	201296		-	-	-	-	-	31.79	29.51
157	269173	201355		-	-	-	-	-	28.79	-
158	269480	201441		-	-	-	-	-	30.89	28.37
159	269171	201620		-	-	-	-	-	31.63	30.26
160	269049	201744		-	-	-	-	-	34.94	34.35
161	268938	201929		-	-	-	-	-	19.77	-
162	259553	203379		-	-	-	-	-	31.59	26.12
163	259287	203556		-	-	-	-	-	27.11	22.72
164	259195	203667		-	-	-	-	-	31.90	28.99
165	259149	203675		-	-	-	-	-	24.52	23.86
166	259148	203690		-	-	-	-	-	28.89	23.99
167	259126	203700		-	-	-	-	-	25.73	23.83
168	259115	203705		-	-	-	-	-	23.26	22.49
169	259013	203747		-	-	-	-	-	24.97	26.06
170	258971	203797		-	-	-	-	-	19.95	18.43
171	258917	203826		-	-	-	-	-	28.08	28.14
172	258887	203859		-	-	-	-	-	26.00	28.36
173	259250	203708		-	-	-	-	-	20.96	19.35
174	259253	203660		-	-	-	-	-	19.60	16.46
175	259251	203638		-	-	-	-	-	18.05	20.68
176	258872	203691		-	-	-	-	-	15.00	12.98
177	258896	203697		-	-	-	-	-	14.87	13.29
178	258986	203684		-	-	-	-	-	14.94	14.74
179	259059	197831		-	-	-	-	-	29.13	-
180	259064	197781		-	-	-	-	-	32.43	32.49
181	259010	197817		-	-	-	-	-	27.49	-
182	259050	197790		-	-	-	-	-	30.96	29.37
183	259036	197795		-	-	-	-	-	34.37	32.08
184	259014	197797		-	-	-	-	-	28.82	-
185	258919	197820		-	-	-	-	-	26.46	-
186	258711	197868		-	-	-	-	-	23.64	-
187	258206	198239		-	-	-	-	-	18.28	-
188	258197	198219		-	-	-	-	-	17.15	-
189	258270	198257		-	-	-	-	-	16.79	-
190	258260	198237		-	-	-	-	-	17.17	-
191	258338	198270		-	-	-	-	-	17.45	-
192	257422	198542		-	-	-	-	-	16.02	-
193	257371	198522		-	-	-	-	-	21.34	-
194	257958	198581		-	-	-	-	-	19.41	-
195	257972	198563		-	-	-	-	-	26.32	-
196	258046	198558		-	-	-	-	-	22.61	-
197	258797	198701		-	-	-	-	-	**38.71**	33.73
198	258811	198701		-	-	-	-	-	**38.49**	36.97
199	254703	195764		-	-	-	-	-	34.16	29.05
200	254582	195821		-	-	-	-	-	27.71	-
201	254522	195859		-	-	-	-	-	30.47	28.39
202	254437	195879		-	-	-	-	-	23.13	-
203	254294	195885		-	-	-	-	-	25.57	-
204	253777	195926		-	-	-	-	-	18.53	-

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m³) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
205	253758	195939		-	-	-	-	-	22.91	-
206	261565	188211		-	-	-	-	-	**51.37**	**47.05**
207	261561	188222		-	-	-	-	-	**45.70**	34.51
208	261541	188215		-	-	-	-	-	**46.18**	**37.59**
209	261534	188198		-	-	-	-	-	**46.87**	**44.72**
210	261516	188207		-	-	-	-	-	**43.61**	31.66
211	261501	188188		-	-	-	-	-	**39.49**	34.34
212	261486	188200		-	-	-	-	-	27.40	27.04
213	261490	188186		-	-	-	-	-	**40.24**	**37.79**
214	261315	188193		-	-	-	-	-	30.17	25.36
215	261299	188191		-	-	-	-	-	28.61	22.93
216	261276	188190		-	-	-	-	-	30.74	25.94
217	260357	188240		-	-	-	-	-	20.60	-
218	260384	188206		-	-	-	-	-	29.64	-
219	260419	188172		-	-	-	-	-	24.64	-
220	261194	188163		-	-	-	-	-	22.70	-
221	260454	188171		-	-	-	-	-	21.22	-
222	260469	188182		-	-	-	-	-	24.74	-
223	266899	197354		-	-	-	-	-	25.61	-
224	266881	197389		-	-	-	-	-	26.85	-
225	266861	197432		-	-	-	-	-	27.53	-
226	266829	197472		-	-	-	-	-	27.33	-
227	266836	197484		-	-	-	-	-	25.70	-
228	266779	197578		-	-	-	-	-	24.43	-
229	266772	197621		-	-	-	-	-	22.56	-
230	266777	197651		-	-	-	-	-	26.39	-
231	268802	197666		-	-	-	-	-	23.96	-
232	266825	197654		-	-	-	-	-	27.63	-
233	266823	197668		-	-	-	-	-	26.07	-
234	266858	197671		-	-	-	-	-	24.15	-
235	266874	197657		-	-	-	-	-	26.97	-
236	266886	197658		-	-	-	-	-	29.39	-
237	266885	197676		-	-	-	-	-	25.90	-
238	266902	197660		-	-	-	-	-	36.38	32.78
239	266181	196022		-	-	-	-	-	**37.70**	33.64
240	266169	195995		-	-	-	-	-	**40.14**	36.36
241	266159	196013		-	-	-	-	-	36.92	31.39
242	265655	193423		-	-	-	-	-	**45.21**	**46.01**
243	265474	194949		-	-	-	-	-	**41.64**	33.82
244	265466	194930	Y	-	-	-	-	-	**47.92**	**38.33**
245	265448	194922	Y	-	-	-	-	-	**49.14**	**41.03**
246	265425	194927		-	-	-	-	-	33.12	26.92
247	265394	194899	Y	-	-	-	-	-	**39.76**	35.47
248	265342	194894		-	-	-	-	-	31.71	25.22
249	265326	194871	Y	-	-	-	-	-	**40.58**	33.94
250	265274	194867		-	-	-	-	-	32.99	28.20
251	265263	194845	Y	-	-	-	-	-	**38.17**	30.76
252	265226	194830	Y	-	-	-	-	-	33.69	31.94
253	265194	194833		-	-	-	-	-	29.98	24.59
254	265142	194816		-	-	-	-	-	30.41	23.45
255	265098	194825		-	-	-	-	-	29.09	24.86

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations ($\mu g/m^3$) Adjusted for bias						
				2005	2006	2007	2008	2009	2010	2011
256	264995	194777		-	-	-	-	-	**45.60**	**39.81**
257	254817	189135		-	-	-	-	-	21.32	-
258	254906	189110		-	-	-	-	-	31.14	26.30
259	254949	189113		-	-	-	-	-	20.10	-
260	254970	189116		-	-	-	-	-	19.06	-
261	254991	189115		-	-	-	-	-	22.75	-
262	255056	189118		-	-	-	-	-	12.93	-
263	262444	193447		-	-	-	-	-	20.38	-
264	262251	193293		-	-	-	-	-	18.44	-
265	266375	198023		-	-	-	-	-	33.26	31.81
266	266380	198043		-	-	-	-	-	23.98	-
267	266382	198028		-	-	-	-	-	32.14	30.76
268	266419	198053		-	-	-	-	-	31.05	29.00
269	266458	198111		-	-	-	-	-	27.34	-
270	266896	198084		-	-	-	-	-	27.21	-
271	266879	198078		-	-	-	-	-	35.52	32.38
272	266888	198074		-	-	-	-	-	36.22	28.91
273	267060	198234		-	-	-	-	-	31.92	-
274	269487	201451		-	-	-	-	-	25.97	-
275	265658	194856	Y	-	-	-	-	-	-	26.00
276	265610	194871	Y	-	-	-	-	-	-	36.03
277	265596	194875	Y	-	-	-	-	-	-	**37.05**
278	265573	194882	Y	-	-	-	-	-	-	**39.11**
279	265555	194926	Y	-	-	-	-	-	-	**50.24**
280	265542	194980	Y	-	-	-	-	-	-	**37.90**
281	265542	194872	Y	-	-	-	-	-	-	36.00
282	265540	194840	Y	-	-	-	-	-	-	33.80
283	265436	195937		-	-	-	-	-	-	30.35
284	265452	195899		-	-	-	-	-	-	33.28
285	266955	197415		-	-	-	-	-	-	**37.51**
286	266938	197377		-	-	-	-	-	-	36.68
287	265715	193902	Y	-	-	-	-	-	-	30.76
288	265698	193878	Y	-	-	-	-	-	-	33.38
289	265702	193842	Y	-	-	-	-	-	-	**37.33**
290	263014	195737	Y	-	-	-	-	-	-	27.86
291	267952	193121		-	-	-	-	-	-	**41.79**

Table 9 – NO_2 Annual Mean concentrations 2005- 2011



Map 11- Passive NO_2 Monitoring locations failing or having potential to fail annual mean objective

LAQM.TG (09) provides a method within box 2.1 page 2-4 to project measured annual mean roadside nitrogen dioxide concentrations to future years. The supporting adjustment factor table was updated during January 2012 in view of the release of updated vehicle emission factors and is obtainable from http://laqm.defra.gov.uk/documents/Is_the_example_in_Box_2.1_TG09_correct.pdf

It is noted that in addition to the above, from http://laqm.defra.gov.uk/whatsnew.html that Defra have produced another update to the previously revised future year projection guidance by way of a further note entitled "Note on Projecting NO2 concentrations" [17] dated April 2012. This note sets out additional alternative methods to project measured NO_2 concentrations to future years. As a result, this authority is considering the implications raised with some of the alternative methods mentioned within this note but have decided to undertake within this USA the more simplistic revised approach detailed within section 2.4. This alternative projection method assumes an average national reduction trend in NO_2 concentrations of 0.68% per year at roadside stations and 0.87% reduction per year at background stations. The adjustment factors presented within table 2 of the April 2012 update are presented as the UK averages of the site classifications i.e. roadside. This newly adopted method allows the comparison of the LAQM.TG(09) revised guidance future year projections issued during January 2010 to the additional revised note dated April 2012. This method produces a range of predicted future year concentrations as to where the NO_2 concentration is likely to lie. Using a combination of these methods the full range of future year projections are presented within table 10 below.

[17] http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m^3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
1		26	27	24	27	22	27	21	27	19	26	18	26	17	26	16	26	15	26
2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Y	28	30	26	30	24	29	23	29	21	29	20	29	19	29	17	28	16	28
5	Y	31	33	29	33	27	33	25	33	24	32	22	32	21	32	19	32	18	31
6	Y	27	29	26	29	24	29	22	29	21	28	20	28	18	28	17	28	16	28
7	Y	48	51	45	50	42	50	38	50	36	49	34	49	32	49	30	48	27	48
8	Y	39	42	37	41	34	41	32	41	30	40	28	40	26	40	24	40	22	39
9		26	27	24	27	23	27	21	27	20	27	18	27	17	26	16	26	15	26
10	Y	24	25	22	25	21	25	19	25	18	24	17	24	16	24	15	24	14	24
11	Y	35	37	33	37	30	36	28	36	26	36	25	36	23	35	22	35	20	35
12	Y	41	44	39	43	36	43	33	43	31	43	29	42	27	42	25	42	24	41
13		26	28	25	28	23	27	21	27	20	27	19	27	18	27	16	27	15	26
14		25	27	24	27	22	26	20	26	19	26	18	26	17	26	16	26	14	25
15		26	27	24	27	22	27	21	27	19	26	18	26	17	26	16	26	15	26
16		29	31	27	30	25	30	23	30	22	30	21	30	19	29	18	29	17	29
17		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Y	46	49	43	48	40	48	37	48	35	47	33	47	31	47	28	47	26	46
19	Y	43	46	40	45	37	45	35	45	33	44	31	44	29	44	27	43	25	43
20	Y	35	37	33	37	31	37	28	36	27	36	25	36	23	36	22	35	20	35
21	Y	29	30	27	30	25	30	23	30	22	30	20	29	19	29	18	29	16	29
22	Y	32	33	30	33	28	33	25	33	24	33	23	32	21	32	20	32	18	32
23	Y	32	34	30	34	28	33	26	33	24	33	23	33	21	32	20	32	18	32
24		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Y	27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	27	16	27
26	Y	38	40	36	40	33	40	31	40	29	39	27	39	25	39	24	39	22	38
27	Y	38	40	35	39	33	39	30	39	28	39	27	38	25	38	23	38	21	38
28	Y	28	30	27	30	25	30	23	29	22	29	20	29	19	29	18	29	16	29
29	Y	50	53	47	53	44	52	40	52	38	52	36	51	33	51	31	51	29	50
30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31		30	31	28	31	26	31	24	31	23	31	21	30	20	30	18	30	17	30
32		31	33	29	33	27	33	25	32	24	32	22	32	21	32	19	31	18	31
33		30	32	28	32	26	31	24	31	23	31	21	31	20	31	19	30	17	30
34		32	34	30	34	28	34	26	34	25	33	23	33	22	33	20	33	18	32
35		38	40	35	40	33	40	30	39	29	39	27	39	25	39	23	38	22	38
36		32	33	29	33	27	33	25	33	24	32	22	32	21	32	19	32	18	32
37		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38		35	37	33	37	30	36	28	36	26	36	25	36	23	35	22	35	20	35
39		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40		26	28	24	27	23	27	21	27	20	27	19	27	17	26	16	26	15	26
41		38	40	36	40	33	40	31	39	29	39	27	39	25	39	24	38	22	38
42		-		-		-		-		-		-		-		-		-	
43		33	35	31	34	28	34	26	34	25	34	23	33	22	33	20	33	19	33
44		28	30	26	30	24	29	23	29	21	29	20	29	19	29	17	28	16	28
45		32	34	30	33	28	33	26	33	24	33	23	32	21	32	20	32	18	32
46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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48		23	24	21	24	20	23	18	23	17	23	16	23	15	23	14	23	13	23
49		27	28	25	28	23	28	21	28	20	27	19	27	18	27	16	27	15	27
50		33	35	31	35	29	35	27	34	25	34	24	34	22	34	21	34	19	33
51		28	30	27	30	25	30	23	29	22	29	20	29	19	29	18	29	16	29
52		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54		34	36	32	36	30	36	27	35	26	35	24	35	23	35	21	34	19	34
55		34	36	32	36	29	35	27	35	26	35	24	35	23	34	21	34	19	34
56		20	22	19	21	18	21	16	21	15	21	14	21	14	21	13	21	12	20
57		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58		31	32	29	32	27	32	25	32	23	31	22	31	20	31	19	31	17	31

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m^3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
59	Y	51	54	47	53	44	53	41	53	38	52	36	52	34	51	31	51	29	51
60		37	39	35	39	32	39	30	39	28	38	26	38	25	38	23	38	21	37
61		36	39	34	38	32	38	29	38	28	38	26	37	24	37	23	37	21	37
62		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
63	Y	22	23	20	23	19	23	18	23	17	22	15	22	14	22	13	22	12	22
64	Y	37	39	34	38	32	38	29	38	28	38	26	37	24	37	23	37	21	37
65	Y	24	25	22	25	21	25	19	25	18	25	17	24	16	24	15	24	14	24
66	Y	29	30	27	30	25	30	23	30	22	30	20	29	19	29	18	29	16	29
67	Y	37	39	35	39	32	39	30	38	28	38	26	38	25	38	23	37	21	37
68		37	39	34	39	32	38	30	38	28	38	26	38	25	37	23	37	21	37
69		38	41	36	40	33	40	31	40	29	39	27	39	25	39	24	39	22	38
70		23	24	21	24	20	24	18	24	17	24	16	23	15	23	14	23	13	23
71		19	20	18	20	16	20	15	20	14	19	13	19	13	19	12	19	11	19
72		24	25	22	25	21	25	19	25	18	25	17	24	16	24	15	24	14	24
73		31	33	29	33	27	32	25	32	24	32	22	32	21	32	19	31	18	31
74		26	28	25	28	23	28	21	27	20	27	19	27	18	27	16	27	15	27
75		39	42	37	41	34	41	32	41	30	41	28	40	26	40	24	40	23	40
76		25	27	24	27	22	26	20	26	19	26	18	26	17	26	16	26	14	25
77		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78		27	29	26	29	24	28	22	28	21	28	19	28	18	28	17	28	16	27
79		35	37	32	36	30	36	28	36	26	36	25	35	23	35	21	35	20	35
80		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	Y	26	27	24	27	23	27	21	27	20	27	18	27	17	26	16	26	15	26
82	Y	24	25	22	25	21	25	19	25	18	25	17	25	16	24	15	24	14	24
83	Y	29	30	27	30	25	30	23	30	22	30	20	29	19	29	18	29	16	29
84	Y	34	36	32	36	30	36	28	35	26	35	24	35	23	35	21	35	20	34
85	Y	36	38	33	38	31	37	29	37	27	37	25	37	24	36	22	36	20	36
86	Y	26	28	25	28	23	27	21	27	20	27	19	27	17	27	16	26	15	26
87	Y	21	22	20	22	18	22	17	22	16	21	15	21	14	21	13	21	12	21
88	Y	30	32	28	32	26	32	24	31	23	31	21	31	20	31	19	30	17	30
89	Y	22	23	20	23	19	23	17	23	16	22	15	22	14	22	13	22	12	22
90	Y	32	34	30	34	28	34	26	34	24	33	23	33	22	33	20	33	18	32
91	Y	31	32	29	32	27	32	25	32	23	32	22	31	20	31	19	31	18	31
92	Y	27	28	25	28	23	28	22	28	20	28	19	28	18	27	17	27	15	27
93		29	31	28	31	26	31	24	31	22	30	21	30	20	30	18	30	17	30
94		28	29	26	29	24	29	22	29	21	28	20	28	18	28	17	28	16	28
95		27	28	25	28	23	28	22	28	20	28	19	27	18	27	17	27	15	27
96		28	29	26	29	24	29	22	29	21	28	20	28	18	28	17	28	16	28
97	Y	33	35	31	35	29	34	26	34	25	34	23	34	22	33	20	33	19	33
98	Y	35	37	33	37	30	37	28	36	27	36	25	36	23	36	22	35	20	35
99	Y	29	30	27	30	25	30	23	30	22	30	20	29	19	29	18	29	16	29
100	Y	24	26	23	26	21	26	20	25	19	25	17	25	16	25	15	25	14	25
101	Y	26	27	24	27	22	27	21	27	19	26	18	26	17	26	16	26	15	26
102		28	29	26	29	24	29	22	29	21	29	20	28	18	28	17	28	16	28
103		30	32	28	32	26	32	24	32	23	31	22	31	20	31	19	31	17	31
104		27	28	25	28	23	28	22	28	20	28	19	27	18	27	17	27	15	27
105		27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	27	16	27
106		31	33	29	33	27	33	25	32	24	32	22	32	21	32	19	32	18	31
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108		29	30	27	30	25	30	23	30	22	30	20	29	19	29	18	29	16	29
109		24	25	22	25	20	25	19	24	18	24	17	24	16	24	15	24	13	24
110		25	26	23	26	21	26	20	26	19	25	18	25	16	25	15	25	14	25
111		27	28	25	28	23	28	22	28	20	28	19	28	18	27	17	27	15	27
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113		29	31	27	31	25	31	24	30	22	30	21	30	19	30	18	30	17	29
114		28	30	26	30	24	29	23	29	21	29	20	29	19	29	17	28	16	28
115		39	41	36	41	34	41	31	40	29	40	28	40	26	40	24	39	22	39
116		39	42	37	41	34	41	32	41	30	41	28	40	26	40	24	40	22	39

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m^3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
117		37	39	35	39	32	39	30	39	28	38	27	38	25	38	23	38	21	37
118		31	33	29	33	27	32	25	32	23	32	22	32	21	31	19	31	18	31
119		34	36	32	36	30	36	28	36	26	35	24	35	23	35	21	35	20	34
120		48	51	45	51	42	50	39	50	36	50	34	49	32	49	30	49	28	48
121	Y	49	52	46	52	43	52	40	51	37	51	35	51	33	50	31	50	28	50
122		35	37	33	37	30	36	28	36	26	36	25	36	23	35	22	35	20	35
123		48	51	45	50	42	50	38	50	36	49	34	49	32	49	30	48	27	48
124		43	45	40	45	37	45	34	44	32	44	30	44	28	43	26	43	24	43
125		40	42	37	42	34	41	32	41	30	41	28	40	26	40	24	40	23	40
126		39	42	37	41	34	41	32	41	30	41	28	40	26	40	24	40	23	39
127		53	56	49	55	46	55	42	55	40	54	38	54	35	54	33	53	30	53
128		40	42	37	42	35	41	32	41	30	41	28	41	26	40	25	40	23	40
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130		41	43	38	43	35	42	33	42	31	42	29	42	27	41	25	41	23	41
131		44	46	41	46	38	46	35	45	33	45	31	45	29	44	27	44	25	44
132		35	37	32	36	30	36	28	36	26	36	25	35	23	35	21	35	20	35
133		28	30	27	30	25	30	23	30	22	29	20	29	19	29	18	29	16	29
134		46	49	43	49	40	48	37	48	35	48	33	47	31	47	29	47	27	46
135	Y	27	29	26	29	24	29	22	29	21	28	20	28	18	28	17	28	16	28
136	Y	26	28	25	28	23	28	21	27	20	27	19	27	18	27	16	27	15	26
137	Y	32	34	30	34	28	34	26	34	25	33	23	33	22	33	20	33	18	32
138		23	24	21	24	20	24	18	24	17	23	16	23	15	23	14	23	13	23
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140		33	35	31	35	29	34	26	34	25	34	23	34	22	33	20	33	19	33
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152		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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157		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
158		27	28	25	28	23	28	21	28	20	27	19	27	18	27	16	27	15	27
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161		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162		25	26	23	26	21	26	20	25	19	25	17	25	16	25	15	25	14	25
163		21	23	20	22	19	22	17	22	16	22	15	22	14	22	13	22	12	21
164		27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	27	16	27
165		22	24	21	24	19	23	18	23	17	23	16	23	15	23	14	23	13	22
166		23	24	21	24	20	23	18	23	17	23	16	23	15	23	14	23	13	23
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168		21	22	20	22	18	22	17	22	16	22	15	22	14	21	13	21	12	21
169		24	26	23	26	21	26	20	25	19	25	17	25	16	25	15	25	14	25
170		17	18	16	18	15	18	14	18	13	18	12	18	12	18	11	17	10	17
171		26	28	25	28	23	28	21	27	20	27	19	27	18	27	16	27	15	26
172		27	28	25	28	23	28	21	28	20	27	19	27	18	27	16	27	15	27
173		18	19	17	19	16	19	15	19	14	19	13	19	12	18	11	18	10	18
174		15	16	14	16	13	16	12	16	12	16	11	16	10	16	10	16	9	15

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m^3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
175		19	21	18	20	17	20	16	20	15	20	14	20	13	20	12	20	11	19
176		12	13	11	13	11	13	10	13	9	13	9	12	8	12	8	12	7	12
177		12	13	12	13	11	13	10	13	9	13	9	13	8	13	8	13	7	13
178		14	15	13	15	12	14	11	14	10	14	10	14	9	14	9	14	8	14
179		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180		30	32	29	32	27	32	25	32	23	31	22	31	20	31	19	31	17	31
181		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
182		28	29	26	29	24	29	22	29	21	28	20	28	18	28	17	28	16	28
183		30	32	28	32	26	31	24	31	23	31	21	31	20	31	19	30	17	30
184		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
187		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
195		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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197		32	33	30	33	28	33	25	33	24	33	23	32	21	32	20	32	18	32
198		35	37	32	36	30	36	28	36	26	36	25	35	23	35	21	35	20	35
199		27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	28	16	27
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201		27	28	25	28	23	28	21	28	20	27	19	27	18	27	16	27	15	27
202		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
205		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206		44	47	41	46	38	46	36	46	33	45	31	45	29	45	27	45	25	44
207		32	34	30	34	28	34	26	34	25	33	23	33	22	33	20	33	19	32
208		35	37	33	37	31	37	28	37	27	36	25	36	23	36	22	36	20	35
209		42	44	39	44	36	44	34	44	32	43	30	43	28	43	26	42	24	42
210		30	31	28	31	26	31	24	31	23	31	21	30	20	30	18	30	17	30
211		32	34	30	34	28	34	26	33	24	33	23	33	21	33	20	33	18	32
212		25	27	24	27	22	26	20	26	19	26	18	26	17	26	16	26	15	25
213		35	38	33	37	31	37	29	37	27	37	25	36	24	36	22	36	20	36
214		24	25	22	25	21	25	19	25	18	25	17	24	16	24	15	24	14	24
215		22	23	20	23	19	22	17	22	16	22	15	22	14	22	13	22	12	22
216		24	26	23	26	21	25	20	25	18	25	17	25	16	25	15	25	14	24
217		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
218		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
219		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
223		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
227		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
229		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
231		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m^3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
233		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
235		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
236		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
237		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
238		31	33	29	32	27	32	25	32	23	32	22	31	20	31	19	31	18	31
239		32	33	30	33	27	33	25	33	24	33	22	32	21	32	20	32	18	32
240		34	36	32	36	30	36	27	35	26	35	24	35	23	35	21	34	20	34
241		29	31	28	31	26	31	24	31	22	30	21	30	20	30	18	30	17	30
242		43	46	40	45	38	45	35	45	33	44	31	44	29	44	27	44	25	43
243		32	34	30	33	28	33	26	33	24	33	23	32	21	32	20	32	18	32
244	Y	36	38	34	38	31	38	29	37	27	37	26	37	24	37	22	36	21	36
245	Y	39	41	36	40	33	40	31	40	29	40	27	39	26	39	24	39	22	39
246		25	27	24	27	22	26	20	26	19	26	18	26	17	26	16	25	14	25
247	Y	33	35	31	35	29	35	27	35	25	34	24	34	22	34	21	34	19	33
248		24	25	22	25	21	25	19	25	18	24	17	24	16	24	15	24	14	24
249	Y	32	34	30	33	28	33	26	33	24	33	23	33	21	32	20	32	18	32
250		26	28	25	28	23	28	21	27	20	27	19	27	18	27	16	27	15	27
251	Y	29	31	27	30	25	30	23	30	22	30	21	30	19	29	18	29	17	29
252	Y	30	32	28	32	26	31	24	31	23	31	21	31	20	30	19	30	17	30
253		23	24	22	24	20	24	19	24	17	24	16	24	15	23	14	23	13	23
254		22	23	21	23	19	23	18	23	17	23	16	23	15	22	14	22	13	22
255		23	25	22	25	20	24	19	24	18	24	17	24	16	24	14	24	13	23
256		37	40	35	39	32	39	30	39	28	38	27	38	25	38	23	38	21	37
257		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
258		25	26	23	26	21	26	20	26	19	25	18	25	16	25	15	25	14	25
259		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
260		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
261		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
262		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
263		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
264		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
265		30	32	28	31	26	31	24	31	23	31	21	31	20	30	18	30	17	30
266		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
267		29	31	27	30	25	30	23	30	22	30	21	30	19	29	18	29	17	29
268		27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	27	16	27
269		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
270		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
271		30	32	28	32	26	32	24	32	23	31	22	31	20	31	19	31	17	30
272		27	29	25	29	24	28	22	28	21	28	19	28	18	28	17	27	16	27
273		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
274		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	Y	24	26	23	26	21	25	20	25	18	25	17	25	16	25	15	25	14	24
276	Y	34	36	32	36	29	35	27	35	26	35	24	35	23	34	21	34	19	34
277	Y	35	37	33	37	30	36	28	36	26	36	25	36	23	35	21	35	20	35
278	Y	37	39	34	39	32	38	30	38	28	38	26	38	24	37	23	37	21	37
279	Y	47	50	44	50	41	49	38	49	36	49	34	48	31	48	29	48	27	47
280	Y	36	38	33	37	31	37	29	37	27	37	25	36	24	36	22	36	20	36
281	Y	34	36	32	36	29	35	27	35	26	35	24	35	22	34	21	34	19	34
282	Y	32	34	30	33	28	33	26	33	24	33	23	32	21	32	20	32	18	32
283		28	30	27	30	25	30	23	30	22	29	20	29	19	29	18	29	16	29
284		31	33	29	33	27	33	25	32	24	32	22	32	21	32	19	32	18	31
285		35	37	33	37	31	37	28	37	27	36	25	36	23	36	22	36	20	35
286		34	36	32	36	30	36	28	36	26	35	24	35	23	35	21	35	20	35
287	Y	29	31	27	30	25	30	23	30	22	30	21	30	19	29	18	29	17	29
288	Y	31	33	29	33	27	33	25	32	24	32	22	32	21	32	19	32	18	31
289	Y	35	37	33	37	30	37	28	36	27	36	25	36	23	36	22	35	20	35
290	Y	26	28	24	27	23	27	21	27	20	27	19	27	17	27	16	26	15	26

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m3 Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012																	
		2012		2013		2014		2015		2016		2017		2018		2019		2020	
291		39	41	37	41	34	41	32	41	30	40	28	40	26	40	24	40	22	39

Table 10 – Future Years projections (2012-2020) NO_2 Annual Mean Concentrations

Using both methods to project forwards to 2020 it is clear that whilst the LAQM.TG(09) method indicates full compliance with the annual mean objective being seen as early as 2016, using the revised April 2012 method, paints a totally different picture, as in 2020, widespread exceedences remain, together with indications that additional numerous sites would still exhibit the potential to exceed the annual mean objective. It is thought that the April 2012 method may well paint a more realistic picture.

Given the above, it is reasonable to assume that widespread exceedences of the nitrogen dioxide annual mean objective will continue to be seen even during 2020.

2.2.4 Particulate Matter PM_{10}

Thermo PM_{10} FDMS system were installed at all 3 sites (Swansea AURN, Morfa and Morriston Groundhogs), during part of 2011 providing equivalency with the EU reference gravimetric method[18]. As mentioned previously above, the Morfa Groundhog was decommissioned during early 2011. However, significant issues have arisen with the operation of the FDMS units at the Swansea AURN. Despite numerous, costly repairs, data quality and thus data capture were continually being questioned by Bureau Veritas. Following another unsuccessful repair of both the PM_{10} and $PM_{2.5}$ FDMS units at the Swansea AURN they were removed completely from site on the 16th November 2011 and replaced with Met One BAM 1020 PM_{10} and $PM_{2.5}$ units on the 28th November 2011.

The FDMS units provide hourly integration data and have all been configured as per DEFRA's FDMS parameter protocol (as amended during February 2008). The RS232 port on the FDMS control unit allows the collection of up to 8 parameters via telemetry. The parameters collected from the FDMS units are: Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. The PM_{10} mass concentration is obtained via post processing of the volatile and non volatile mass parameters by creating a calculated channel within the database to subtract volatile mass from the non volatile mass.

The Met One Bam 1020 PM_{10} has taken part in UK equivalency trials and has been deemed to be compliant with the EU reference gravimetric method subject to the application of a 1.211 offset. Each hour, a small 14C (carbon-14) element emits a constant source of high-energy electrons (known as beta rays) through a spot of clean filter tape. These beta rays are detected and counted by a sensitive scintillation detector to determine a zero reading. The BAM-1020 automatically advances this spot of tape to the sample nozzle, where a vacuum pump then pulls a measured and controlled amount of dust-laden air (16.7l/min) through the filter tape, loading it with ambient dust. At the end of the hour this dirty spot is placed back between the beta source and the detector thereby causing an attenuation of the beta ray signal which

[17] DEFRA and devolved administrations report UK Equivalence Program for Monitoring of Particulate Matter section 5.5.2 dated 5th June 2006 at http://www.airquality.co.uk/archive/reports/cat05/0606130952_UKPMEquivalence.pdf

is used to determine the mass of the particulate matter on the filter tape and the volumetric concentration of particulate matter in ambient air.

Data collected from the FDMS units and BAM 1020 PM_{10} units have an integration period of 1-hour. Hourly ratified Particulate Matter PM_{10} data for 2011 has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector for the Swansea AURN and via the Welsh Air Quality Forum ratified datasets at http://www.welshairquality.co.uk/data_and_statistics.php for the Morriston Groundhog site. Since the Welsh Assembly Government awarded the contract to run the Welsh Air Quality Forum to AEA Energy and Environment in April 2004, all FDMS equipment on site is fully audited yearly by AEA Energy and Environment. As part of the service and maintenance contract with Enviro Technology Services Plc, each dryer unit was replaced annually until 2010 but due to budget restraints this has now ceased. Dryer units are now only replaced as and when they fail.

These hourly data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present.[19]

The datasets collected from the FDMS / Met One BAM PM_{10} systems are not directly comparable to the historical R&P PM_{10}TEOM datasets even given that the use of the advised interim default correction factor (1.3) was advised to estimate the EU reference gravimetric method. This correction factor has been called into dispute by various studies at diverse locations throughout the UK each deriving differing correction factors. TEOM PM_{10} data since 2006 has not therefore been included within table 11. These TEOM PM_{10} data pre 2006 have last been reported within the authorities Progress Report during May 2008. It is not proposed to use the Volatile Correction Model for TEOM analysers developed by Kings College to “correct” the historical (2001-2006) R&P PM_{10}TEOM datasets at the Morfa and Morriston stations within this report. The date that the PM_{10} FDMS systems were installed/removed from

[19] *LAQM.TG(09) Annexe 1- Monitoring A1.216 page A1-48*

the Swansea AURN site are given below table 11 for information. Similarly, the date of provision of the BAM1020 units at the Swansea AURN is also provided for information and clarity on the instrument composition of this dataset.

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2007 %	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Data Capture 2011 %	Annual mean concentrations (µg/m³)				
								2007	2008	2009	2010	2011
1 *	Swansea AURN	Y	**82.2**	98.4	97.53	98.63	**62.19**	**18.29**	**17.49**	**17.19**	**15.79**	**14.70**
2 **	Morfa Groundhog	Y	**86.8**	**50.0**	**54.25**	**65.48**	**-**	**27**	**29.34**	**30.41**	**20.06**	**-**
3 ***	Morriston Groundhog	N	**79.5**	**60.1**	90.68	**78.36**	**81.64**	**21.56**	**23.46**	**22.53**	**18.67**	**17.96**

Table 11 Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean Objective

* FDMS unit installed 26th September 2006. FDMS units removed 16th November 2011. Met One BAM 1020 unit installed 28th November 2011

** FDMS unit installed 28th November 2006. Site decommissioned May 2011

*** FDMS unit installed 27th October 2006

Site ID	Location	Within AQMA	Data Capture 2007 %	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Data Capture 2011 %	Number of Exceedences of 24-hour mean (50 µg/m³)				
								2007	2008	2009	2010	2011
1	Swansea AURN	Y	**82.2**	98.4	97.53	98.63	**62.19**	7 **(32.5)**	6	4	0	5 **(29.8)**
2	Morfa Groundhog	Y	**86.8**	**50.0**	**54.25**	**65.48**	**-**	22 **(45.6)**	15 **(45.8)**	14 **(45.1)**	1 **(30.5)**	-
3	Morriston Groundhog	N	**79.5**	**60.1**	90.68	**78.36**	**81.64**	8 **(33.1)**	11 **(37.2)**	6	1 **(29.6)**	**8 (30.3)**

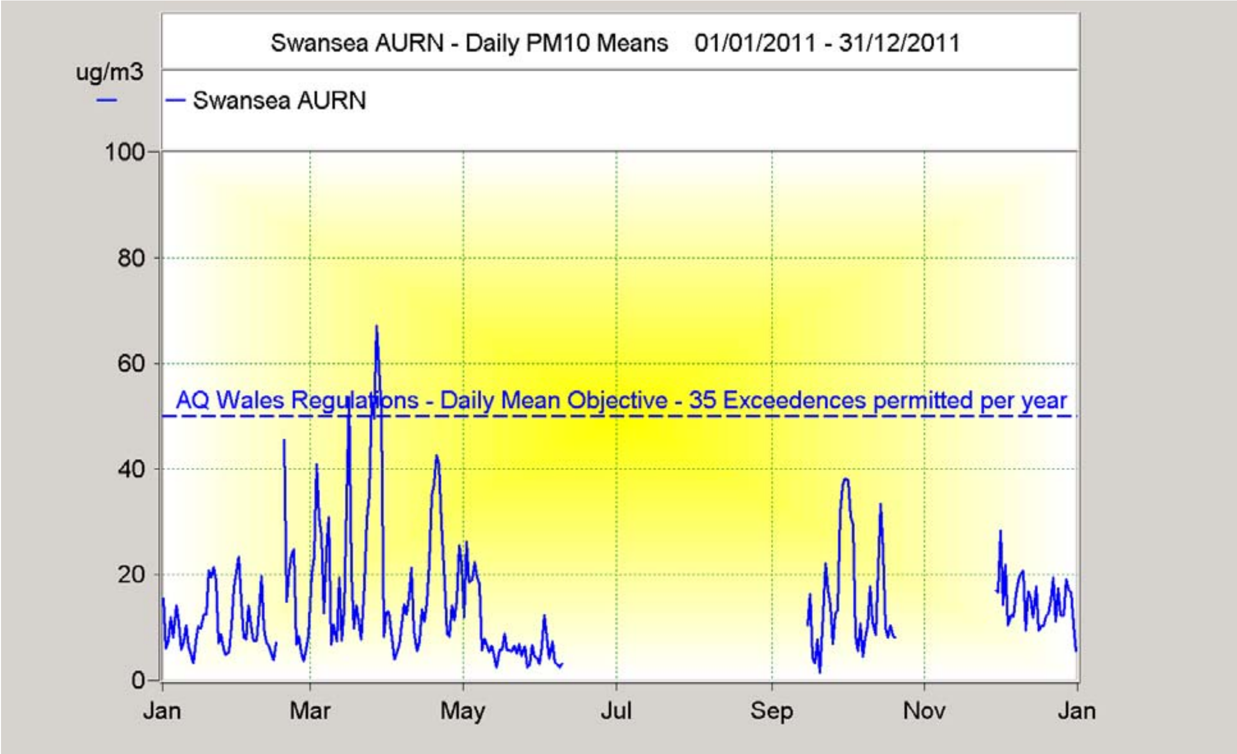
Table 12 Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

The 90th percentile's of the daily means of measurements made during 2007-2011 are presented in bold within brackets in table 12 where appropriate, as the data capture rates fall below the required 90%[20] due to the problematic FDMS installations at the Swansea AURN and Morriston Groundhog sites. There have been numerous problems since the installation of the Thermo Inc FDMS PM_{10} analysers at all 3 sites during late 2006, resulting in significant periods of data loss. These issues have been both costly and time consuming to rectify. Problems have ranged from the inability to gain a stable frequency response within the tuner board, corruption of the software within the control unit, status error codes due to ice within the chiller unit, to complete sensor unit failures. These issues have extended over the whole period of operation but as the introduction of FDMS units has increased within the UK National AURN Network, additional problems have been identified with their routine operation. Extensive problems remain with the operation of the FDMS units within the Swansea

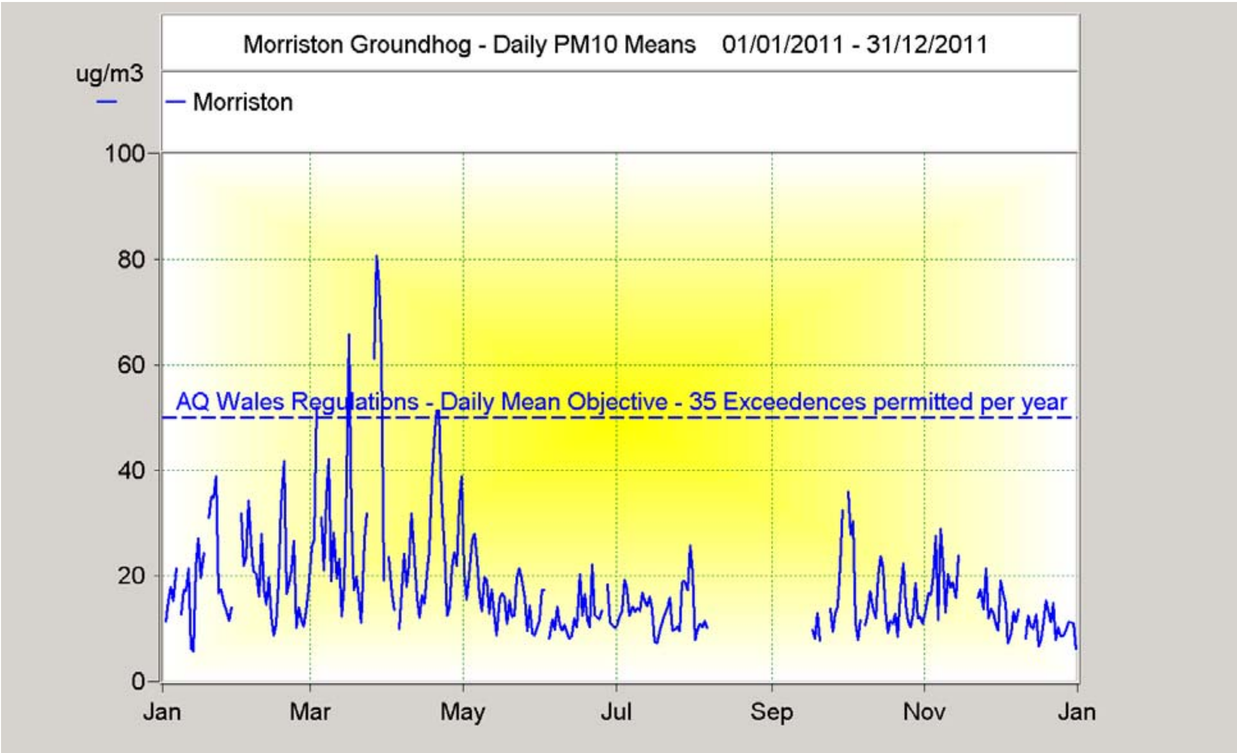
[20] LAQM TG(09) Annexe A1 – A1.157 page A1-34

Network as can be seem from the data capture rates above in tables 11 and 12. The volatile data from the Morfa FDMS unit was queried during 2009 and again during 2010 due to very erratic measurements being seen. These data were consistently greater than at the other two FDMS PM_{10} stations within Swansea and therefore the calculated mass concentration being seen was consistently on average 20ug/m^3 above that seen at either the Swansea AURN or Morriston units. This effect can be seen within the annual means reported within table 12 above. No fault could be traced by the service engineers during numerous visits to the site. It was not until the Welsh Air Quality Forum QA/QC audit during March 2010 identified a leak, that the problem was then identified and resolved. This single incident led to data being rejected from the 11th August 2009 to 7th April 2010. Problems continued with the reliability of the FDMS units throughout 2011 with yet more data being rejected resulting in significant data loss – during 2011 the Swansea AURN units (both $PM_{2.5}$ and PM_{10}) saw significant data loss which ultimately drove the decision to replace the units during November 2011 with MetOne BAM1020 units. It is the intention to replace the FDMS unit at the Morriston Groundhog site once budgets permit. No decision has been made with regard to the relocation of the Morfa Groundhog unit as yet, as again, this is driven by budgetary issues.

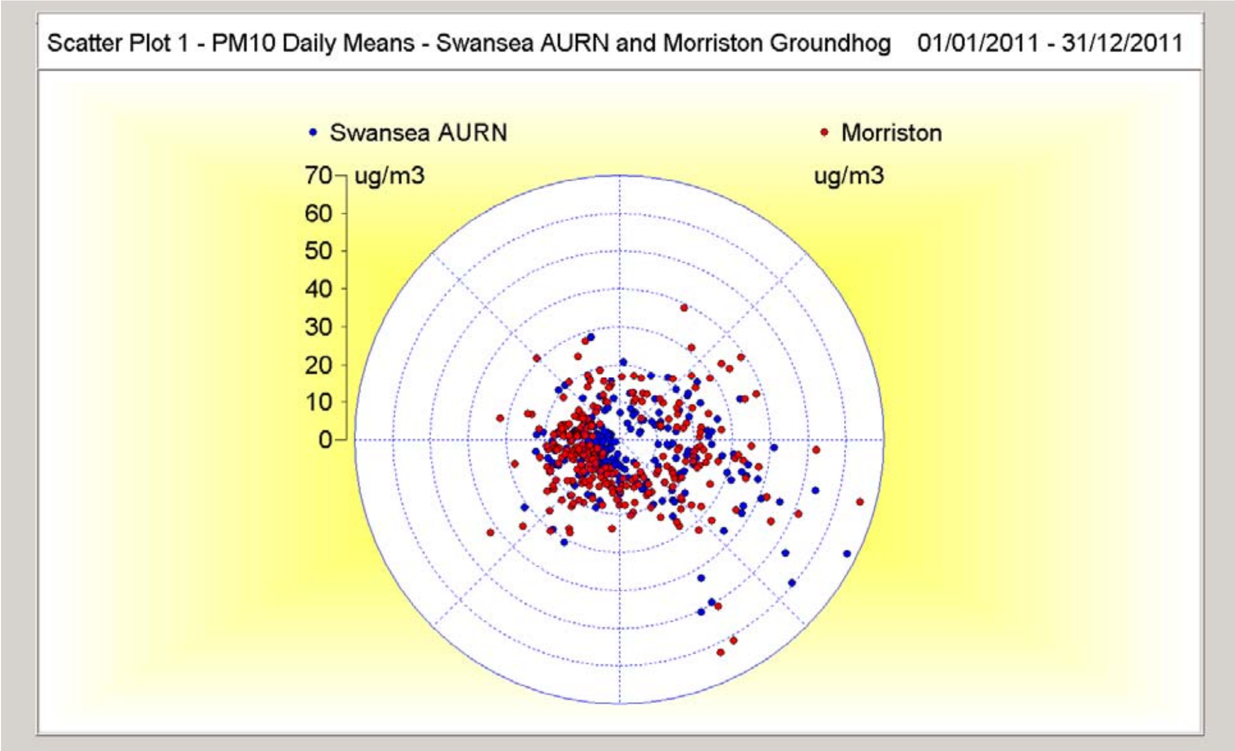
Graphs 7 and 8 below indicate the monitoring undertaken during 2011 with scatter plot 1 summarising the period of measurement.



Graph 7 – Swansea AURN 24-hour PM_{10} concentrations 2011
* FDMS units removed 16th November 2011. Met One BAM 1020 unit installed 28th November 2011

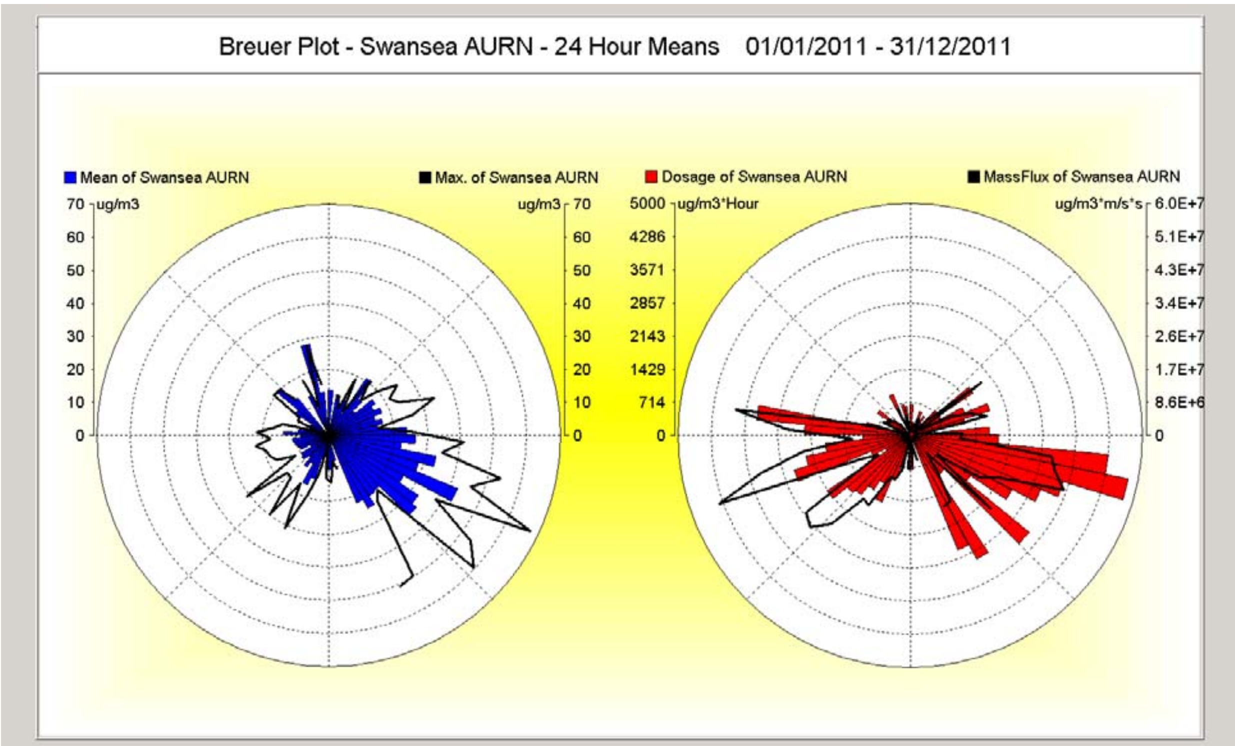


Graph 8 – Morriston Groundhog 24-hour PM_{10} (FDMS) concentrations 2011



Scatter Plot 1 – PM_{10} daily Means 2011

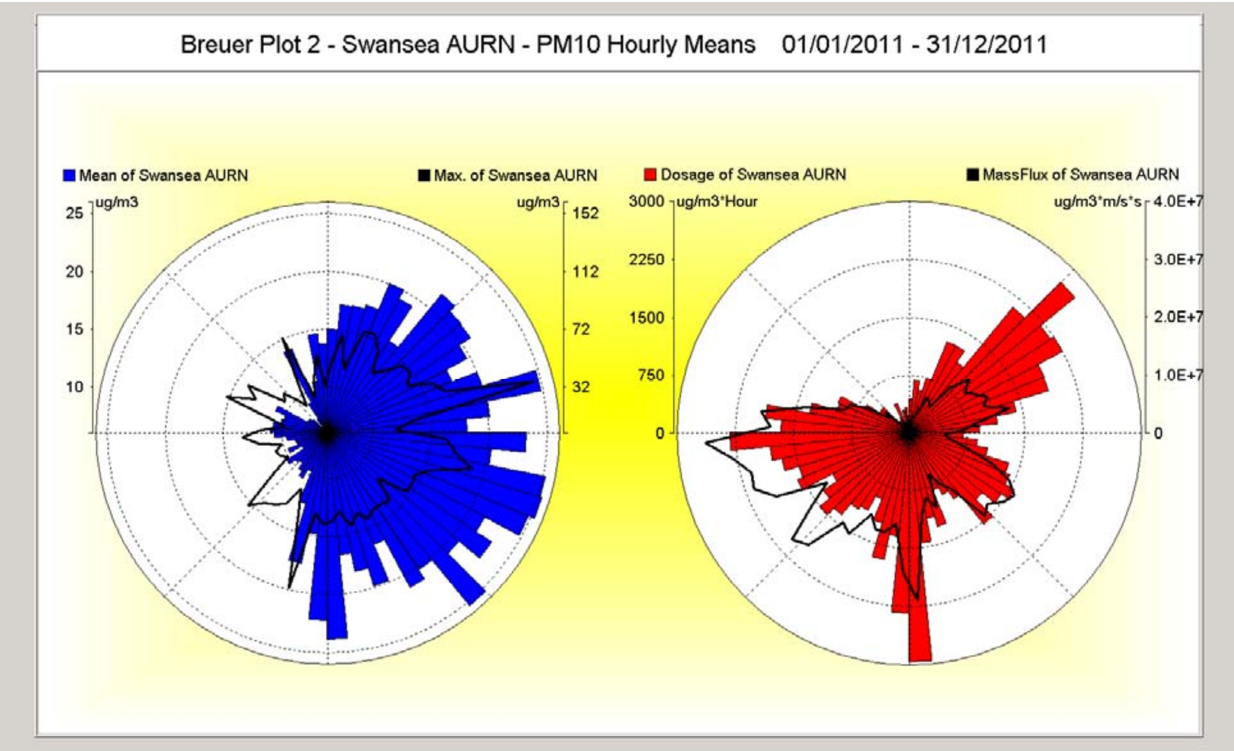
As has been seen during previous year (although this was not evident during 2010) there is a noticeable trend during 2011 for elevated concentrations to emanate from a south-easterly direction. The Corus steelworks is located in a south-easterly direction across Swansea Bay at Port Talbot.



Breuer Plot 1 – Swansea AURN – PM_{10} Daily Means 2011

Breuer Plot 1 above reinforces that daily mean concentrations with associated maximum concentrations emanate from a south-easterly direction. Dosage is taken to be the accumulated time multiplied with the average value of PM_{10}. This is useful for calculations of likely exposure at these locations. Mass Flux is also indicated and is taken to be: Flux - the wind speed multiplied with the operand distributed over the wind direction. All data that has valid integrated data for all three positions are included in this calculation. (Note: The average distributed wind speed and the average distributed parameter [PM_{10}] are not used to calculate the result). The result is presented in the multiplied units of the wind speed and the parameter (PM_{10}). Mass flux is the same as flux, but the result is multiplied with the accumulated integration time. This gives the mass transport in different directions.

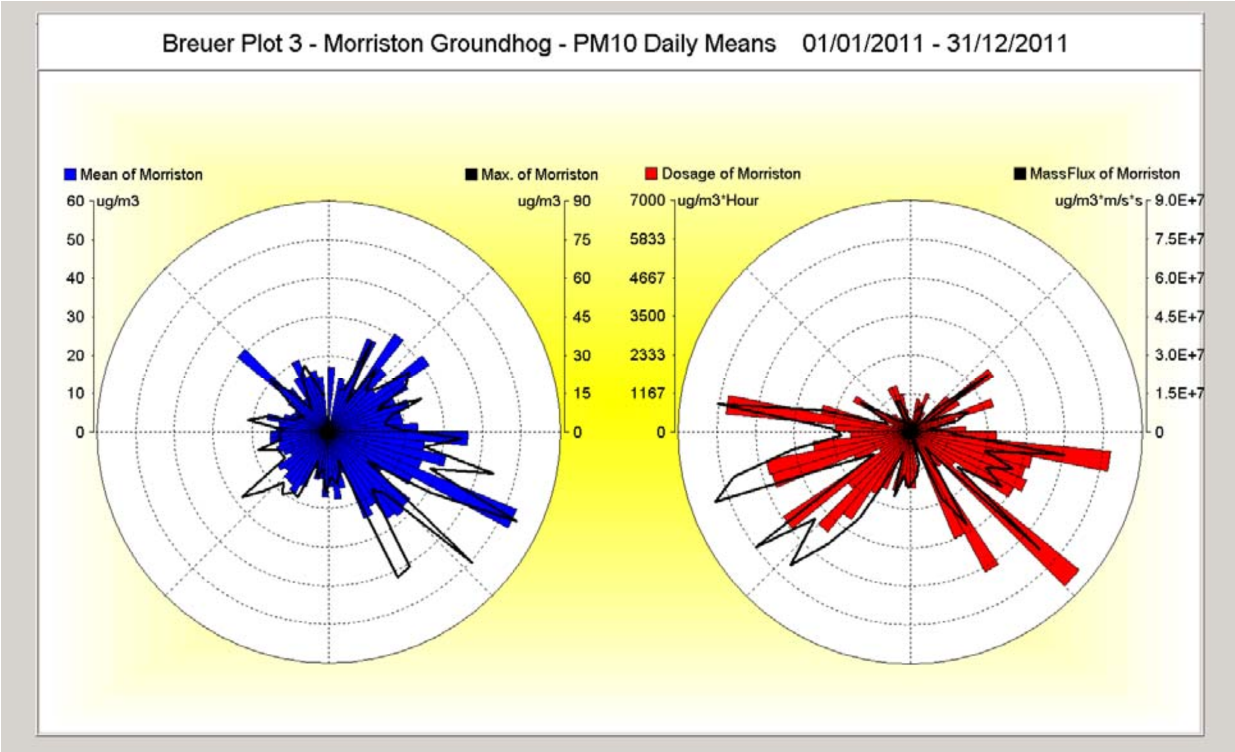
Breuer Plot 2 below presents the hourly mean concentrations at the Swansea AURN.



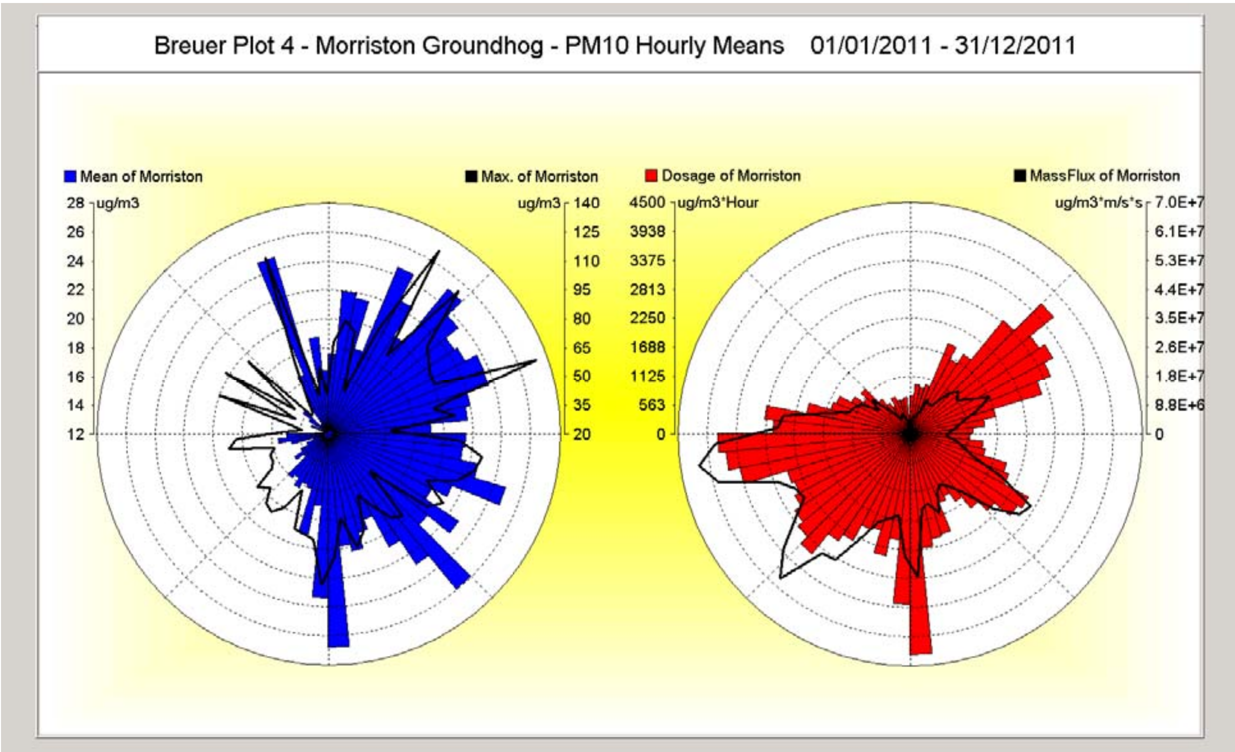
Breuer Plot 2 – Swansea AURN – PM_{10} Hourly Means 2011

From Breuer Plot 2 it is evident that whilst the means/maximum hourly concentrations emanate predominantly from an easterly direction that dosage and mass flux probably reflect more local sources/influences.

Breuer Plots 3 and 4 below represent an identical analysis and conclusion undertaken with data from the Morriston Groundhog for 2011.



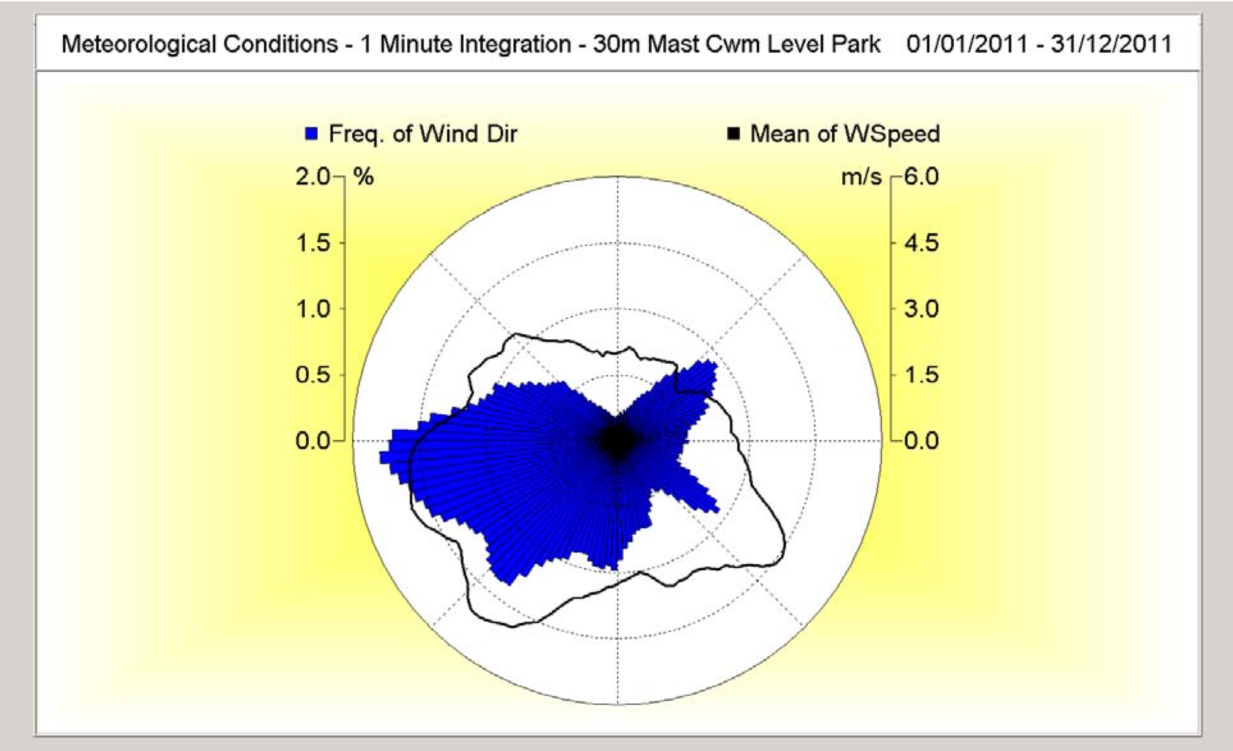
Breuer Plot 3 – PM_{10} Daily Means – Morriston Groundhog 2011



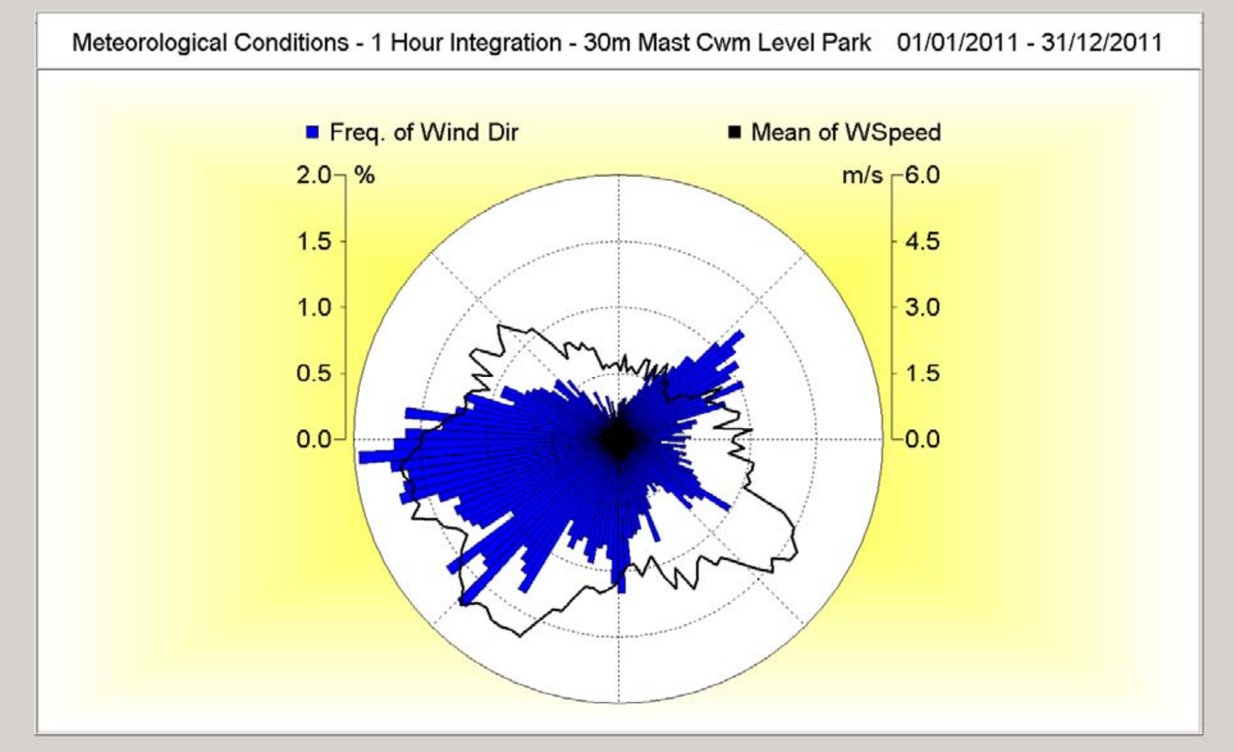
Breuer Plot 4 – PM_{10} Hourly Means – Morriston Groundhog 2011

The week of 21st March 2011 - 30th March 2011 saw elevated PM_{10} levels across Swansea and Wales/UK. Back trajectory calculations undertaken by AEA Energy and Environment showed the air mass origin from Eastern Europe. PM_{10} concentrations remained above 50ug/m^3 for several days as can be seen within graphs 7 and 8 above. Concentrations were washed out with rainfall that started at approx 1-2am/early morning of the 30/3/2011 with PM_{10} concentrations returning to "background" levels shortly after.

Breuer Plots 5 and 6 below indicate meteorological conditions observed at the 30m Meteorological Mast at Cwm Level Park. Data is presented at 1 minute integration within Breuer Plot 5 and at 1 hour integration within Breuer Plot 6. This site is within the lower Swansea Valley and is highly representative of conditions throughout Swansea.



Breuer Plot 5 – Meteorological Conditions – 1 Minute Integration – 30m Meteorological Mast Cwm Level Park 2011



Breuer Plot 6 – Meteorological Conditions – 1 Hour Integration – 30m Meteorological Mast Cwm Level Park 2011

From Breuer Plots 5 and 6 it can be seen that 2011 can be considered meteorology as a typical or "normal" year with the wind direction being from a predominantly south-westerly direction. There is, once again, normally during winter months, periods of north-easterly winds. Examination of the meteorological conditions at the Cwm Level Mast for 2010 and reported within the Progress Report 2011 indicated atypical conditions in that there was a predominantly north-easterly influence.

Meteorological conditions represented within Breuer Plots 5 and 6 help explain the dosage and mass flux plots within Breuer Plots 2 and 4 above.

As mentioned above, there is heavy industry located to the south east of Swansea Bay in the form of the Tata Steelworks at Port Talbot. This has been the traditional dominant source of localised and directionally apportioned PM_{10} seen within Swansea since measurement of PM_{10} commenced during the late 1990's. This influence can be seen during 2011 within the Scatter and Breuer Plots above.

As can be seen from tables 11 and 12 above, **no exceedences of the annual mean objective** were seen at any of the monitoring stations. Similarly, **no breach of the 35 permitted exceedences of the 24 hour objective** was seen, **nor, where data**

capture was below 90% did the 90th percentile (given in brackets after the number of exceedences) **exceed 50ug/m3**.

LAQM.TG(09) provides a method to project measured annual mean roadside PM_{10} concentrations to future years[21]. Using this method, the following future year projections for 2015 and 2020 are presented below within table 13. In order to reach the final calculation, the following steps were taken: All steps were undertaken using the latest download data files from http://laqm.defra.gov.uk/maps/maps2010.html

Steps 1-4	Measured 2011 Conc.	2010 Background Conc.	2011 Local Road Contribution	Road Cont 2015	Road Cont 2020
Swansea AURN	14.7	14	0.7	0.469408	0.82610
Morriston	17.96	14	3.96	0.357374	0.71702

Step 5	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	0.400098531	0.70412476
Morriston	0.338020629	0.67819211

Step 6	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	0.280068972	0.492887334
Morriston	1.33856169	2.685640758

Site ID	**Location**	**Within AQMA?**	**Measured Annual Mean 2011**	**Future Years Projections**	
				2015	**2020**
1	*Swansea AURN	Y	14.7	12.54	12.29
3	**Morriston Groundhog	N	17.96	13.26	14.15

Table 13 PM_{10} Annual Mean projections

Data capture for 2011* **62.19%
*** Data capture for 2011* **81.64%**

From table 13 it can be seen that from the 2011 annual mean concentrations seen at the various sites that come 2015 or 2020 there is remarkable projected harmony between the projected PM_{10} concentrations. It should be noted that these projections are lower than has been projected within previous reports. It should also be noted

[21] LAQM.TG(09) box 2.2 page 2-5

that these projections are based on data capture rates below the required 90%. Projections for both 2015 and 2020 are for PM_{10} concentrations to remain considerably below the annual mean objective.

The City & County of Swansea facilitated a research study by a group comprising: School of Earth and Ocean Sciences Cardiff University, School of Biosciences Cardiff University, and the Centre for Health and Environment Research, Department of Primary Care and Public Health, Neuadd Meirionydd into ultrafine and nanoparticles using a Dekati™ Electrical Low Pressure Impactor within a street canyon environment. The site chosen for measurements was the Hafod Post Office, Neath Road, Hafod, Swansea. This site is located within the Hafod Air Quality (NO_2) Management Area. **Full details of the study are reproduced with the permission of the group, within Annexe 7. The study confirmed the existence of an early morning diurnal pattern within the ultrafine fraction which appears to match the diurnal NO_2 pattern highlighted above within section 2.2, seemingly confirming the likelihood that traffic is the dominant source for these two pollutants**.

2.2.5 Sulphur Dioxide

There have been major alterations to the authority's network of SO_2 analysers during 2010. These changes have been reported within the authorities Progress Report 2011 but are repeated within this report for clarity. Due to budget restrictions and the knowledge that SO_2 concentrations have remained low for several years with no exceedence of any of the objectives, the decision was made to switch off the Advanced Pollution Instrumentation (API) real-time SO_2 analysers at the Swansea AURN, Morfa and Morriston Groundhog stations.

SO_2 is now only monitored at one location within Swansea - the St.Thomas DOAS (see sec 2.1.7 above). St.Thomas is ideally placed for this monitoring, being in close proximity to Swansea Docks with the Tata Steelworks to the south-east across Swansea Bay. This has been the traditional dominant source of SO_2 seen within Swansea since measurement of SO_2 commenced during the late 1970's.

The derived 15-minute means have been compiled into hourly averages by the software package OPSIS Enviman Reporter. In order to compile a valid hourly mean, a minimum of 3, 15-minute means were specified[22]. Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to calculate both the hourly and 24-hour objectives. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the ratified hourly means were specified to be present[23]

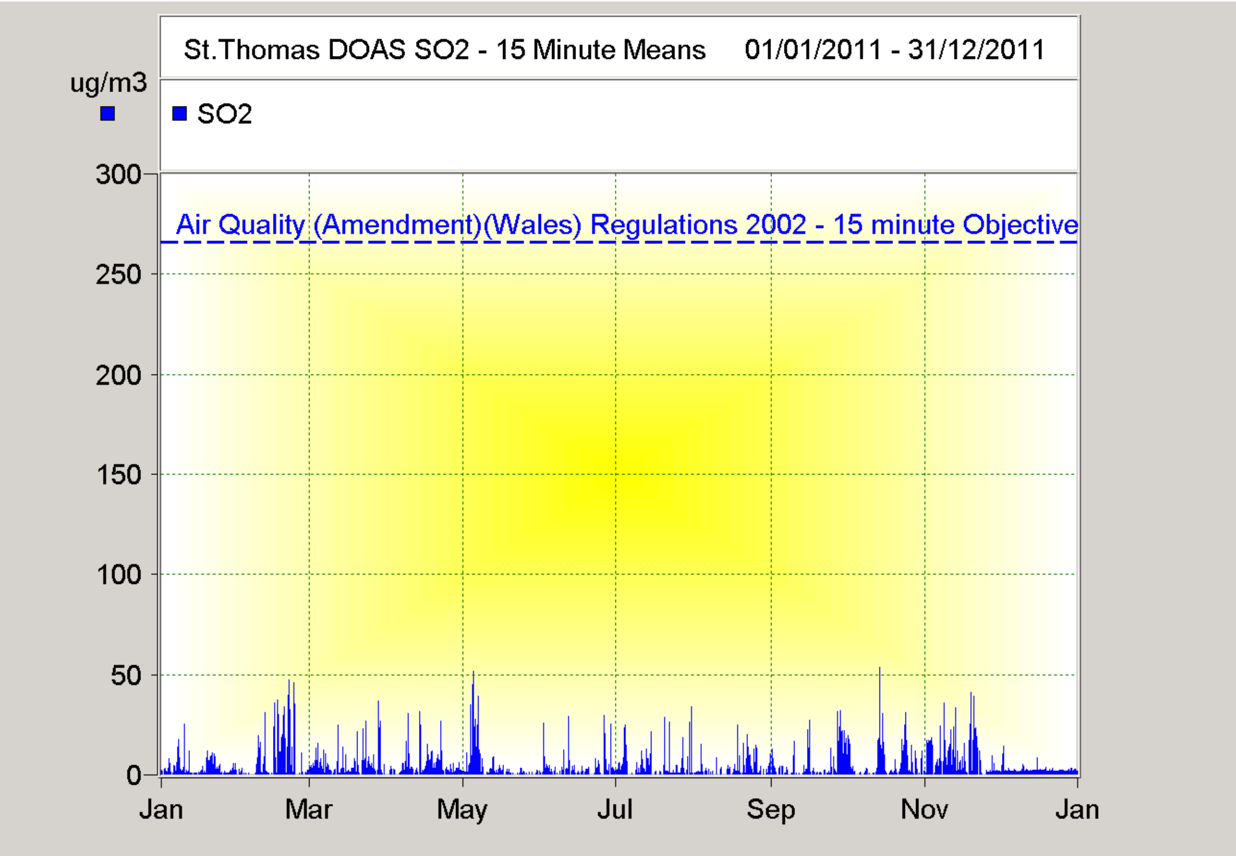
The data capture rates are presented within table 14 and, where applicable, the percentile value corresponding to the objective exceedence value is given should the data capture rate fall below 90%[24]

Graphs 9-11 are presented below, representing time series measurements made during 2011 with the accompanying Breuer plot 7 providing an insight into the more likely source direction.

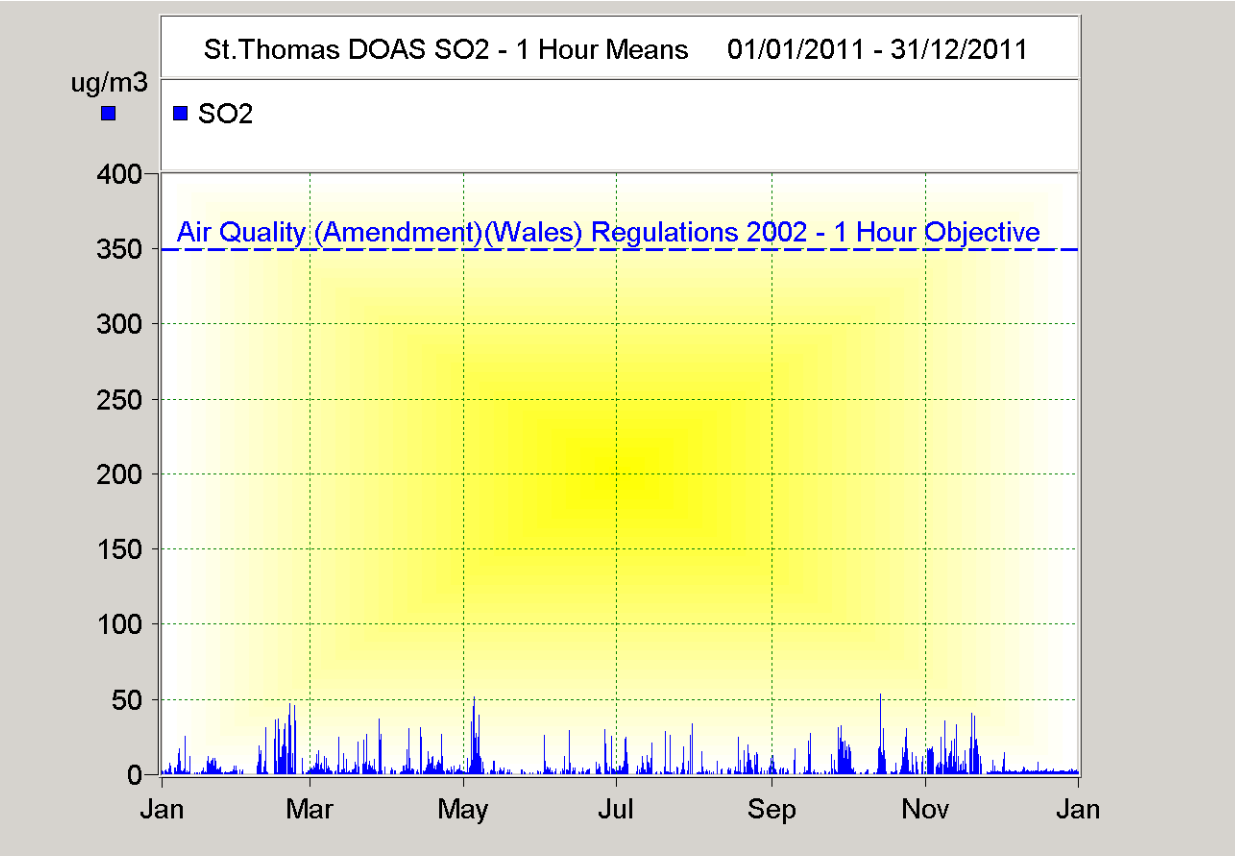
[22] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47
[23] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-48
[24] LAQM TG(09) Annexe A1 – A1.157 page A1-34

St.Thomas DOAS 2011	Max 15-Min Mean µg/m^3 (266µg/m^3)	Max 1-hour Mean µg/m^3 (350µg/m^3)	Max 24-Hour Mean µg/m^3 (125µg/m^3)
Data Capture	92.99%	88.54%	92.33%
Concentration	69.93	53.50	17.25
Exceedences	0	0	0
Date of Max	31st July 2011	14th October 2011	5th May 2011
Time of Max	04:15	09:00	-
2011 Percentiles	15 Minute	1 Hour	24-Hour
99.9th Percentile	N/A	-	-
99.7th Percentile	-	32.64	-
99th Percentile	-	-	N/A

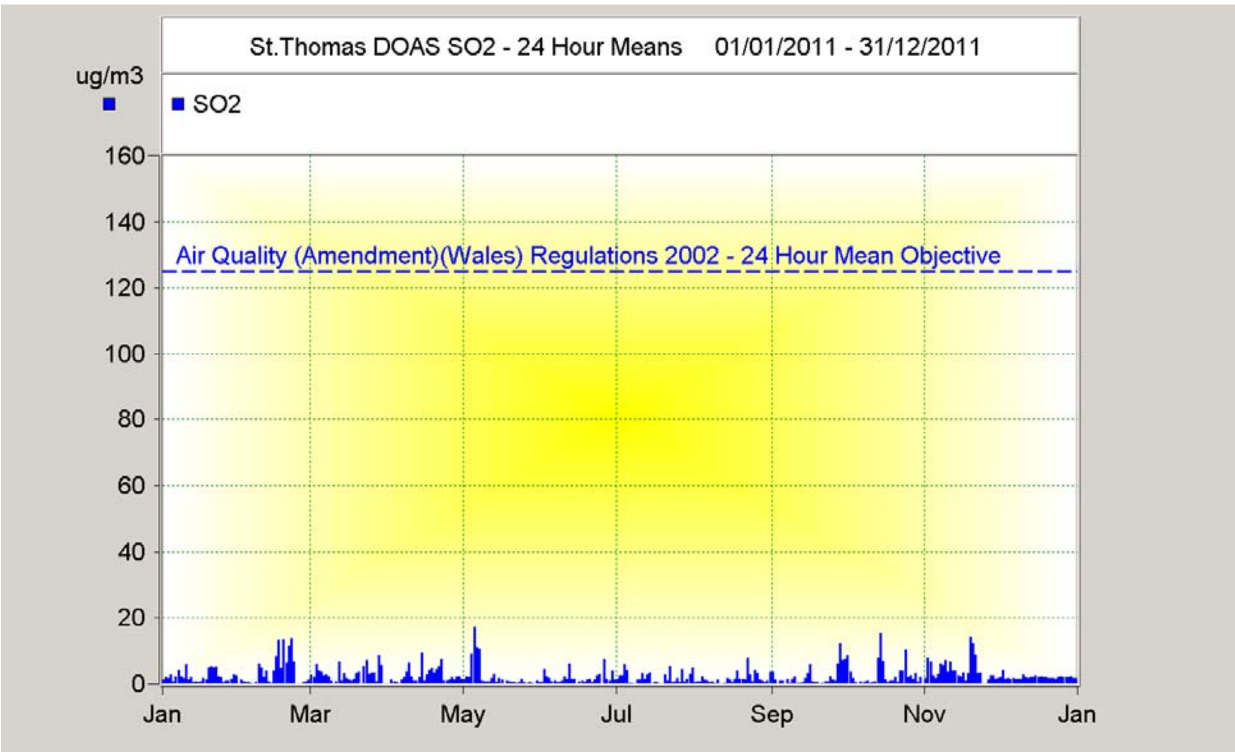
Table 14 – SO_2 Concentrations 2010 St.Thomas DOAS



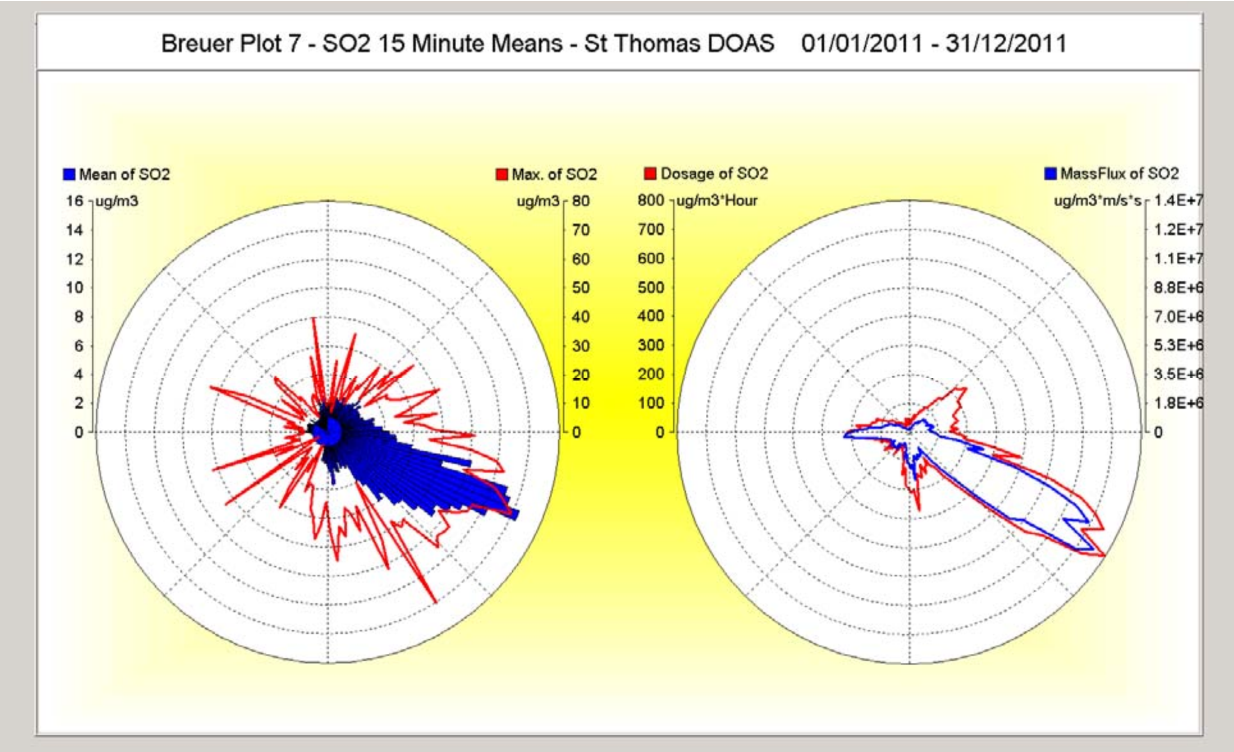
Graph 9 – 15 Minute SO_2 Means – St.Thomas DOAS 2011



Graph 10 – 1 Hour SO_2 Means – St.Thomas DOAS 2011



Graph 11 – 24 Hour SO_2 Means – St.Thomas DOAS 2011



Breuer Plot 7 – 15 Minute SO_2 Data St.Thomas DOAS 2011

From Breuer Plot 7 it is evident that whilst low SO_2 concentrations are seen in Swansea, it is clear that the south-easterly direction still dominates as has been seen during previous years as the source of the measured concentrations. Breuer Plot 7 would seem to suggest that whilst the mean concentrations are dominated by sources to the south-east, that there is likely to be another source to the south-south east which is influencing the maximum concentrations seen. This has also been noted during previous reporting. The St Thomas DOAS station is approximately half a mile from the docks area, (in a more south-south easterly direction) so it would seem likely that the docks activities contribute to maximum concentrations seen. Whilst there may be more local influences, it should be noted that there is heavy industry located to the south east of Swansea Bay in the form of the Tata Steelworks at Port Talbot. This has been the traditional dominant source of SO_2 seen within Swansea since measurement of SO_2 commenced during the late 1970's. From 2011 data this would seem to remain the case and is reinforced by examination of the dosage and Mass Flux plots within Breuer plot 7. Dosage is taken to be the accumulated time multiplied with the average value of SO_2. This is useful for calculations of likely exposure at these locations. Mass Flux is also indicated and is taken to be: Flux - the wind speed multiplied with the operand distributed over the wind direction. All data that has valid integrated data for all three positions are included in this calculation. (Note: The average distributed wind speed and the average distributed parameter [SO_2] are not used to calculate the result). The result is presented in the multiplied units of the wind speed and the parameter (SO_2). Mass flux is the same as flux, but the result is multiplied with the accumulated integration time. This gives the mass transport in different directions.

2.2.6 Benzene

Benzene is measured in real-time at two roadside sites in Swansea with Opsis DOAS instruments. Sections 2.1.6 and 2.1.7 above outline the systems in operation at the Hafod (along Neath Road) and at St.Thomas (Pentreguinea Road) sites.

Annual means for benzene and the underlying data capture for 2008-2011 are provided below within table 15.

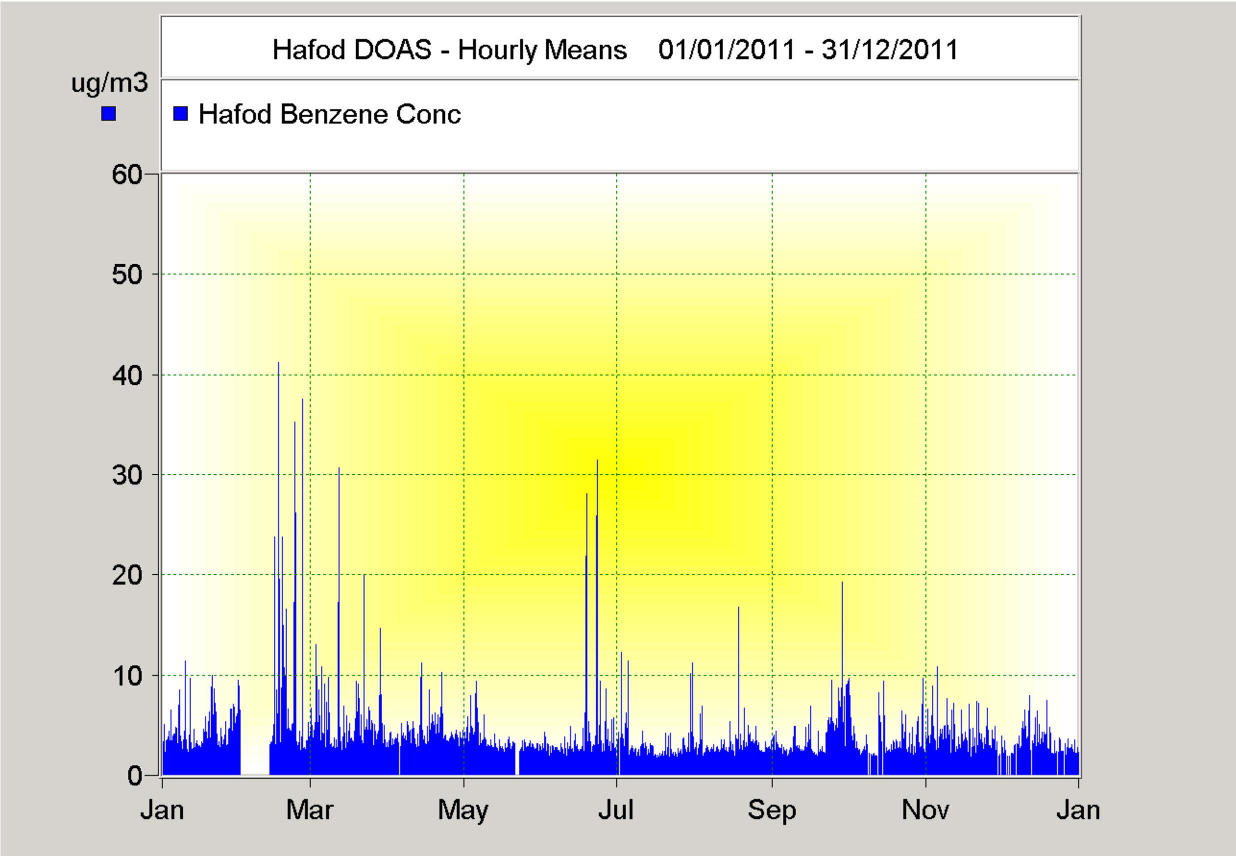
Site ID (see table 2 above)	Location	Within AQMA	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Data Capture 2011 %	Annual mean concentrations (µg/m³)			
							2008	2009	2010	2011
5	Hafod DOAS	Y	**35%**	98%	**76.7%**	**75.2%**	2.28	1.88	3.69	3.10
6	St.Thomas DOAS	N	96%	**88%**	**80%**	**81.7%**	2.52	1.81	3.58	3.09

Table 15 Benzene annual means 2008-2011

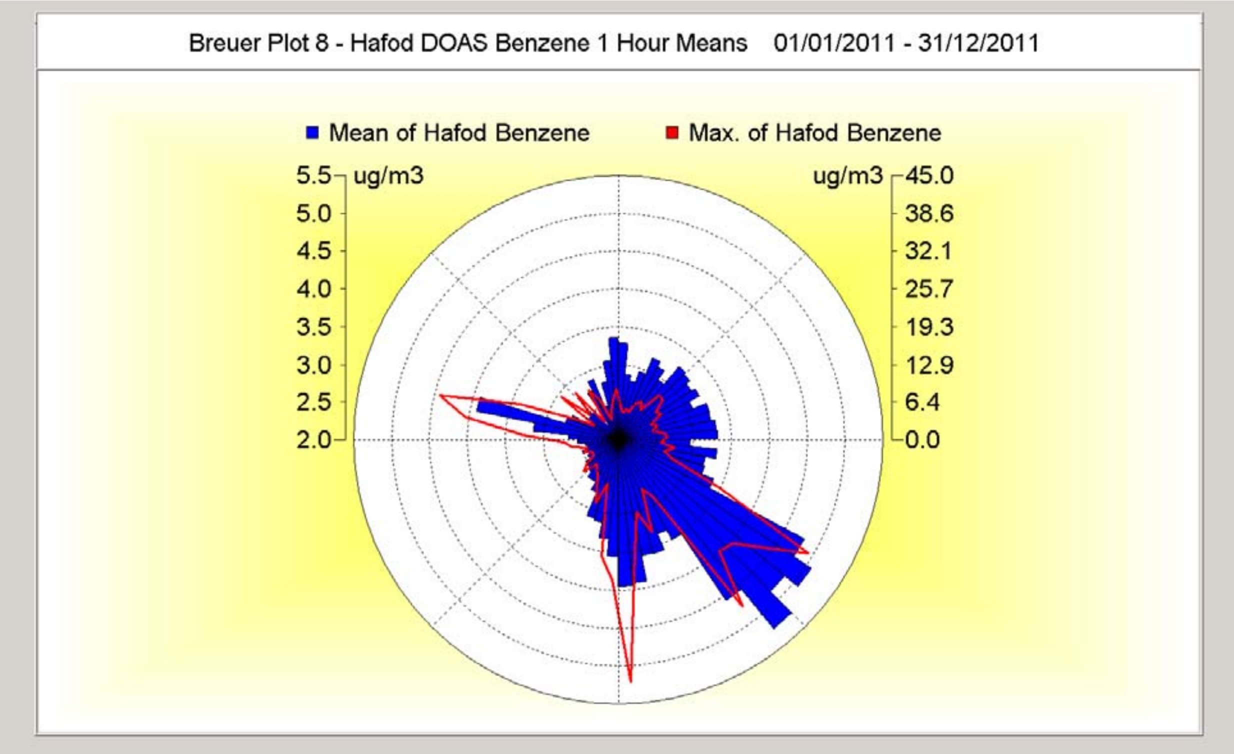
Significant data has been lost at these sites in previous years due to operational issues and also building renovation works in the case of the Hafod site. Analysis of the data for 2011 has once again produced data capture rates below the recommended 90%. However, this can partly be explained by the validation rules outlined within sections 2.1.6 – 2.1.7 together with some periods of measurement cycles being close to the “limit of detection” resulting in a high standard deviation of the measurement and thus rejection if the standard deviation is more than twice the concentration measured.

Graphs 13 and 14 below illustrate some exceptionally high hourly “spikes” of benzene throughout the year for short periods of time at both sites, and importantly at the same time, indicating a likelihood of the same source.

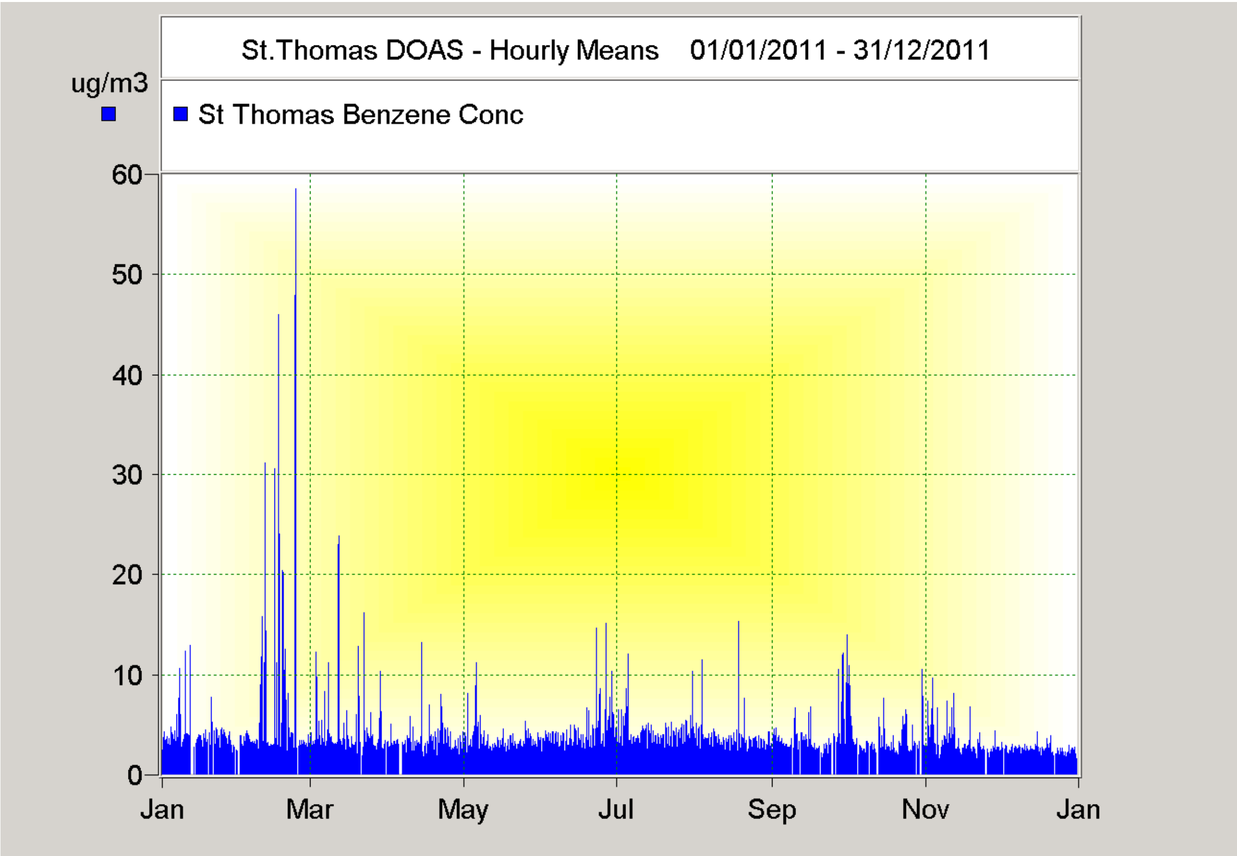
Both sites show a reduction in annual mean concentrations over those reported for 2010 and concentrations continue to remain below the annual mean objective level of 5µg/m^3. It is thought that the annual mean concentrations returned for 2010 were influenced by the atypical meteorological conditions experienced during 2010, particularly during the early winter months of late 2010. However, it is thought that 2011 exhibited typical meteorological conditions and that this has been reflected within the returned annual mean concentrations. Interestingly, if charts 10 and 11 above for the St Thomas DOAS SO_2 (15 minute and hourly means) are examined, the cluster of benzene spikes during mid to late February within charts 13 and 14 below correlate to a cluster of SO_2 spikes during the same time period.



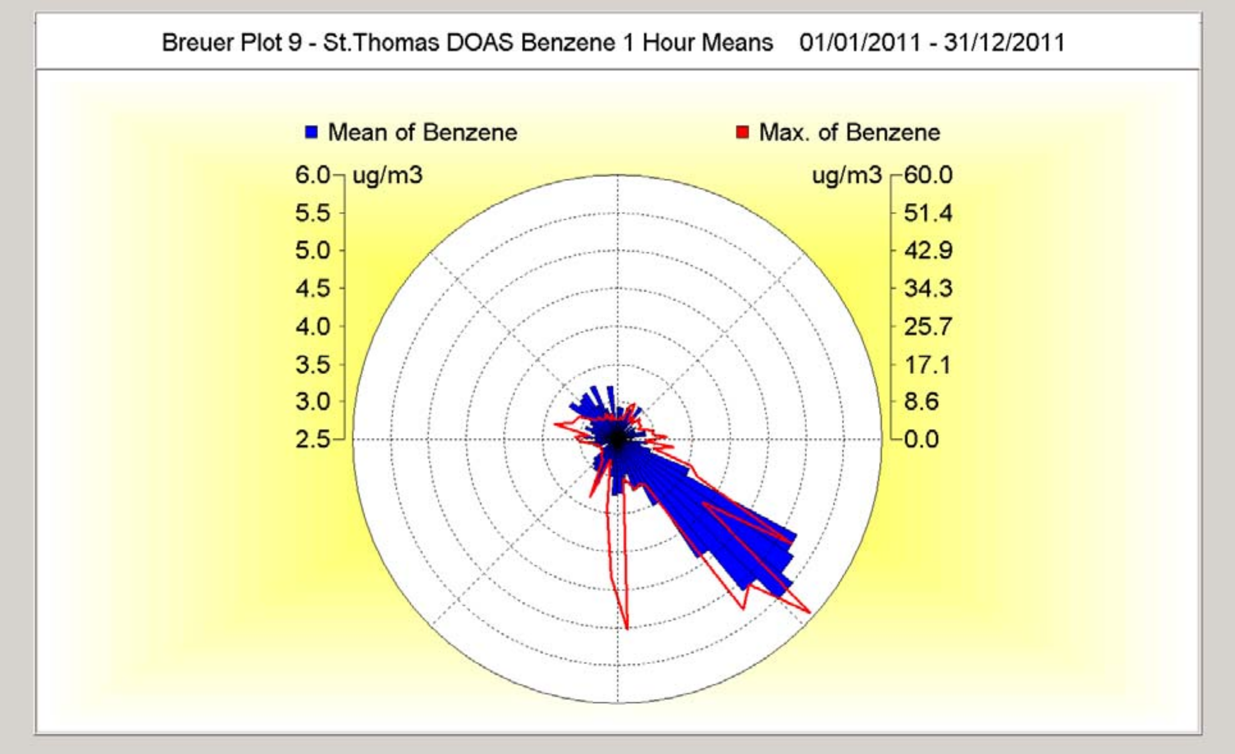
Graph 13 – Hourly benzene concentrations Hafod DOAS 2011



Breuer Plot 8 Hafod DOAS 1-Hour Benzene Means 2011



Graph 14 – Hourly benzene concentrations St.Thomas DOAS 2011



Breuer Plot 9 St.Thomas DOAS 1-Hour Benzene Means 2011

Breuer Plot 8 above indicates three primary directions of sources for benzene concentrations during 2011. The more dominant source is from the south east and this is more probably associated with emissions from the heavy industry to the east of Swansea Bay. Also shown is the source to the south/south east which is thought to be from industry within Swansea Docks. However, within Breuer Plot 8 an additional source is indicated from the North West. These concentrations from the North-West are atypical of what would normally be expected, but during June 2011 there was a major tyre fire within the Fforestfach area of Swansea that took several weeks to extinguish. There were approximately 8,000 tonnes of shredded tyre flock within a former factory unit that combusted. During the management of the incident, high hourly concentrations of benzene were reported to both Gold Command as well as colleagues within the Health Protection Agency and Environment Agency.

Breuer Plot 9 from St Thomas indicates both the primary source to the south-east as well as the influence from the southerly/south east, thought to be the Swansea Docks area. The influence from the Fforestfach fire mentioned above is visible but is of much less significance at the St Thomas site.

From table 15 above it can be seen that no annual mean exceeds 5ug/m^3 at either site and compliance is, therefore, being achieved at both sites.

2.3 Other pollutants monitored

The authority has previously monitored additional pollutants (carbon monoxide and ozone) at the majority of the automatic sites. However, due to the financial restraints that the authority is now operating under, all carbon monoxide monitoring has ceased at the Swansea AURN, and Morriston Groundhog sites, resulting in no roadside carbon monoxide monitoring being undertaken within Swansea since 2009. Ozone monitoring ceased at the Swansea AURN site on the 27th November 2008 with the analyser being transferred to the Cwm Level Park monitoring site following the reorganisation of the UK Network. Ozone also continues to be measured at the Morriston Groundhog and the Hafod and St Thomas DOAS sites. Lastly, $PM_{2.5}$ is measured at the Swansea AURN Roadside station by way of the Thermo TEOM FDMS system (co-located with Thermo TEOM FDMS PM_{10}) until November 2011 when due to continued operational issues the FDMS systems were replaced with Met One Bam 1020 units.

In addition, the authority participate in the UK Heavy Metals Monitoring Network with The Department of the Environment, Transport and the Regions (DETR) monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes. The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale Europe being located within the authority's area at Clydach. Further details and information can be found within section 2.1.10. The analysed parameters are: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Magnesium (Mn), Nickel (Ni), Lead (Pb), Platinum (Pt), Vanadium (V), Zinc (Zn) and Mercury (Hg).

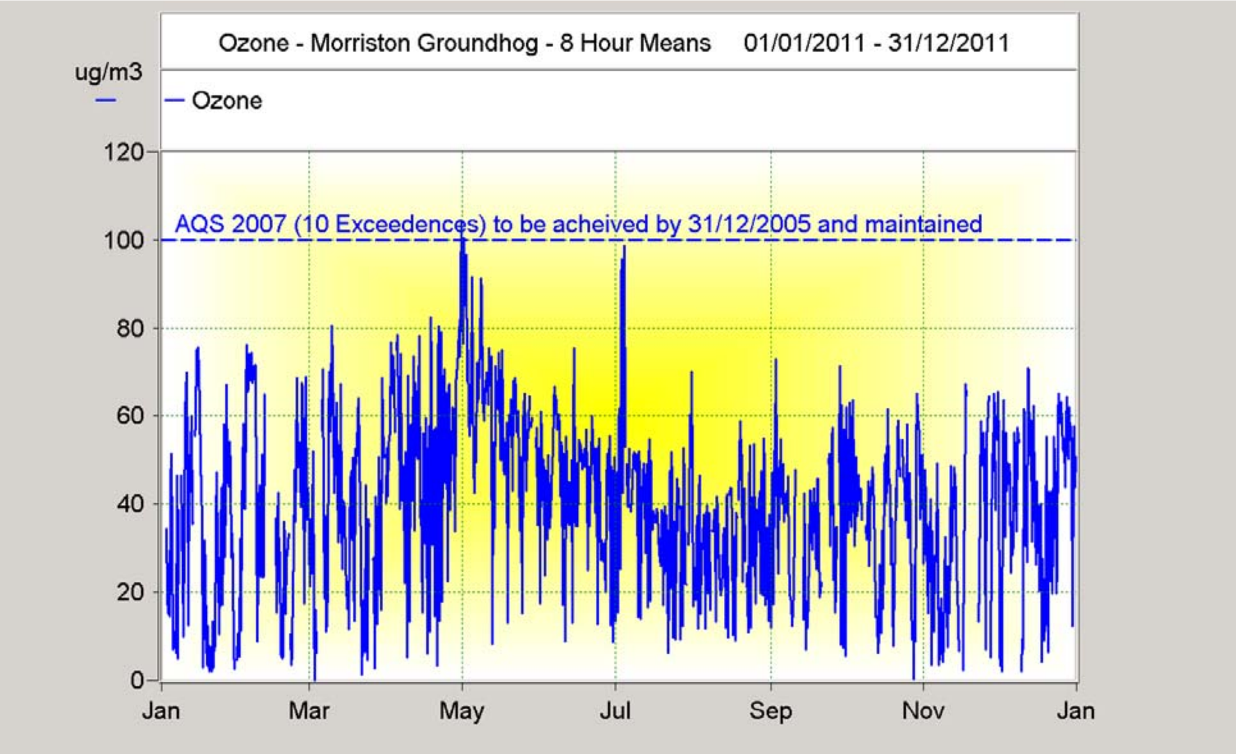
2.3.1 Ozone

Whilst the objective for ozone has not been set in regulation as yet as it is seen as a national rather than local authority problem, details have been included here of the measurements made during 2011. The objective for ozone is for the 8-hour means not to exceed 100μg/m^3 on more than 10 occasions with a compliance date of 31st December 2005.

Measurements are undertaken with Advanced Pollution Instrumentation (API) real-time O_3 analysers at the Cwm Level Park and Morriston Groundhog sites with the DOAS measurements from the St Thomas and Hafod sites. The O_3 analyser from the Swansea AURN was decommissioned on the 27th November 2008 and relocated at Cwm Level Park.

The logged 15-minute means have been compiled into hourly averages by the software package OPSIS Enviman Reporter. In order to compile a valid hourly mean, a minimum of 3, 15-minute means were specified[25]. Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to calculate the 8-hour means. In order to form a valid 8-hour mean 75% of the hourly means were required to be present i.e. 6 out of every 8. Tables 16 - 19 detail the monitoring undertaken during 2011 along with previous years results. Data ratification procedures undertaken at the Hafod and St Thomas DOAS sites are described in more detail within sections 2.1.6 and 2.1.7

[25] LAQM.TG(09) Calculation of Exceedence Statistics A1.216 page A1-47

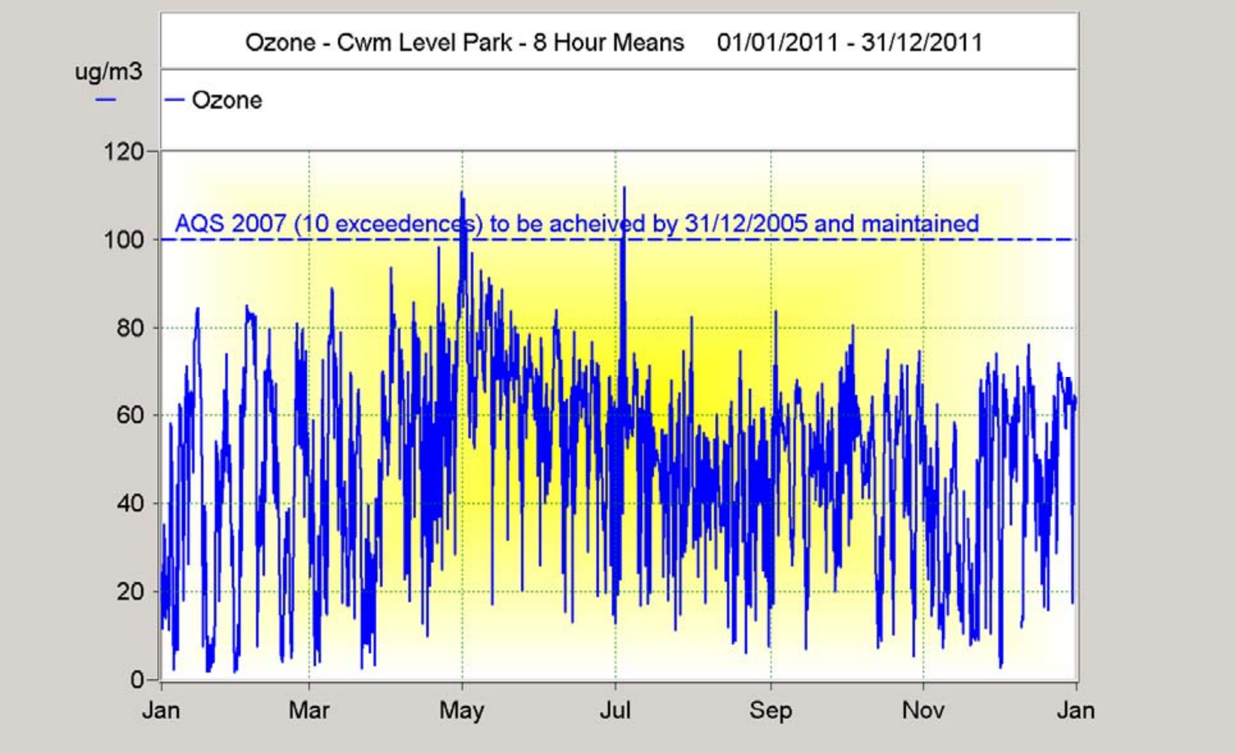


Graph 15 – Morriston Groundhog – 8-Hour Ozone means 2011

Morriston Groundhog	Max 8-hour Mean ($\mu g/m^3$)	Data capture	Exceedences of 8-hour objective $100\mu g/m^3$ (10 permitted)
2002	109.50	83.3%	3
2003	169.25	95.71%	28
2004	142.75	98%	23
2005	113.00	97.6%	1
2006	152.20	98.8 %	15
2007	114	98%	4
2008	120.75	88.43%	3
2009	103.25	89.04%	2
2010	103.5	94.34%	1
2011	104.25	90.78%	2

Table 16 - Morriston Groundhog Ozone 8-hour means 2002-2011

Cwm Level Park

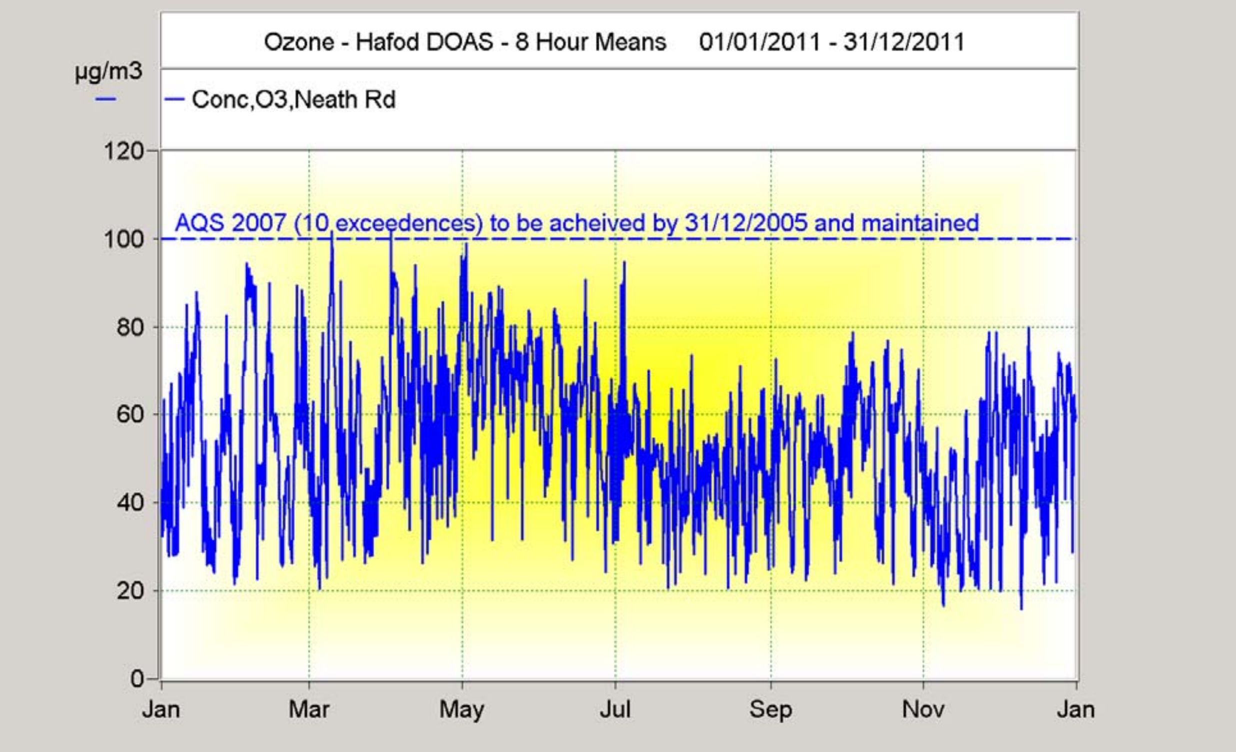


Graph 16 – Cwm Level Park – 8-Hour Ozone means 2011

Cwm Level Park	Max 8-hour Mean (μg/m^3)	Data capture	Exceedences of 8-hour objective 100μg/m^3 (10 permitted)
2009	100.75	92.6%	1
2010	106.5	98.26%	1
2011	112.0	98.63	5

Table 17 – Cwm Level Park Ozone 8-hour means 2009-2011

Hafod DOAS

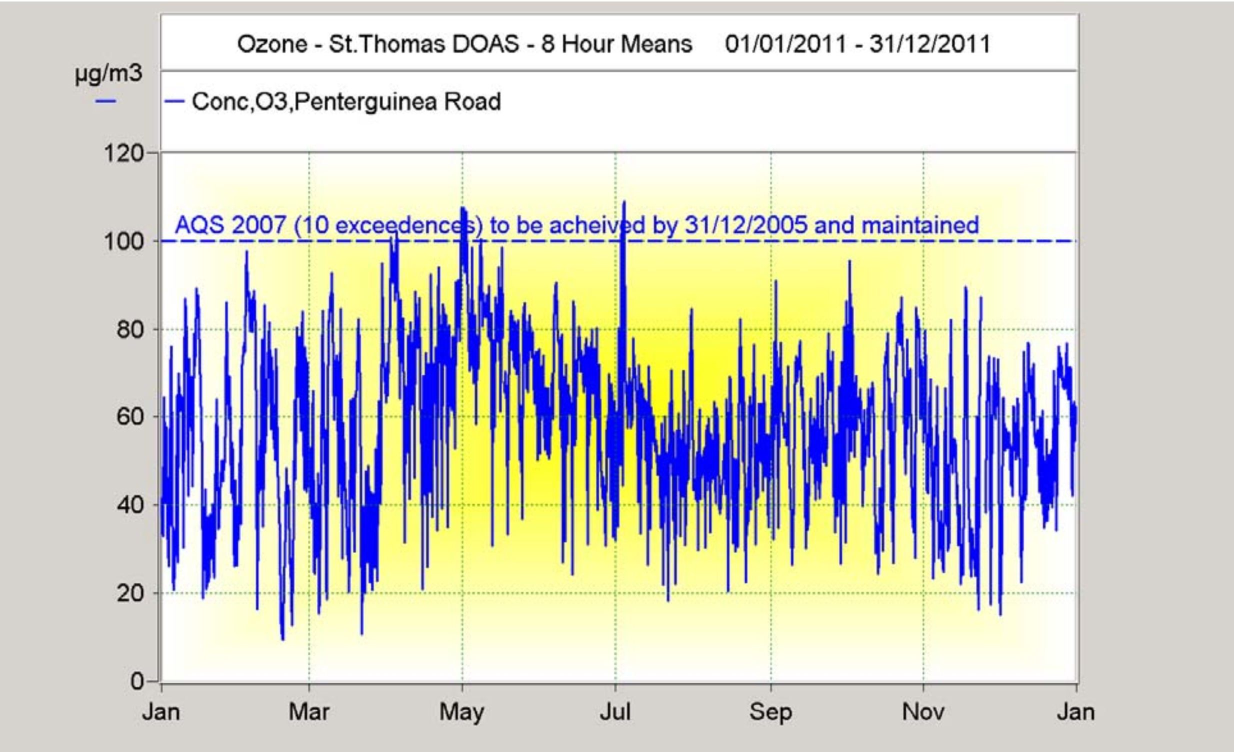


Graph 17 – Hafod DOAS – 8-Hour Ozone means 2011

Hafod DOAS	Max 8-hour Mean (µg/m^3)	Data capture %	Exceedences of 8-hour objective 100µg/m^3 (10 permitted)
2006	95.95	53.7%	0
2007	87.36	82.3%	0
2008	98.96	38.5%	0
2009	118.49	94.70%	50
2010	115.53	95.98%	6
2011	102.19	99.91%	2

Table 18 –Hafod DOAS Ozone 8-hour means 2006-2011

St.Thomas DOAS



Graph 18 – St.Thomas DOAS Ozone - 8-hour means

St Thomas DOAS	Max 8-hour Mean (μg/m^3)	Data capture	Exceedences of 8-hour objective 100μg/m^3 (10 permitted)
2006	150.6	94.9%	47
2007	106.4	98.7%	10
2008	127.9	99.9%	91
2009	118.93	99.4%	48
2010	120.45	99.36%	37
2011	108.90	99.54%	9

Table 19 – St.Thomas DOAS Ozone 8-hour means 2006-2011

It should be restated here that the DOAS technique produces a spatial measurement between the transmitter and receiver units of 250m at the Hafod DOAS site and 280m at the St.Thomas site. Whilst being located alongside roads with AADT's of 15888 and 19440 respectively during 2011, it's clear that considerable photochemistry is evident along Pentreguinea Road, St Thomas. However, given previous years monitoring the situation has improved during 2011 which is more probably as a result of meteorological conditions than any other factor. This is true for the other sites with the exception of the background site at Cwm Level Park which has seen a marked increase in concentrations over previous years.

The results from the open path measurements at Hafod and St.Thomas clearly differ over the years from those made at the traditional fixed point stations and present a different picture as to what the actual levels over a much wider sampling area may actually be.

2.3.2 Particulate Matter $PM_{2.5}$

The Thermo FDMS $PM_{2.5}$ system was installed upon commissioning of the relocated Swansea Roadside AURN site, and went live on the 26th September 2006.

The data collected for 2006 from the FDMS $PM_{2.5}$ unit amounts to just over two months at best and is not reported here as the period was fraught with breakdowns and other issues. Brief operational issues that have been identified are outlined here for information as the operation of the FDMS units differs substantially from that of the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[26]. Opinions vary as to the exact optimum temperature but Swansea's experience indicates around 18-20°C to be adequate and one that is capable of being maintained relatively stably by the installed air conditioning system.

The FDMS unit provided hourly integration data and had been configured as per DEFRA's FDMS parameter protocol (as amended during February 2008). The RS232 port on the FDMS control unit allows the collection of up to 8 parameters via telemetry. The parameters collected from the FDMS units are : Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refered to these parameters in different terminology. However, the FDMS unit will not directly produce a $PM_{2.5}$ mass concentration. The $PM_{2.5}$ mass concentration is obtained via post

[26] UK Equivalence Program for Monitoring of Particulate Matter dated 5th June 2006 section 5.5.2

processing of the volatile and non volatile mass parameters by creating a calculated channel the software package Opsis Enviman ComVisioner.

Data collected from the FDMS unit had an integration period of 1-hour. $PM_{2.5}$ mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Opsis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present[27]. LAQM.TG(09) provides no direct guidance on $PM_{2.5}$,except for paragraphs 3.50 – 3.53.

There have been numerous problems since the commissioning of the site in September 2006 with the installation of the Thermo Inc FDMS $PM_{2.5}$ analyser, resulting in significant periods of data loss. During 2007, there were several periods where data has been removed from the dataset. There are: 1st – 5th January 2007; 16th - 18th January 2007; 24th – 26th January 2007; 1st -2nd March 2007; 7th – 21st May 2007(leak test failure and uncertainty in data due to swap out of loan/replacement sensor units). These issues resulted in a ratified data capture rate of 90.7% for 2007.

Operation during 2008 saw a data capture rate of 94.81% with far fewer operational issues arising. However, significant issues were again seen within the data for 2009. Significant data has either been rejected or is absent during January, February, May-August, October and December 2009. The resulting data capture rate for 2009 is a disappointing 49.86% (daily means with 75% of 1 hour means present). During 2010, the operation of the $PM_{2.5}$ FDMS has been queried on many occasions as the $PM_{2.5}$ unit was reporting higher concentrations of $PM_{2.5}$ than the PM_{10} unit. Both FDMS units have been investigated for leaks, dryer issues, pump vacuum issues during. However, problems continued with the reliability of the FDMS from late December 2010 and throughout 2011. Data has been rejected by the UK network from the 21st December 2010 to the 14th September 2011 at 15:00.

[27] LAQM.TG(09) Calculation of Exceedence Statistics A1.216 page A1-48

Due to the ongoing reliability and data quality issues from the $PM_{2.5}$ (and also PM_{10}) FDMS systems a decision was made during the summer of 2011 to remove both FDMS units. Both FDMS units were removed from site on the 16th November 2011. Met One BAM 1020 $PM_{2.5}$ (smart Bam) and PM_{10} units were installed on the 28th November 2011.

The Met One Bam $PM_{2.5}$ (smart Bam) is heated and has been determined to show equivalency to the EU reference method during recent trials without the need for the application of a correction factor.[28] [29]

Each hour, a small 14C (carbon-14) element emits a constant source of high-energy electrons (known as beta rays) through a spot of clean filter tape. These beta rays are detected and counted by a sensitive scintillation detector to determine a zero reading. The BAM-1020 automatically advances this spot of tape to the sample nozzle, where a vacuum pump then pulls a measured and controlled amount of dust-laden air through the filter tape, loading it with ambient dust. At the end of the hour this dirty spot is placed back between the beta source and the detector thereby causing an attenuation of the beta ray signal which is used to determine the mass of the particulate matter on the filter tape and the volumetric concentration of particulate matter in ambient air.

Due to the problems experienced during 2011 the combined FDMS $PM_{2.5}$ and BAM1020 $PM_{2.5}$ hourly integrated data capture rate is 28.66%. Chart 19 below present's daily mean data for 2011. Table 20 summarises $PM_{2.5}$ data between 2007 and 2011.

It should be stated that following installation of the Bam 1020 $PM_{2.5}$ unit that data capture since installation and throughout 2012 has vastly improved.

[28] http://www.metone.com/documents/Met_One_Letter_5.pdf
[29] http://uk-air.defra.gov.uk/reports/cat05/0606130952_UKPMEquivalence.pdf

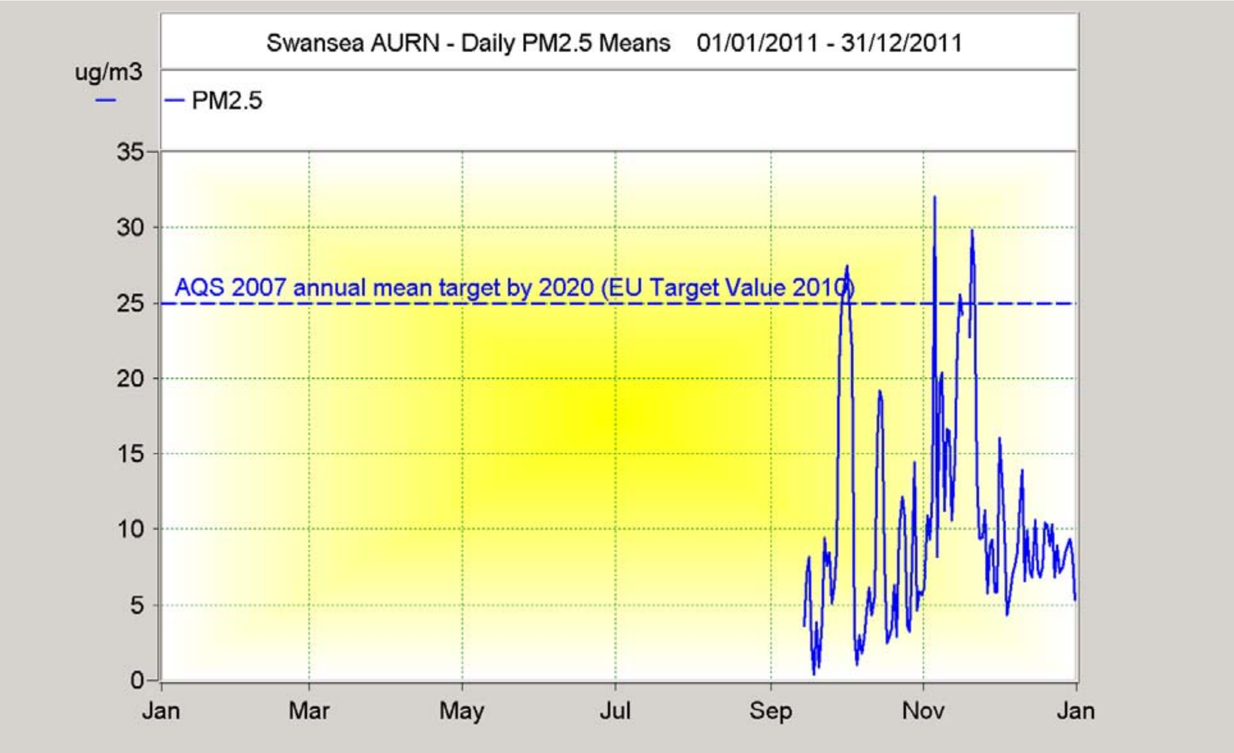


Chart 20 – Swansea AURN Daily $PM_{2.5}$ data 2011

Swansea Roadside AURN $PM_{2.5}$ (FDMS)	Data capture	Annual Mean (25µg/m^3)	Max Daily Mean (µg/m^3)	Max 1-hour mean (µg/m^3)
2007	90.7%	13.84	68.9	262
2008	94.81%	12.53	70.42	202
2009	49.86%	11.84	60.54	91
2010	94.52%	8.97	33.63	102
2011	28.66%	10.33	32.04	230 *

Table 20 - Swansea AURN $PM_{2.5}$ data 2007 – 2011

**Max 1-hour 2011 occurred on 5th November 2011*

The Air Quality Strategy 2007 focuses attention on $PM_{2.5}$ particulate matter to that of an exposure reduction approach. Between 2010 and 2020 for UK Urban Areas there is a target of 15% reduction in concentrations at urban background. The 25µg/m^3 is a cap to be seen in conjunction with the 15% reduction. The current policy framework and the legislative requirement to meet EU air quality limit values everywhere in the UK tends to direct LAQM attention to localised hotspot areas of pollution. There is clear and unequivocal health advice that there is no accepted threshold effect, i.e. no recognised safe level for exposure to fine particles $PM_{2.5}$. For $PM_{2.5}$, the current policy framework is therefore not going to generate the maximum improvement in public health for the investment made, as it focuses attention on localised hotspots only, despite much more widespread adverse effects on health being likely.

Therefore, an exposure reduction approach has been adopted for $PM_{2.5}$ to seek a more efficient way of achieving further reductions in the health effects of air pollution by providing a driver to improve air quality everywhere in the UK rather than just in a small number of localised hotspot areas, where the costs of reducing concentrations are likely to be exceedingly high. These measurements will act to make policy measures more cost-effective and is more likely to maximise public health improvements across the general population.

The City & County of Swansea facilitated a research study by a group comprising: School of Earth and Ocean Sciences Cardiff University, School of Biosciences Cardiff University, and the Centre for Health and Environment Research, Department of Primary Care and Public Health, Neuadd Meirionydd into ultrafine and nanoparticles using a Dekati™ Electrical Low Pressure Impactor within a street canyon environment. The site chosen for measurements was the Hafod Post Office, Neath Road, Hafod, Swansea. This site is located within the Swansea Air Quality (NO_2) Management Area 2010.

Full details of the study are reproduced with the permission of the group, within Annexe 7.

2.3.3 Heavy Metals Monitoring

The Department of Environment, Food and Rural Affairs (DEFRA) is funding a monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes.

The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale (Formerly Vale INCO/ INCO Europe) being located within the authority's area at Clydach. Full details on this monitoring program can be found within section 2.1.10 above which outlines the overall monitoring program and sites chosen.

Several years of monitoring data are available and can be viewed within previous LAQM Progress Report reporting cycles undertaken online at http://www.swansea.gov.uk/index.cfm?articleid=9929

During August 2007, Vale INCO Europe commenced an abatement improvement program with the installation of particulate bag filters on the main high stack discharge point. Data is presented below from 2007-2011 representing the last 5 years of monitoring. Additional factors should be taken into account when viewing the monitoring data. Due to the economic downturn, Vale have operated for the last year or so at a reduced capacity primarily operating on one kiln. Whilst both the improved abatement techniques and reduced capacity are clearly seen within the data from the four monitoring stations within the City & County of Swansea's area, colleagues from Neath Port Talbot Borough Council have identified a previously unrecognised local, and now deemed significant source of nickel within Pontardawe. This source within Pontardawe was previously being masked and has only now come to light due to the increased monitoring and analysis undertaken within the Swansea valley into ambient levels of nickel. This additional work is in part being driven by the Nickel in South Wales Review Group whose membership includes the Welsh Assembly Government (Policy and Technical Services Division), DEFRA, Environment Agency Wales, AEA Technology, National Physics Laboratory together with the relevant operators and local authorities.

Annexe 1 of the Directive details the target values for arsenic, cadmium, nickel and bezo(a)pyrene and, for ease of reference these are repeated below as table 21.

Pollutant	Target value ng/m^{-3}
Arsenic	6
Cadmium	5
Nickel	20
Benzo(a)pyrene	1

Table 21 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Tables 22-26 below detail the monthly means during 2007-2011 for the **Glais Primary School ❷** site. All results are expressed in ng/m^{-3}.

Glais Primary School 2007												
2007	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.75	0.14	3.68	3.7	72	1.27	**29.39**	4.8	0.00	0.18	4.8	0.23
Feb	0.81	0.17	2.94	3.9	151	3.19	**27.01**	10.0	0.00	0.83	20.3	0.03
Mar	1.07	0.25	3.19	3.6	271	5.46	**20.72**	8.4	0.00	1.64	15.4	0.52
April	1.32	0.30	4.64	6.7	397	10.39	**16.47**	14.2	0.00	3.35	41.0	0.48
May	2.37	0.99	7.18	10.1	283	5.39	**21.33**	27.5	0.00	1.66	15.2	0.50
June	0.52	0.10	4.82	3.5	83	2.69	**50.21**	3.7	0.00	2.04	17.5	0.31
July	0.44	0.07	3.07	3.3	96	2.42	**46.97**	2.7	0.00	1.61	12.9	0.09
Aug	-	-	-	-	-	-	**-**	-	-	-	-	-
Sept	-	-	-	-	-	-	**-**	-	-	-	-	-
Oct	-	-	-	-	-	-	**-**	-	-	-	-	-
Nov	-	-	-	-	-	-	**-**	-	-	-	-	-
Dec	0.78	0.19	1.95	5.2	152	4.56	**12.25**	12.3	0.00	1.79	19.5	0.03
Ann Av.	**1.01**	**0.28**	**3.94**	**5.0**	**188**	**4.42**	**28.04**	**10.5**	**0.00**	**1.64**	**18.3**	**0.27**

Table 22 – Heavy Metals monitoring 2007 Glais Primary School

Significant operational issues were seen at the Glais Primary School site during 2007-2009. These issues mainly relate to data loss due to instrument faults or more lengthy periods of data loss due to the subsidence and subsequent reconstruction of the building that housed the instrument.

Glais Primary School 2008												
2008	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.71	0.11	0.05	3.5	195	3.59	**7.1**	5.9	<0.01	1.59	6.8	0.14
Feb	1.36	0.46	5.17	7.2	224	6.93	**21.0**	14.0	<0.01	2.82	23.5	0.06
Mar	0.26	0.11	1.19	2.9	96	1.94	**12.6**	6.5	<0.01	0.79	9.1	0.03
April	0.41	0.17	1.61	5.5	139	3.10	**10.6**	6.3	0.01	1.42	13.5	0.04
May	0.63	0.27	1.50	4.6	285	6.83	**5.7**	10.1	0.01	2.28	25.1	0.05
June	0.52	0.18	1.64	5.1	209	4.41	**16.9**	7.3	<0.01	0.80	20.6	0.06
July	0.37	0.15	0.42	3.9	175	3.45	**10.8**	10.2	<0.01	0.87	16.4	0.05
Aug	0.22	0.07	0.11	3.3	81	1.76	**2.9**	4.5	<0.01	0.37	9.8	<0.01
Sept	0.77	0.21	0.94	5.6	294	4.52	**8.6**	17.3	<0.01	1.26	18.1	<0.01
Oct	0.73	0.30	0.62	8.8	247	4.03	**9.8**	12.3	<0.01	1.62	17.2	<0.01
Nov	*1.07*	*0.41*	*0.30*	*9.8*	*109*	*2.96*	***7.7***	*17.9*	*<0.01*	*0.63*	*22.4*	*<0.01*
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	**0.64**	**0.22**	**1.23**	**5.48**	**186.5**	**3.95**	**10.34**	**10.21**	**0.01**	**1.31**	**16.59**	**0.06**

Table 23 – Heavy Metals monitoring 2008 Glais Primary School

Glais Primary School 2009												
2009	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-
April	0.38	0.17	0.01	3.5	100	2.59	1.9	9.1	<0.01	1.35	53.1	<0.01
May	0.39	0.10	0.06	3.0	87	2.30	1.73	6.0	<0.01	0.94	34.9	0.01
June	0.59	0.18	0.04	7.7	169	4.51	3.8	9.2	<0.01	1.64	16.6	0.01
July	0.30	0.08	3.58	3.1	59	1.40	7.3	3.8	<0.01	1.48	8.4	0.01
Aug	0.38	0.10	0.34	3.4	96	2.06	1.4	6.8	<0.01	0.83	7.8	0.02
Sept	0.64	0.27	2.12	4.6	137	2.93	8.2	6.4	<0.01	0.60	7.9	0.01
Oct	0.69	0.19	3.28	5.1	234	4.51	6.3	9.9	<0.01	0.96	15.3	0.01
Nov	0.48	0.13	0.79	3.9	126	2.37	6.4	6.6	<0.01	1.08	10.9	0.01
Dec	0.80	0.18	0.28	4.2	136	2.36	4.7	7.6	<0.01	1.01	12.1	<0.01
Ann Av.	**0.52**	**0.15**	**1.17**	**4.29**	**126.9**	**2.78**	**4.64**	**7.27**	**<0.01**	**1.10**	**18.56**	**0.01**

Table 24– Heavy Metals monitoring 2009 Glais Primary School

Glais Primary School 2010												
2010	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.73	0.20	0.40	3.6	131	2.43	4.7	9.9	<0.01	1.06	14.9	0.01
Feb	0.50	0.19	0.77	3.5	158	2.90	6.5	10.1	<0.001	1.25	11.7	0.014
Mar	0.62	0.31	1.47	4.6	266	6.79	7.1	11.9	<0.001	1.44	44.9	0.013
April	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-	-	-	-	-
July	0.45	0.08	1.75	5.46	111	2.7	7.9	5.1	<0.001	0.74	8.2	0.024
Aug	0.43	0.11	3.07	4.78	110	2.5	10.0	6.0	<0.001	0.61	8.1	0.016
Sept	0.65	0.22	1.40	9.13	160	3.4	7.9	10.9	<0.001	0.61	65.7	<0.01
Oct	0.72	0.18	1.28	5.50	152	3.7	5.9	9.9	<0.001	0.71	15.4	0.013
Nov	-	-	-	-	-	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	0.58	0.19	1.45	4.73	155	3.5	7.0	9.1	<0.001	0.93	19.3	0.013

Table 25– Heavy Metals monitoring 2010 Glais Primary School

Significant operational issues were seen at the Glais Primary School site during 2010 due to instrument faults.

Glais Primary School 2011												
2011	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.60	0.12	<0.01	4.33	76	1.2	11.4	6.9	<0.001	0.27	9.0	0.009
Feb	0.64	0.30	0.75	4.49	165	4.1	3.7	12.9	0.004	1.10	22.2	0.013
Mar	0.90	0.49	2.04	7.9	292	8.3	5.3	14.1	0.002	1.56	32.8	0.023
April	0.69	0.29	2.15	6.3	276	6.8	10.5	10.0	0.002	1.61	22.8	0.019
May	0.14	0.16	3.62	4.5	186	4.65	3.7	6.5	<0.001	1.48	14.5	<0.01
June	0.07	0.10	2.67	2.2	115	2.57	3.7	4.9	<0.001	0.93	13.1	<0.01
July	0.26	0.29	3.08	3.7	187	4.32	5.1	13.8	0.001	0.92	13.5	0.016
Aug	0.34	0.20	4.55	5.58	128	2.94	8.4	15.4	<0.001	0.74	11.8	0.002
Sept	0.56	0.14	4.45	4.50	121	2.84	6.0	7.3	<0.001	1.07	12.7	<0.001
Oct	0.62	0.24	3.90	7.39	274	9.19	6.1	10.1	<0.001	2.74	25.5	<0.001
Nov	0.71	0.34	2.92	5.61	180	4.37	4.2	10.3	<0.001	1.67	27.7	0.008
Dec	0.43	0.11	1.63	4.16	98	1.31	8.1	7.1	<0.001	0.22	6.0	0.005
Ann Av.	**0.50**	**0.23**	**2.89**	**5.05**	**174.9**	**4.38**	**6.34**	**9.95**	**0.00**	**1.19**	**17.65**	**0.01**

Table 26– Heavy Metals monitoring 2011 Glais Primary School

Tables 27-31 detail the monthly means for the **Coed-Gwilym Cemetery site ❸** between 2007 and 2011. All results are expressed in ng/m^{-3}.

Coed-Gwilym Cemetery 2007

2007	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	1.08	0.39	4.02	2.9	56	1.41	**68.4**	4.3	<0.01	1.17	13.1	0.07
Feb	1.02	0.25	3.71	4.3	173	3.49	**39.2**	11.3	<0.01	1.32	28.6	0.13
Mar	1.20	0.57	2.97	7.1	331	9.23	**30.1**	17.5	<0.01	2.88	50.4	0.69
April	1.04	0.27	2.58	7.2	251	7.65	**9.0**	11.1	<0.01	3.09	39.2	0.82
May	6.19	0.22	7.57	2.7	175	4.88	**22.9**	7.5	<0.01	*100**	25.2	0.15
June	0.81	0.22	7.64	3.3	206	5.84	**39.9**	8.8	<0.01	4.24	18.5	0.08
July	0.19	0.12	3.45	2.7	69	2.19	**59.6**	3.7	<0.01	0.89	5.4	0.21
Aug	0.24	0.10	2.06	2.1	94	2.76	**39.9**	3.1	<0.01	1.22	4.5	0.32
Sept	1.06	0.23	7.20	3.9	145	4.36	**34.5**	27.6	<0.01	0.35	19.1	0.18
Oct	0.90	0.22	9.26	5.8	179	5.68	**50.2**	10.8	<0.01	1.08	18.9	0.08
Nov	1.33	0.27	4.92	8.1	112	3.06	**34.6**	13.0	<0.01	0.60	14.7	0.13
Dec	1.04	0.38	7.63	8.2	259	9.13	**19.4**	17.9	<0.01	2.56	31.0	0.09
Ann Av.	**1.34**	**0.27**	**5.25**	**4.88**	**171**	**4.97**	**37.31**	**11.38**	**0**	**1.77**	**22.39**	**0.25**

Table 27– Heavy Metals monitoring 2007 Coed-Gwilym Cemetery

- *The vanadium levels measured during May were mostly extremely high. This is thought to be owing to an instrument fault affecting the first in the series of analytes to be measured, which is vanadium. These values should be treated with caution and should have a very high uncertainty attached to them. If these values appeared as part of the UK Heavy Metals Monitoring Network results they would most likely be excluded during ratification as extreme outliers*

Coed-Gwilym Cemetery 2008

2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.29	0.14	3.31	4.1	135	2.9	**16.66**	6.2	0.00	1.14	7.0	0.02
Feb	1.29	0.44	8.32	7.8	244	7.9	**31.69**	13.1	0.00	1.88	24.7	0.09
Mar	0.27	0.09	1.98	2.5	83	1.7	**22.79**	5.2	0.00	0.34	6.9	0.03
April	0.60	0.16	3.14	3.3	129	2.9	**17.02**	6.5	0.00	1.20	11.7	0.05
May	0.58	0.26	3.51	4.4	279	6.1	**15.61**	10.3	0.00	2.25	25.3	0.03
June	0.26	0.10	2.33	3.4	135	2.9	**20.43**	5.2	0.00	0.61	13.7	0.08
July	0.23	0.12	1.34	3.4	119	2.5	**17.00**	6.3	0.00	0.74	9.8	0.07
Aug	0.23	0.06	0.09	2.5	55	1.1	**9.28**	2.8	0.00	0.47	6.0	0.01
Sept	0.51	0.21	1.69	4.3	161	3.7	**14.92**	8.3	0.00	1.71	15.7	0.01
Oct	0.30	0.12	2.70	2.7	112	2.2	**15.13**	5.6	0.00	0.89	7.6	0.01
Nov	0.46	0.14	2.70	5.8	96	1.9	**30.56**	7.2	0.00	0.21	10.9	0.01
Dec	0.90	0.15	2.85	10.0	145	2.5	**24.26**	19.4	0.00	0.57	20.1	0.01
Ann Av.	**0.49**	**0.17**	**2.83**	**4.5**	**141**	**3.2**	**19.61**	**8.0**	0.00	**1.00**	**13.3**	**0.04**

Table 28– Heavy Metals monitoring 2008 Coed-Gwilym Cemetery

Coed-Gwilym Cemetery 2009

2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.74	0.33	4.20	4.5	133	3.4	**25.7**	11.8	<0.001	0.86	15.3	0.009
Feb	0.69	0.18	6.23	5.0	139	2.6	**30.1**	11.3	<0.001	0.87	19.3	0.009
Mar	0.58	0.17	3.89	4.5	158	3.3	**23.0**	9.5	<0.001	1.34	14.0	0.006
April	0.50	0.17	2.19	3.3	186	4.2	**9.60**	11.5	<0.001	1.87	15.4	0.005
May	0.38	0.13	0.06	3.8	124	3.1	**3.86**	6.6	<0.001	1.00	11.2	0.007
June	0.57	0.19	1.52	4.4	157	4.3	**9.10**	8.5	<0.001	1.78	13.7	0.010
July	0.27	0.08	7.14	2.4	52	1.4	**9.68**	3.2	<0.001	1.49	14.9	0.004
Aug	0.32	0.09	2.98	3.1	88	2.0	**4.93**	5.2	<0.001	1.04	9.2	0.011
Sept	0.69	0.16	4.66	3.9	126	3.0	**19.4**	5.5	<0.001	0.59	6.9	0.014
Oct	0.50	0.14	4.86	4.5	190	3.7	**16.3**	10.4	<0.001	0.97	12.4	0.033
Nov	0.38	0.14	1.48	3.5	121	2.4	**19.1**	7.9	<0.001	0.65	9.4	0.020
Dec	1.76	0.68	3.91	9.2	250	4.6	**21.4**	30.9	<0.001	0.69	24.2	0.137
Ann Av.	**0.61**	**0.20**	**3.59**	**4.3**	**144**	**3.2**	**16.0**	**10.2**	**<0.001**	**1.10**	**13.8**	**0.022**

Table 29– Heavy Metals monitoring 2009 Coed-Gwilym Cemetery

Coed-Gwilym Cemetery 2010

2010	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.87	0.24	1.71	3.5	125	2.62	**10**	9.5	<0.0001	0.87	13.9	0.027
Feb	0.52	0.19	3.37	3.0	134	2.61	**10.8**	9.9	<0.0001	0.80	10.9	0.021
Mar	0.58	0.26	2.97	3.4	248	5.62	**8.43**	10.3	<0.0001	1.28	26.8	0.010
April	0.84	0.32	6.62	4.4	444	11.3	**8.51**	11.8	<0.0001	1.43	24.9	0.055
May	0.44	0.21	1.97	3.0	177	4.38	**7.22**	8	<0.0001	0.80	12.7	0.012
June	0.38	0.18	2.67	3.1	171	4.01	**10.1**	6.1	<0.001	1.30	10.8	0.004
July	0.45	0.13	2.66	5.1	92	2.23	**10.3**	6.5	<0.0001	0.72	8.1	0.013
Aug	0.41	0.09	5.08	3.1	78	2.15	**18.2**	3.7	<0.0001	0.48	5.2	0.017
Sept	0.46	0.11	2.45	3.9	117	2.55	**12.5**	5.3	<0.0001	0.67	10.4	0.018
Oct	0.92	0.14	3.01	4.9	156	3.93	**9.18**	8.5	<0.0001	0.58	14.3	0.012
Nov	1.41	0.20	2.95	5.5	137	2.55	**9.02**	9.6	<0.0001	0.49	13.6	0.011
Dec	1.78	0.26	3.51	4.7	160	3.4	**11.02**	12.1	<0.0001	0.94	16.5	0.014
Ann Av.	**0.76**	**0.19**	**3.25**	**3.98**	**168**	**3.91**	**10.48**	**8.4**	**<0.0001**	**0.85**	**13.8**	**0.018**

Table 30– Heavy Metals monitoring 2010 Coed-Gwilym Cemetery

From August 2011, NPL changed the reporting format from a monthly overall result and weekly result to only a weekly result at the UK Network sites of which Coed-Gwilyn cemetery forms a part. The annual mean presented for 2011 is that as reported by NPL within the annual report dated June 2012 [30] with Excel being used for presentation purposes only of the monthly means between August and December 2011.

[30] http://uk-air.defra.gov.uk/reports/cat13/1206131002_Defra_UK_Heavy_Metals_Network_Annual_Report_2011_FINAL.pdf

Coed-Gwilym Cemetery 2011												
2011	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.77	0.17	1.90	5.15	107	1.97	**20.04**	10.18	0.00	0.45	10.50	0.02
Feb	0.63	0.18	2.11	4.74	113	2.54	**10.65**	11.26	0.00	0.90	13.56	0.02
Mar	0.71	0.25	4.62	5.75	221	6.43	**8.22**	10.99	0.00	1.01	26.58	0.02
April	0.92	0.25	3.45	6.26	237	6.31	**10.33**	11.31	0.00	1.39	19.80	0.02
May	0.27	0.10	3.08	3.23	158	4.34	**9.90**	4.28	0.00	1.10	9.66	0.03
June	0.13	0.10	2.99	2.03	115	2.66	**6.62**	4.66	0.00	0.76	13.39	0.02
July	0.32	0.12	3.12	2.93	159	3.72	**5.49**	6.93	0.00	1.01	11.16	0.01
Aug	0.26	0.10	4.06	3.18	101	2.67	**15.91**	5.18	0.00	0.83	5.96	0.01
Sept	0.31	0.10	3.05	3.09	96	2.29	**13.79**	5.53	0.00	0.96	7.56	0.00
Oct	0.47	0.19	4.43	4.72	281	5.62	**12.49**	9.09	0.00	1.79	18.68	0.00
Nov	0.68	0.26	3.32	4.82	158	3.76	**6.76**	8.17	0.00	1.52	21.06	0.01
Dec	0.27	0.04	1.71	3.48	79	1.19	**15.70**	3.73	0.00	0.07	6.10	0.00
Ann Av.	**0.50**	**0.17**	**0.20**	**3.23**	**4.16**	**157**	**3.78**	**10.91**	**7.88**	**0.00**	**0.36**	**1.04**

Table 31– Heavy Metals monitoring 2011 Coed-Gwilym Cemetery

** December 2011 result based on 1 weekly filter*

Tables 32-36 detail the monthly means for the **Morriston Groundhog ❺** site during 2007 -2010. All results are expressed in ng/m^{-3}

Morriston Groundhog 2007												
2007	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg(p)**
Jan	1.11	0.41	4.31	21.6	399	5.02	**14.1**	20.7	<0.01	1.08	23.7	0.06
Feb	1.65	0.45	4.49	32.9	848	16.38	**22.2**	31.2	<0.01	1.83	77.7	0.14
Mar	0.92	0.37	3.74	20.8	524	8.35	**18.1**	16.2	<0.01	2.15	32.7	1.09
April	2.91	0.71	9.24	37.4	1073	24.25	**32.4**	43.0	<0.01	18.45	85.7	1.90
May	6.69	0.06	8.01	0.6	34	1.18	**0.3**	1.4	<0.01	*162******	9.3	0.07
June	0.84	0.29	5.10	18.1	539	10.91	**18.1**	18.3	<0.01	3.08	43.0	0.14
July	0.55	0.65	0.11	18.2	322	5.38	**24.6**	12.2	<0.01	1.19	16.5	0.23
Aug	1.04	0.57	2.21	19.1	374	6.09	**21.0**	11.5	<0.01	0.97	19.2	0.18
Sept	0.87	0.26	0.55	28.7	518	9.05	**15.5**	34.6	<0.01	1.11	29.4	0.16
Oct	0.97	0.38	1.79	34.7	617	11.56	**22.9**	26.7	<0.01	2.44	34.6	0.02
Nov	1.18	0.28	3.79	32.8	583	8.47	**22.6**	15.9	<0.01	1.12	27.9	0.03
Dec	1.29	0.39	2.65	43.4	518	8.65	**8.2**	36.6	<0.01	2.73	43.5	0.02
Ann Av.	**1.67**	**0.40**	**3.83**	**25.68**	**529**	**9.61**	**18.3**	**22.37**	**0**	**3.29**	**36.93**	**0.34**

Table 32 – Heavy Metals monitoring 2007 Morriston Groundhog

***** The vanadium levels measured during May were mostly extremely high. This is thought to be owing to an instrument fault affecting the first in the series of analytes to be measured, which is vanadium. These values should be treated with caution and should have a very high uncertainty attached to them. If these values appeared as part of the UK Heavy Metals Monitoring Network results they would most likely be excluded during ratification as extreme outliers.

Morriston Groundhog 2008											
2008	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg(p)**
Jan	0.41	0.19	0.22	16.7	385	5.6	**3.16**	7.5	0.01	1.59	56.7	0.01
Feb	1.29	0.71	4.43	43.3	970	19.2	**14.20**	30.7	0.00	3.22	66.6	0.02
Mar	0.30	0.54	2.92	54.3	1223	14.5	**5.57**	44.9	0.00	0.93	83.1	0.04
April	0.44	0.27	1.69	32.5	399	6.0	**6.81**	26.3	0.01	1.25	24.4	0.05
May	0.70	0.38	1.87	54.9	471	9.7	**7.49**	32.5	0.01	1.93	41.9	0.05
June	0.24	0.13	1.13	19.1	331	5.0	**4.81**	15.3	0.00	0.65	17.5	0.11
July	0.31	0.12	0.89	12.1	348	5.7	**4.24**	8.1	0.00	0.72	17.2	0.05
Aug	0.18	0.09	0.82	15.5	285	3.6	**2.20**	6.9	0.00	0.64	12.1	0.01
Sept	0.18	0.24	2.40	18.7	463	7.0	**3.40**	15.3	0.00	1.88	32.8	0.01
Oct	0.38	0.25	2.20	30.8	556	8.5	**13.89**	16.6	0.00	1.82	26.9	0.01
Nov	0.69	0.45	3.12	34.1	568	6.7	**7.36**	20.4	0.00	0.35	26.3	0.01
Dec	0.94	0.22	3.08	39.9	686	8.6	**18.11**	21.2	0.01	0.62	32.0	0.01
Ann Av.	**0.51**	**0.30**	**2.06**	**31.0**	**557**	**8.3**	**7.60**	**20.5**	**0.00**	**1.30**	**36.5**	**0.03**

Table 33– Heavy Metals monitoring 2008 Morriston Groundhog

Morriston Groundhog 2009												
2009	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg(p)**	**Hg (v)**
Jan	0.98	0.36	4.63	27.1	589	8.2	**13.7**	21.7	0.001	1.37	38.5	0.008	1.8
Feb	0.82	0.42	2.98	26.7	500	7.2	**29.7**	32.9	0.001	1.35	38.3	0.012	1.6
Mar	0.57	0.17	1.92	19.6	483	7.2	**17.0**	11.5	0.001	1.38	24.1	0.003	1.9
April	0.76	0.37	0.50	17.5	497	9.6	**13.5**	21.4	0.002	2.36	31.5	0.018	1.8
May	0.46	0.13	0.95	16.0	341	5.2	**2.25**	9.4	0.001	1.17	15.9	0.007	1.6
June	0.72	0.26	1.31	23.8	501	9.1	**4.88**	16.5	0.001	1.99	27.5	0.009	1.6
July	0.44	0.16	8.53	15.5	312	4.6	**10.2**	6.8	0.001	2.03	19.5	0.01	1.2
Aug	1.45	0.34	4.28	26.3	323	4.8	**1.03**	12.9	0.001	0.95	20.7	0.009	1.1
Sept	0.94	0.41	4.66	51.9	602	7.6	**2.30**	18.1	0.001	0.73	29.1	0.007	1.6
Oct	0.77	0.42	2.46	44.2	707	11.1	**8.62**	30.0	0.004	0.91	37.4	0.040	3.0
Nov	0.57	0.23	1.54	18.2	488	6.7	**0.97**	13.4	0.003	0.76	22.1	0.092	1.7
Dec	1.93	0.28	1.94	34.4	758	9.0	**7.93**	13.9	0.004	0.56	27.0	0.032	1.3
Ann Av.	**0.87**	**0.30**	**2.98**	**26.8**	**508**	**7.5**	**9.34**	**17.4**	**0.001**	**1.30**	**27.6**	**0.020**	**1.7**

Table 34– Heavy Metals monitoring 2009 Morriston Groundhog

Morriston Groundhog 2010													
2010	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg (p)**	**Hg (v)**
Jan	0.87	0.25	0.53	21.4	559	7.68	**40.0**	15.0	0.004	0.83	28.3	0.013	1.17
Feb	0.71	0.31	2.42	31.3	735	11.0	**9.42**	20.2	0.001	1.06	47.2	0.009	1.28
Mar	0.74	0.41	2.34	21.9	672	12.6	**7.71**	18.3	0.001	1.59	62.7	0.008	1.48
April	1.10	0.43	3.65	30.1	793	16.5	**11.1**	18.2	<0.001	1.73	52.6	0.020	1.00
May	0.65	0.31	3.17	23.0	508	7.82	**9.45**	12.3	0.001	0.97	38.8	0.006	1.53
June	0.47	0.28	1.81	31.0	427	7.19	**10.3**	15.9	0.003	1.46	29.2	0.006	1.41
July	0.70	0.21	3.00	29.0	334	5.18	**6.48**	15.3	0.001	0.86	17.0	0.024	1.97
Aug	0.48	0.12	3.86	32.3	371	4.70	**10.4**	11.4	0.002	0.67	12.5	0.015	1.84
Sept	0.78	0.18	2.77	39.4	540	8.49	**14.0**	13.6	0.001	1.00	26.1	0.010	1.64
Oct	0.91	0.23	2.12	58.0	540	8.36	**18.0**	25.7	<0.001	0.66	31.8	0.012	1.24
Nov	1.56	0.34	5.73	52.2	647	7.49	**16.5**	24.7	<0.001	0.65	28.9	0.008	1.90
Dec	1.50	0.46	3.05	76.4	825	9.8	**28.15**	24.9	0.001	0.88	46.1	0.011	1.44
Ann Av.	**0.88**	**0.30**	**2.85**	**37.3**	**582**	**8.95**	**15.28**	**18.1**	**0.001**	**1.03**	**35.5**	**0.012**	**1.49**

Table 35 – Heavy Metals monitoring 2010 Moriston Groundhog

Morriston Groundhog 2011													
2011	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg (p)**	**Hg (v)**
Jan	1.02	0.25	3.78	50.15	626	8.03	**28.80**	19.05	0.00	0.71	39.96	0.02	-
Feb	0.74	0.28	3.35	31.23	457	7.12	**4.56**	24.08	0.00	1.46	32.26	0.04	-
Mar	1.11	0.49	4.82	67.77	688	11.77	**10.92**	33.04	0.00	1.47	48.89	0.05	-
April	1.16	0.35	4.93	48.59	605	11.30	**15.02**	18.81	0.00	1.70	45.95	0.02	-
May	0.46	0.23	6.74	27.74	621	10.04	**2.58**	9.59	0.00	1.72	31.33	0.05	-
June	0.29	0.28	4.81	26.03	417	6.65	**6.23**	12.32	0.00	0.93	35.37	0.03	-
July	0.39	0.23	4.50	25.20	561	8.62	**4.31**	18.03	0.00	1.23	25.67	0.01	-
Aug	0.31	0.14	4.23	30.19	433	5.90	**10.55**	15.80	0.00	1.17	16.21	0.00	-
Sept	0.63	0.21	4.82	28.81	490	7.78	**7.09**	13.53	0.00	1.35	23.74	0.00	-
Oct	0.44	0.20	5.39	21.02	579	8.37	**5.16**	19.90	0.00	1.24	20.78	0.00	-
Nov	1.03	0.51	3.99	27.97	698	12.11	**7.06**	19.48	0.00	2.07	50.44	0.03	-
Dec	0.41	0.08	2.54	27.10	517	4.82	**7.68**	12.33	0.00	0.47	14.78	0.00	-
Ann Av.	**0.78**	**0.33**	**5.29**	**39.61**	**657**	**10.18**	**9.75**	**21.40**	**0.00**	**1.57**	**38.01**	**0.03**	**-**

Table 36 – Heavy Metals monitoring 2011 Moriston Groundhog

As mentioned above within section 2.1.10 above, monitoring at the site **YGG Gellionnen** ❹ (Welsh Primary School) commenced during November 2007. There is little valid data that can be presented for 2007 so, for the sake of clarity, no data is reported here for 2007. Details of the monitoring undertaken during 2008 -2010 can be found below within tables 37 - 40.

YGG Gellionnen 2008												
2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.38	0.16	1.87	4.7	202	3.59	**10.4**	6.2	<0.01	0.52	10.1	0.26
Feb	*0.01*	*0.14*	*1.49*	*7.3*	*157*	*2.83*	***9.4***	*5.5*	*<0.01*	*0.39*	*16.8*	*0.06*
Mar	0.06	0.08	0.61	2.8	84	1.52	**6.3**	4.8	<0.01	0.31	7.1	0.04
April	0.35	0.73	0.72	3.7	122	2.81	**6.3**	10.7	<0.01	1.13	17.4	0.07
May	0.70	0.27	1.59	5.6	350	7.37	**16.8**	14.3	0.01	1.97	38.0	0.05
June	0.24	0.20	1.03	3.0	133	3.01	**12.3**	10.5	<0.01	0.74	12.5	0.09
July	0.38	0.12	0.30	4.2	145	2.94	**10.0**	7.7	<0.01	0.76	11.3	0.05
Aug	0.16	0.11	1.86	2.9	77	1.36	**7.7**	4.3	<0.01	0.27	8.2	<0.02
Sept	0.42	0.29	0.10	4.1	188	4.23	**7.1**	9.7	<0.01	1.29	15.3	<0.01
Oct	0.45	0.20	0.14	5.2	144	2.90	**20.8**	8.8	<0.01	1.10	12.5	<0.01
Nov	0.32	0.11	0.34	4.2	76	1.54	**13.9**	5.3	<0.01	0.27	11.2	<0.01
Dec	0.64	0.16	0.59	4.2	129	2.08	**10.9**	20.8	<0.01	0.62	18.0	<0.01
Ann Av.	**0.34**	**0.21**	**0.89**	**4.33**	**150.6**	**3.01**	**10.99**	**9.04**	**0.01**	**0.78**	**14.86**	**0.09**

Table 37– Heavy Metals monitoring 2008 YGG Gellionnen

YGG Gellionnen 2009												
2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.99	0.28	1.70	5.5	136	3.11	**22.9**	13.9	<0.01	1.22	20.1	<0.01
Feb	0.60	0.18	1.96	3.8	144	2.46	**39.7**	13.1	<0.01	1.05	18.0	<0.01
Mar	0.68	0.20	1.38	4.9	157	3.89	**12.7**	9.9	<0.01	1.68	19.7	0.02
April	0.73	0.20	0.01	5.1	191	5.05	**20.0**	14.1	<0.01	2.02	18.5	0.01
May	0.36	0.10	0.47	3.3	80	2.22	**6.81**	5.6	<0.01	1.14	7.9	<0.01
June	0.52	0.21	0.28	4.1	159	4.44	**7.0**	9.8	<0.01	1.60	12.8	0.01
July	0.32	0.10	5.29	2.3	48	1.26	**10.2**	4.6	<0.01	1.50	10.3	<0.01
Aug	0.31	0.10	0.91	4.2	105	2.35	**12.2**	5.0	<0.01	0.88	8.5	0.01
Sept	0.70	0.13	4.15	4.0	127	3.43	**3.7**	6.0	0.01	0.87	12.3	<0.01
Oct	0.60	0.14	0.67	4.2	174	3.55	**11.7**	23.5	<0.01	0.63	15.4	0.02
Nov	0.44	0.11	0.04	3.3	111	2.07	**22.7**	6.4	<0.01	0.50	9.8	0.02
Dec	0.80	0.15	<0.01	2.5	107	2.07	**61.0**	8.9	<0.01	0.24	10.0	0.01
Ann Av.	**0.59**	**0.16**	**1.53**	**3.93**	**128.4**	**2.99**	**19.22**	**10.06**	**0.01**	**1.11**	**13.60**	**0.01**

Table 38– Heavy Metals monitoring 2009 YGG Gellionnen

YGG Gellionnen 2010											
2010	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.57	0.16	<0.01	2.1	116	2.25	34.5	10.4	<0.01	0.98	14.6	0.01
Feb	0.46	0.15	0.01	2.2	155	2.78	7.2	9.5	<0.001	0.61	15.5	0.003
Mar	0.56	0.29	0.04	3.4	202	5.26	20.3	9.3	0.011	1.24	25.0	0.011
April	0.98	0.63	<0.01	4.1	391	10.4	19.7	16.1	0.004	1.06	28.6	0.003
May	0.42	0.15	1.10	3.4	203	4.8	8.7	8.8	0.005	0.84	14.2	0.009
June	0.33	0.14	3.03	4.1	187	4.5	10.0	6.6	<0.001	1.48	12.4	<0.001
July	0.25	0.10	1.69	4.0	79	1.6	12.0	10.5	<0.001	0.48	8.5	<0.001
Aug	0.31	0.09	0.59	4.7	88	2.1	6.2	4.7	<0.001	0.41	6.3	0.001
Sept	0.41	0.11	1.54	3.8	129	3.0	11.1	5.0	<0.001	0.73	10.5	0.003
Oct	0.51	0.09	1.29	5.7	119	2.6	20.1	5.1	<0.001	0.57	9.5	0.011
Nov	0.65	0.18	0.56	4.2	117	2.9	6.8	9.0	<0.001	0.85	15.1	0.002
Dec	1.20	0.22	0.28	9.7	162	2.8	28.2	11.9	<0.001	0.57	16.0	0.016
Ann Av.	**0.60**	**0.18**	**0.91**	**4.2**	**159**	**3.6**	**15.0**	**8.4**	**0.003**	**0.80**	**14.2**	**0.008**

Table 39– Heavy Metals monitoring 2010 YGG Gellionnen

YGG Gellionnen 2011											
2011	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	0.56	0.17	<0.01	4.5	77	1.2	13.2	7.4	<0.001	0.47	6.8	0.009
Feb	0.60	0.25	0.70	7.5	156	3.9	9.5	12.5	0.003	0.99	21.7	0.016
Mar	0.89	0.27	1.18	7.4	266	7.0	7.2	16.7	0.004	1.40	28.2	0.023
April	0.66	0.22	2.67	6.3	272	7.1	19.8	9.2	0.002	1.64	22.3	0.038
May	0.14	0.09	3.62	3.8	159	4.23	11.3	5.1	0.001	1.32	10.0	0.03
June	0.08	0.08	2.21	2.4	127	3.21	4.9	4.7	<0.001	0.89	10.9	<0.01
July	0.17	0.29	2.69	2.8	161	4.13	4.1	7.7	<0.001	0.63	12.9	0.004
Aug	0.31	0.09	4.18	2.5	121	2.88	8.0	4.4	<0.001	0.66	8.1	0.001
Sept	0.30	0.10	4.30	3.1	118	2.73	7.1	3.9	<0.001	0.97	9.4	<0.001
Oct	0.47	0.21	2.39	4.1	208	5.21	15.7	8.5	<0.001	2.14	19.3	0.002
Nov	0.71	0.27	1.86	4.1	123	3.35	9.2	12.1	<0.001	2.33	18.3	0.004
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	**0.44**	**0.19**	**2.58**	**4.4**	**162**	**4.08**	**10.0**	**8.38**	**0.00**	**1.22**	**15.27**	**0.01**

Table 40– Heavy Metals monitoring 2011 YGG Gellionnen

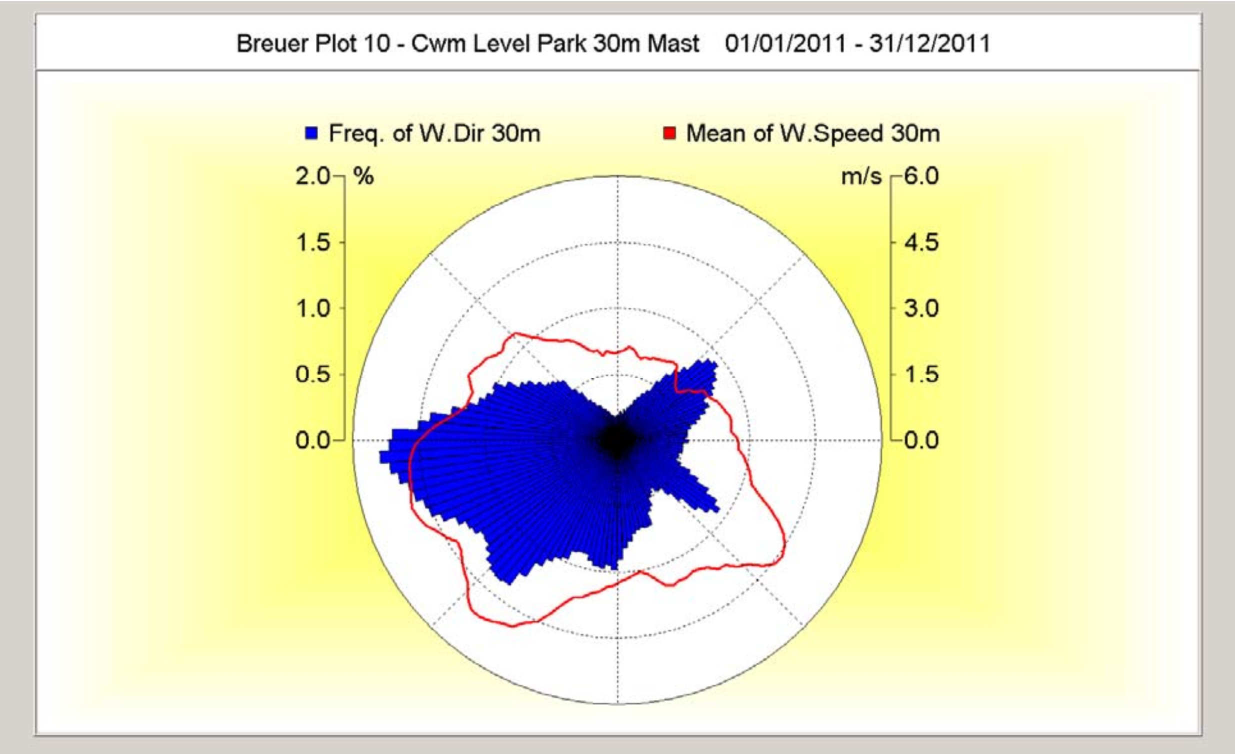
Table 41 presents the nickel annual means from all four monitoring sites for the years 2002-2011 where appropriate.

Year	Glais Primary School ❷	Coed-Gwilym Cemetery ❸	YGG Gellionnen ❹	Morriston Groundhog ❺
2002	**28.91**	-	-	-
2003	18.14	-	-	-
2004	**33.83**	-	-	-
2005	19.62	-	-	-
2006	**26.13**	-	-	-
2007	**28.04**	**37.31**	-	18.3
2008	10.34	19.61	10.99	7.6
2009	4.64	16.0	19.22	9.34
2010	7.0	10.48	15.0	15.28
2011	6.34	10.91	10.0	9.75

Table 41 – Swansea Nickel Annual Means 2002 – 2011

Whilst it is evident that nickel compliance has been achieved at all monitoring sites (both UK Network sites and the City & County of Swansea funded sites) since 2008, the 2008 result at Coed-Gwilym Cemetery and the 2009 result at the YGG Gellionnen sites (98% and 96% of the target value respectively) would still indicate a significant source. The debate on what impacts the newly identified source further up the Swansea Valley in Pontardawe has on the monitoring stations within Swansea is still ongoing but the effect of the improved abatement at the high discharge point within the Vale site can be seen from the data, albeit slightly tempered by the knowledge of a downturn in production due to the economic conditions that have been witnessed globally. The latest monitoring data from 2011 would indicate that the highest annual mean from the four sites within the City & County of Swansea, sits at 54% of the target value with a continued downward trend in concentrations continuing to be evident. The situation is different within Pontardawe with one site being at 138% of the target value.

Breuer Plot 10 below shows the meteorological conditions recorded during 2011 at Cwm Level Park in the lower Swansea Valley. Conditions seen here broadly represent the wider area and indicate a prevalence of predominantly south-westerly/westerly winds. As in previous years, there is also an indication of north-easterly winds which would blow down the alignment of the Swansea valley, taking any concentrations from the release point(s) at Clydach and Pontardawe down to the Morriston site.



Breuer Plot 10 – Swansea Meteorological Conditions 2011

From the data available within tables 22-41, it is clear that annual mean concentrations for arsenic and cadmium at all monitoring locations fall well below the 4th Daughter Directive Target Values.

Additionally, from the data available within tables 22-41, it is clear that annual mean concentrations for lead at all monitoring locations fall well below the $0.25ug/m^3$ required under the Air Quality (Amendment) (Wales) Regulations 2002 to be achieved by the 31st December 2008.

PAH data analysis/ratification from the monitoring site within the compound of the 30m meteorological mast at Cwm Level Park, Landore is complete for 2011 with data thus available up to the end of December 2011. Results of all compounds measured from 2007 to December 2011 can be found by following links at: http://uk-air.defra.gov.uk/data/data_selector - select "Search Daily and Multi-Day Networks" Tab – Select the date range (press Save Selection) and select Site Name-Swansea Cwm Level Park (press Save Selection) from the Select Monitoring Sites dropdown box and then either select the individual pollutant name or Monitoring Network (PAH Digitel (solid phase) from the Select Pollutants dropdown box (press Save Selection) and then use the GET DATA button in the green column to the right.

2.4 Summary of Compliance with AQS Objectives

The City & County of Swansea has measured concentrations of nitrogen dioxide during 2011 above the annual mean objective at relevant locations outside of the existing **Swansea Air Quality Management Area 2010.**

3 Road Traffic Sources

Whilst the report guidance/template indicates that details should only be provided of **new** road traffic sources identified since the last Updating and Screening Assessment, it is thought worthwhile to repeat and update these details from those contained within the City & County of Swansea's USA 2009 and the latest Progress Report 2011.

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

In order to consider which streets fell within the definition of narrow congested streets with a traffic flow of 5000 vehicles per day,[31] the emissions database (EDB) which has been under development over the last several years was first examined during 2009. All road links within the EDB (circa 15,000) were exported into an Excel worksheet and index by the Annual Average Daily Traffic flow (AADT). Details held were examined where the AADT for individual road links was above 4,500 vehicles. This approach was taken as numerous counts from temporary or short duration surveys were held i.e. 1 week duration, where, underestimates of the flow could feasibly be possible due to the time of the year the survey was undertaken i.e. during the school holidays. Once individual road links were identified they were then cross referenced with those roads within the then Hafod Air Quality Management Area and discounted[32] from further consideration.

Numerous road links were identified with flows in excess of an AADT of 4,500 but, these roads were discounted as they did not fit the fit the definition of a narrow congested street with residential properties within 2m of the carriageway on at least one side of the road.

[31] LAQM.TG(09) USA Checklist Box 5.3 – A1 Narrow congested streets with residential properties close to the kerb
[32] LAQM.TG(09) USA Checklist Box 5.3 – (A) Overview

Following this exercise, the streets listed below within table 42 were identified. These roads were not previously thought likely to present problems with the nitrogen dioxide annual mean objective but have been brought back into the scope of assessment due to the AADT requirement. The identified roads suffer congestion as defined within LAQM [33] to one extent or another mainly due to parked vehicles and restricted movements.

Road Name	Area
Hebron Road	Clydach
High Street	Clydach
Lone Road	Clydach
Vardre Road	Clydach
Chemical Road	Morriston / Cwmrhydyceirw
Cwmrhydyceirw Road	Cwmrhydyceirw
Alexandra Road	Gorseinon
Belgrave Road	Gorseinon
Courtney Street	Manselton
Clyndu Street	Morriston
Morfydd Street	Morriston
Parry Road	Morriston
Newton Road	Mumbles
Highpool Lane	Newton
Parkmill Road	Parkmill
Beach Road	Penclawdd
Blodwen Terrace	Penclawdd
Sea View	Penclawdd
Station Road	Penclawdd
Bolgoed Road	Pontardulais
St Teilo Crescent	Pontardulais
Water Street	Pontardulais
Carnglas Road	Tycoch

Table 42 – Identified narrow Streets with AADT > 5000

The authorities' monthly exposure of passive nitrogen dioxide diffusion tubes was increased from 134 sites to 274 sites during November 2009 to assess locations within the above table. This work has now been undertaken and the results of monitoring are presented within tables 3 and 7 of section 2.3 above. Monitoring has found that annual mean concentrations are below the objective level at the majority but not at all of the identified locations for the two complete years of monitoring undertaken. Therefore due to financial restrictions, further monitoring ceased at those sites during May 2011that had exhibited bias corrected annual means concentrations

[33] LAQM.TG(09) USA Checklist Box 5.3 – A1 Narrow congested streets approach page 5-10

30ug/m^3 . For completeness, these sites are annotated within table 3 and highlighted within the results table 7 above.

However, there are some notable exceptions, mainly Newton Road in Mumbles. The situation at Newton road is outlined within section 2.3 where further monitoring has been undertaken during 2011. This monitoring has continued into 2012 and is likely to continue into the foreseeable future. The results of this further monitoring have confirmed the exceedence of the annual mean nitrogen dioxide objective first observed during 2010. **The authority's intentions with regard to Newton Road are outlined within section 8 – Conclusions and Proposed Actions**.

Monitoring will continue within the Pontardulais area despite several sites exhibiting annual bias corrected annual means below 30ug/m^3 as a commitment was made to assess the impact of a major food retail outlet.

3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

Assessments within the city centre commenced following the introduction of the Metro scheme and associated changes to the city centre road network. The monitoring details are included within section 2.3 above and the results contained within table 7. The sites within the city centre are sites 112 - 134.

From the passive NO_2 tube survey work undertaken within the city centre during 2010, several locations were showing the potential to exceed the 1-hour mean objective. In particular, sites 126 and 127 along The Kingsway, Swansea indicated during 2010 annual mean concentrations exceeding 60ug/m^3 and therefore exceedences of the 1-hour NO_2 objected were thought likely.[34] These locations are either close to, or adjacent to, café environments situated on the pavement area alongside the busy roadway. However, during 2011, whilst concentrations remain above the annual mean objective at these sites, there has been no indication that exceedence of the 1-hour objective was likely to have been observed. In terms of LAQM it could therefore now be argued, that relevant exposure no longer exists at

[34] Laxen et al July 2003 - Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites

these locations along the Kingsway. This view is tempered by the knowledge that relevant exposure does exist at locations along the Kingsway in the form of a development comprising of student flats opposite the café environment and another block of flats approximately 50 meters on the same side of the dual carriageway that are yet to be occupied. It has proved impossible to directly monitor at the student flats location as the development has taken place above an existing retail food outlet and directly outside a series of bus stops that presents no suitable monitoring points.

Concerns also exist for sections of High Street that fall outside of the existing Swansea AQMA 2010 exceeding the NO_2 annual mean objective. The situations are described within section 2.3 above. Whilst these data are below an annual mean of 60ug/m^3, there is published evidence[35] to support the possibility that exceedences of the 1-hour NO_2 objective may be seen with an annual mean below 60ug/m^3. Statistically the chances of this occurring are low (around 5% and mainly in the south-east of England) but the possibility remains, given both the increased primary NO_2 now being seen from newer EURO diesel vehicles and the knowledge that High Street witnesses an LDV composition in the traffic flow of over 11.7%.

Planning Applications received and those proposed for numerous sites along High Street are focusing on introducing residential dwellings in the form of flats into this once commercial area. One such development (Urban Village) has commenced and is now well advanced. A brief outline is provided within section 2.3 above whilst discussing the NO_2 passive tube diffusion results. Other proposals along High Street have not as yet progressed to the application stage to convert former office/vacant commercial premises mainly at 1st floor level into living accommodation.

The authority's intentions with regard to the High Street area are outlined within section 8 – Conclusions and Proposed Actions.

[35] AEA Energy & Environment - Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective. AEAT/ENV/R/2641 may 2008

3.3 Roads with a High Flow of Buses and/or HGV's.

The authority operate 44 GPRS traffic counters that have been configured to produce a vehicle classification split into the EUR 6 basic categories as detailed below within table 43. Their location can be seen within Annexe 6. These tend to be within the lower Swansea Valley area in and around the Hafod area but latest deployment have seen this provision expand into other areas, mainly around some of the busier major traffic junctions. Funding is being sought to once again expand this monitoring program but within the current financial climate, expansion is unlikely.

Vehicle class:	Description
0	Unclassified vehicles
1	Motorcycles
2	Cars or light Vans
3	Cars or light Vans with Trailer
4	Heavy Van, Mini bus, L/M/HGV
5	Articulated lorry, HGV+Trailer
6	Bus

Table 43 – EUR6 Classification scheme

Data from the ATC network has been analysed for the years 2004 – 2011 for the basic three categories from the EUR6 classification employed that are required to produce the composition of flow within LAQM.TG(09) box 5.3 Section A3 page 5-12. These details are provided separately for EUR6 classification categories 4-6 below within tables 44-47. Table 47 summarises the total HDV flows.

Heavy Van, Mini bus, L/M/HGV	2004	2005	2006	2007	2008	2009	2010	2011
Site 1	5.2	4	5.1	4.8	4.1	3.5	3.6	3.8
Site 2	6	5.9	6.4	6.1	6.6	6.1	6.2	6.4
Site 3	4.1	3.2	4.3	4.5	7.4	16.2	4.7	4.8
Site 4	4	3.9	4.4	4.4	4.4	4.4	4.5	4.7
Site 5	5.6	5.3	5.6	5.8	5.9	5.4	5.6	5.5
Site 6	6.1	6.3	6.9	7.4	7.4	7.2	7.5	7.4
Site 7	3.9	3.8	4.2	4.5	4.8	4.6	4.7	4.8
Site 8	29.4	30	29.9	29.8	30.3	29.8	29.9	30.6
Site 9	6.4	6.2	6.4	6.6	6.2	5.8	6	6.2
Site 10	5	4.8	4.8	4.8	4.6	4.3	4.3	4.4
Site 11	5.8	5.8	6	6.5	6.9	6.3	6.9	6.5
Site 12	5.2	4.7	5.1	4.9	4.8	4.6	4.7	4.6
Site 13	4.9	4.5	4.7	4.6	4.5	4.3	4.6	4.5
Site 14	5.2	5.2	5.6	5.7	5.9	5.4	5.6	5.6
Site 15	5.4	13.5	8.4	14.4	6.1	6.1	6	6.2
Site 16	5.7	4.7	4.6	4.8	4.8	4.6	4.6	4.7
Site 17	2.2	2	4.3	4.1	5.3	5.1	5.3	5.4
Site 18	5	11	6.7	6.4	6.3	6.5	6.5	6.5
Site 19	5.6	5.4	5.6	5.7	5.7	5.4	5.6	5.7
Site 20	6	5.7	4.9	4.6	4.3	3.9	4.2	4.3
Site 21	6.1	5.8	6.4	6.5	6.7	6.5	6.5	6.7
Site 22	6.1	6.2	6.9	7	6.9	6.7	6.1	5.8
Site 23	4.7	4.5	4.8	5	4.9	4.5	4.6	4.7
Site 24	-	5.5	5.7	5.7	5.5	5.5	5.9	6.1
Site 25	-	4.1	4.5	6.2	6.0	5.6	5.9	6.0
Site 26	4.8	5.1	5.5	5.7	5.6	5.4	5.6	5.9
Site 27	4.3	4.5	5.1	5.5	5.7	15.6	4.5	4.6
Site 28	4.2	4.3	4.8	4.9	4.9	4.6	4.4	4.6
Site 29	4.7	4.4	4.7	4.9	4.7	4.7	4.8	5
Site 30	-	12.6	6.6	4.1	4.2	3.9	4.2	4.1
Site 31	4.1	4.1	4.4	4.6	4.7	4.7	4.8	5.1
Site 32	-	16.8	8.2	3.8	3.8	3.9	3.9	3.9
Site 33	4.1	3.9	4.2	4.4	4.4	4.5	4.6	4.5
Site 34	-	13.2	6.8	4.3	4.4	4.4	4.2	4.1
Site 35	-	37.5	13.9	5.3	5.7	4.8	5	5.1
Site 36	-	-	-	-	-	-	-	
Site 37	-	3.8	3.4	3.8	3.9	3.5	3.6	3.8
Site 38	-	5.9	6.4	6.5	6.3	5.8	8.6	18.8
Site 39	-	4.5	4.7	4.6	5.2	4.9	5.2	5
Site 40	3	3.1	3.5	3.8	3.9	4.0	3.8	3.9
Site 41	-	2.9	2.9	2.7	3.4	3.0	3.1	3.2
Site 42	-	10.9	6.9	5.2	5.1	5.0	4.8	4.9
Site 43	-	4.8	5.1	5.6	5.6	5.3	5.5	5.8
Site 44	-	-	-	6.1	6.1	5.8	6.0	6.1

Table 44 – EUR6 Classification scheme 2004-2011 Class 4

Comments

Site 8 located on Morfa Road, The Stand is directly outside the access road to the main City & County of Swansea transport depot and also to a small industrial estate further up Morfa Road, hence the consistent high percentage composition for this classification.

Site 35 suffered configuration problems during 2005 which failed to take into account the possibility of parked vehicles affecting the classification. This was identified but not fully understood as to why the configuration issues with loop tuning only affected this Class 4 scheme until some time later.

Site 38 – it is not clear why the sudden increase during 2011 occurred but major gas main replacement works were undertaken along Carmarthen Road (outbound) causing significant delays along Carmarthen Road with traffic possibly diverting to avoid delays.

Artic HGV + trailer	2004	2005	2006	2007	2008	2009	2010	2011
Site 1	0.3	0	0.2	0	0	0.2	0.2	0.2
Site 2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Site 3	0	0	0.0	0.0	0.0	0.2	0.0	0.0
Site 4	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Site 5	0	0	0.3	0.3	0.3	0.3	0.3	0.0
Site 6	0.6	0.6	0.8	0.8	0.8	0.7	0.4	0.6
Site 7	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Site 8	2.9	2.9	1.9	1.1	1.8	2.1	2.3	2.4
Site 9	0.5	0.5	0.6	0.4	0.4	0.4	0.4	0.4
Site 10	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2
Site 11	0	0	0	0	0	0.0	0	0
Site 12	0.3	0.4	0.2	0.2	0.1	0.1	0.1	0.1
Site 13	0.5	0.4	0.4	0.4	0.2	0.2	0.2	0.4
Site 14	0.2	0.2	0.3	0.3	0.1	0.2	0.3	0.3
Site 15	0	0.3	0.1	0.3	0.1	0.2	0.5	0.4
Site 16	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 17	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 18	0.3	0.8	0.2	0.4	0.2	0.5	0.6	0.6
Site 19	0.3	0.4	0.2	0.2	0.1	0.2	0.2	0.2
Site 20	0.8	0.8	0.7	0.5	0.5	0.4	0.4	0.4
Site 21	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Site 22	0.7	0.6	0.4	0.4	0.4	0.2	0.4	0.3
Site 23	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.2
Site 24	-	0	0.2	0.2	0.2	0.3	0.3	0.3
Site 25	-	1.1	0.5	0.4	0.3	0.3	0.4	0.4
Site 26	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2
Site 27	0.2	0.3	0.3	0.2	0.4	0.3	0.4	0.2
Site 28	0	0.2	0.2	0.2	0.2	0.4	0.4	0.4
Site 29	0	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Site 30	-	0.3	0.2	0.1	0.1	0.1	0.2	0.1
Site 31	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2
Site 32	-	0	0.1	0	0	0.0	0	0
Site 33	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 34	-	0.6	0.3	0.2	0.1	0.1	0.8	0.1
Site 35	-	1.2	0.7	0.2	0.4	0.2	0.2	0.4
Site 36	-	-	-	-	-	-	-	-
Site 37	-	0.4	0.4	0.5	0.5	0.5	0.5	0.6
Site 38	-	0	0.3	0	0.3	0.3	0.3	0.5
Site 39	-	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Site 40	0	0	0	0	0	0.0	0	0
Site 41	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 42	-	0.4	0.2	0.2	0.2	0.2	0.2	0.2
Site 43	-	1.1	0.9	0.9	1	0.8	1	0.9
Site 44	-	-	-	0.4	0.4	0.4	0.4	0.4

Table 45 – EUR6 Classification scheme 2004-2011 Class 5

Comments

Again, Site 8 is located on Morfa Road, The Stand directly outside the access road to the main City & County of Swansea transport depot and also to a small industrial estate further along Morfa Road, hence the consistent high percentage composition for this classification.

There are some sites (Sites 2,3, 4,11,32 and Site 40 that see consistent negligible artic trailer flow – these sites tend to be within areas that have no reason to see these type of vehicles within the area.

Bus	2004	2005	2006	2007	2008	2009	2010	2011
Site 1	0.3	0.3	1.2	1.6	1.4	1	0.8	0.6
Site 2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3
Site 3	0.2	0.2	0.5	0.5	0.6	0.6	0.6	0.6
Site 4	0	0.3	0.5	0.7	0.7	0.7	0.7	0.5
Site 5	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Site 6	1.4	1.3	1.8	1.9	1.7	1.0	0.6	0.3
Site 7	0.5	0.4	0.6	0.8	1	0.7	1.4	0.6
Site 8	1.5	1.4	0	1.1	0	0.0	0	0
Site 9	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Site 10	0.4	0.3	0.7	0.9	0.5	0.2	0.2	0.2
Site 11	0.8	0.8	2.7	2.9	3.4	2.9	2.9	2.9
Site 12	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Site 13	0.6	0.4	0.2	0.2	0.4	0.4	0.2	0.2
Site 14	1.5	1.3	2	2.2	1.9	1.3	1	0.9
Site 15	0.9	1	1.1	1.2	1.1	0.9	0.6	0.5
Site 16	0.7	0.2	0.3	0.3	0.4	0.3	0.2	0.2
Site 17	0.3	0.2	0.4	0.4	0.4	0.3	0.2	0.2
Site 18	1	1.6	2.1	2.1	1.7	1.3	1.3	1
Site 19	1.2	1.2	2.5	3.3	3.6	3.3	3.1	2.9
Site 20	1.1	1.1	1	0.9	0.9	0.9	0.9	0.9
Site 21	0.2	0.3	0.5	0.5	0.3	0.3	0.3	0.3
Site 22	3.6	3.2	6.7	8.4	8.7	7.4	6.5	5.6
Site 23	0.5	0.4	0.7	0.9	0.9	0.8	0.8	0.8
Site 24	-	0.6	0.7	0.7	0.7	0.8	0.8	0.8
Site 25	-	0.7	0.5	0.8	0.8	0.8	0.9	0.9
Site 26	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.5
Site 27	0.5	0.4	0.5	0.6	0.6	0.6	0.4	0.4
Site 28	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4
Site 29	0	0.3	1.3	1.7	1.7	1.7	1.6	1.4
Site 30	-	0.8	0.8	0.8	0.8	0.8	0.6	0.7
Site 31	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5
Site 32	-	1.3	1.3	1.4	1.4	1.2	1.2	1
Site 33	0.2	0.5	1.1	1.5	1.3	1.3	1.3	1
Site 34	-	1.5	1.5	1.7	1.7	1.6	0.9	0.3
Site 35	-	2	1.6	1.5	1.4	1.2	1	0.9
Site 36	-	-	-	-	-	-	-	-
Site 37	-	0.9	0.8	0.7	0.8	0.8	0.7	0.8
Site 38	-	0.7	1.6	2.1	1.8	1.0	1.2	1.8
Site 39	-	0.2	0.4	0.7	0.8	0.8	0.9	0.7
Site 40	0	0.3	0.7	0.7	0.7	0.7	0.8	0.5
Site 41	-	0.2	0.2	0.2	0.2	0.3	0.4	0.4
Site 42	-	0.8	1	1.1	1.1	1.1	1	0.8
Site 43	-	0.4	0.4	0.4	0.4	0.4	0.4	0.3
Site 44	-	-	-	0.9	0.9	0.9	1.0	0.9

Table 46 – EUR6 Classification scheme 2004-2011 Class 6

Comments

Site 11 exhibits a relatively low AADT but it is evident that the fraction of class 6 buses is "significant" within the overall flow. This increased following the opening of the Liberty Stadium and Morfa Shopping complex nearby.

Site 22 has shown increased composition of buses following the developments mentioned above and the fact that all bus services now use High Street (stopping outside the main railway station) as the primary access route leading into the city centre. This effect can also be seen at site 19 Carmarthen Road which leads directly into High Street.

Total HDV as % of Traffic Flow	2004	2005	2006	2007	2008	2009	2010	2011
Site 1	5.8	4.3	6.5	6.4	5.5	4.7	4.6	4.6
Site 2	6.4	6.3	6.6	6.3	6.9	6.4	6.6	6.7
Site 3	4.3	3.4	4.8	5	8	17	5.3	5.4
Site 4	4	4.2	4.9	5.1	5.1	5.1	5.2	5.2
Site 5	5.6	5.3	5.9	6.1	6.2	5.7	5.9	5.5
Site 6	8.1	8.2	9.5	10.1	9.9	8.9	8.5	8.3
Site 7	4.6	4.3	4.9	5.4	5.9	5.4	6.2	5.5
Site 8	33.8	34.3	31.8	32	32.1	31.9	32.2	33
Site 9	7.4	7	7.4	7.4	7	6.6	6.8	7
Site 10	5.8	5.5	5.7	5.9	5.3	4.7	4.7	4.8
Site 11	6.6	6.6	8.7	9.4	10.3	9.2	9.8	9.4
Site 12	5.8	5.5	5.4	5.2	5	4.8	4.9	4.8
Site 13	6	5.3	5.3	5.2	5.1	4.9	5	5.1
Site 14	6.9	6.7	7.9	8.2	7.9	6.9	6.9	6.8
Site 15	6.3	14.8	9.6	15.9	7.3	7.2	7.1	7.1
Site 16	6.7	5.1	5.1	5.3	5.4	5.1	5	5.1
Site 17	2.6	2.4	4.9	4.7	5.9	5.6	5.7	5.8
Site 18	6.3	13.4	9	8.9	8.2	8.3	8.4	8.1
Site 19	7.1	7	8.3	9.2	9.4	8.9	8.9	8.8
Site 20	7.9	7.6	6.6	6	5.7	5.2	5.5	5.6
Site 21	6.7	6.4	7.1	7.2	7.2	7	7	7.2
Site 22	10.4	10	14	15.8	16	14.3	13	11.7
Site 23	5.5	5.1	5.7	6.1	6	5.4	5.6	5.7
Site 24	-	6.1	6.6	6.6	6.4	6.6	7	7.2
Site 25	-	5.9	5.5	7.4	7.1	6.7	7.2	7.3
Site 26	5.8	5.9	6.2	6.5	6.4	6	6.3	6.6
Site 27	5	5.2	5.9	6.3	6.7	6.5	5.3	5.2
Site 28	4.6	4.9	5.5	5.6	5.6	5.4	5.2	5.4
Site 29	4.7	5	6.2	6.8	6.6	6.6	6.6	6.6
Site 30	-	13.7	7.6	5	5.1	4.8	5	4.9
Site 31	4.7	4.6	5.1	5.3	5.4	5.4	5.5	5.8
Site 32	-	18.1	9.6	5.2	5.2	5.1	5.1	4.9
Site 33	4.5	4.6	5.5	6.1	5.9	6	6.1	5.7
Site 34	-	15.3	8.6	6.2	6.2	6.1	5.9	4.5
Site 35	-	40.7	16.2	7	7.5	6.2	6.2	6.4
Site 36	-	-	-	-	-	-	-	
Site 37	-	5.1	4.6	5	5.2	4.8	4.8	5.2
Site 38	-	6.6	8.3	8.6	8.4	7.1	10.1	21.1
Site 39	-	4.9	5.4	5.6	6.3	6	6.4	6
Site 40	3	3.4	4.2	4.5	4.6	4.7	4.6	4.4
Site 41	-	3.3	3.3	3.1	3.8	3.5	3.7	3.8
Site 42	-	12.1	8.1	6.5	6.4	6.3	6	5.9
Site 43	-	6.3	6.4	6.9	7	6.5	6.9	7
Site 44	-	-	-	7.4	7.4	7.1	7.4	7.4

Table 47– HDV composition from EUR6 Classification scheme 2004-2011

LAQM.TG(09) box 5.3 Section A3 page 5-12 defines roads with an unusually high proportion of HDV as ones with a HDV content greater than 20%. From table 46 it can be seen that only site 8 at Morfa Road consistently meets this definition. As explained above, there is at present no relevant exposure at this location as Morfa Road leads into an industrial estate that also houses the main transport depot for the authority. However, this situation will change within the next 6-12 months as residential development at the former Unit Superheaters site has commenced during mid 2011. Morfa Road falls within the development proposals of The Tawe Riverside Development Corridor. These proposals include residential developments along the banks of the river Tawe, encompassing Morfa Road. These proposals have already seen the purchase and demolition of several commercial/industrial units in preparation for parts of the privately funded scheme. The economic downturn has not seen construction works commence until mid 2011 but it is inevitable that further works will commence in the coming years. It is open to debate at present as to how long the whole scheme will take to complete as it is inevitable that some commercial/industrial units will remain whilst development proceeds along Morfa Road. This ATC will allow monitoring of the composition during the transition of the area from a commercial/industrial area to primarily, a residential area.

The high HDV composition at site 38 during 2011 may be as a result of gas main replacement works along the outbound carriageway of Carmarthen Road causing traffic to divert to avoid delays and congestion. Data for 2012 indicates that flows have returned to what can be considered as “normal”. No significance has been placed on the 2011 data as an indication of likely future flows.

Site 22 High Street was approaching the 20% threshold in previous years but it should be noted that whilst relevant exposure exits within 10m along this section of High Street, the area already lies within the Hafod Air Quality Management Area as described above within section 3.3. However, again as described in section 3.3, concerns are growing in regard to the lower sections of High Street that fall outside of the Hafod AQMA that forms part of The Swansea Air Quality Management Area 2010.

Since the completion of the redevelopment works at the Quadrant Bus Station along Westway in the city centre, all bus routes now enter and egress the terminal along Westway. Residential properties exist along this route but due to funding restrictions there are no finances available to install ATC counters along Westway. Site 36 within tables 44-47 has already been identified as the proposed site at Westway.

The City and County of Swansea confirms that there are no new/newly identified roads with high flows of buses/HDVs.

3.4 Junctions

Guidance within LAQM.TG(09) box 5.3 Section A4 page 5-15 requires the identification of all "busy" junctions. A busy junction is defined within LAQM.TG(09) as one with more than 10,000 vehicles per day. An additional requirement is to determine if there is relevant exposure within 10m of the kerb (Swansea's population of approx. 240,000 does not take it into the major conurbation category where relevant exposure would be within 20m of the kerb). Whilst as stated within the 2nd round of review and assessment there were several junctions that it was thought would meet the traffic volumes required, it was not thought there were receptor locations within 10m of the kerb. However, this situation has now changed with the construction of the new SA1 junction along Fabian Way and the construction of the new Tesco access road /junction following the reconstruction and expansion of its outlet at Nantyffin Road, Llansamlet

Passive nitrogen dioxide measurements are already being made around several junctions mentioned within previous reporting and these data are included within section 2.3 above.

It is thought that to measure PM_{10} at these locations would provide more meaningful data in preference to DMRB calculations. It has proved to be not economically viable or practical to deploy Thermo FDMS PM_{10} analysers at these locations. Therefore, alternative real-time instruments had been sourced to undertake the monitoring works that are desirable. The instruments chosen were Met One Instruments Inc. E-

Type sampler (http://www.metone.com/documents/esamplerParticulate.pdf) It is recognised that these were not true gravimetric or type approved instruments for use on the UK network but current guidance indicates that use of the near forwards light scattering technique was suitable for screening assessments. This coupled with their ease of deployment made them an ideal alternative in these situations. It has not been possible to progress this matter since the original comments within the 2nd round USA due to technical difficulties with the operation of the monitoring equipment. Whilst the infrastructure for the monitoring is now in place, the Etype samplers have proved unreliable in operation. Major problems have been experienced with pump failures and other operational issues. The plans to utilise

Photo 13 - SA1 PM_{10} EBam Installation

Photo 14- Typical PM_{10} Pump Pack

Photo 15 – SA1 PM_{10} Ebam

these samplers has now changed and funding was provided to source a different analyser. The unit chosen was the MetOne EBam PM_{10} [36] (similar in operation to the MetOne PM_{10} Bam1020) but not referenced for equivalency to the EU gravimetric method. However, given these limitations it is thought that the PM_{10} EBams will provide more reliable/robust data than previous instruments as considerable effort has been made to provide external pumps capable of delivering a consistent 16.7 l/min. During August 2012 five PM_{10} EBam units were installed at Fforestfach Cross, Sketty Cross, Uplands, Westway, and SA1 junction (Port Tennant Road). Photos 13-15 above show the typical installation that has been undertaken at the SA1 junction (Port Tenant Road).

[36] http://www.metone.com/documents/E-BAM_Datasheet_Rev_Aug09.pdf

It should be noted that the nearest monitoring location may in the majority of cases be greater than 10m away from the main junction. Practical considerations i.e. power requirements have also dictated the exact siting.

The junctions with combined traffic volumes likely to be >10,000 AADT flow to be monitored by way of passive nitrogen dioxide diffusion tubes and/or PM_{10} measurements are:

a) Fforestfach Cross
b) Sketty Cross
c) Oystermouth Road
d) Llansamlet Cross
e) Quay Parade Bridges
f) Dyfatty Junction
g) Uplands Cross
h) SA1 junction, Fabian Way
i) Westway (opposite major bus station and major food retailer)

Whilst it has been possible to report the results of the NO_2 monitoring around several of these junctions, reliable long term PM_{10} monitoring has not proved possible due to the issues described above. This has now changed with the installation of the five EBam units described above. Data from the EBams will be reported in subsequent reports. It is not known if/when funding will be available to permit installation of EBams at the other five locations above.

3.5 *New Roads Constructed or Proposed Since the Last Round of Review and Assessment*

The City and County of Swansea confirms that there are no new/proposed roads within the authority's area.

3.6 Roads with Significantly Changed Traffic Flows

Data is available from 2006-2011 and these data are presented below within tables 48 - to assess trends with the composition of the traffic flows being measured. Class 0 is intended to provide evidence of data capture as should problems be experienced within the traffic counter with classification then vehicles would manifest within this category. As can be seen within tables 48 - very few operational issues have been experienced. This does not account for downtime where the loops have been completely severed by either resurfacing works or gas main replacement works. In these situations data loss the ATC site is total.

2006	Percentage Vehicle Classes							AADT	AWDT
	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6		
Site 1	0.8	0.8	91.5	0.4	5.1	0.2	1.2	**12072**	**12792**
Site 2	0.0	0.7	92.4	0.3	6.4	0.0	0.2	**14160**	**15288**
Site 3	0.0	0.4	94.6	0.2	4.3	0.0	0.5	**13272**	**14016**
Site 4	0.0	0.5	94.4	0.2	4.4	0.0	0.5	**10392**	**10848**
Site 5	0.0	0.9	92.9	0.3	5.6	0.3	0.0	**7728**	**8376**
Site 6	0.0	1.3	88.7	0.5	6.9	0.8	1.8	**14616**	**15240**
Site 7	0.0	0.7	94.2	0.2	4.2	0.1	0.6	**21576**	**22680**
Site 8	0.0	3.7	63.6	0.9	29.9	1.9	0	**2568**	**3264**
Site 9	0.0	0.6	91.7	0.4	6.4	0.6	0.4	**12984**	**13488**
Site 10	0.0	0.6	93.5	0.3	4.8	0.2	0.7	**21672**	**22992**
Site 11	0.0	0.5	89.6	1.1	6	0	2.7	**4368**	**4560**
Site 12	0.0	0.6	93.8	0.1	5.1	0.2	0.1	**19440**	**21144**
Site 13	0.0	0.5	93.9	0.4	4.7	0.4	0.2	**13320**	**15168**
Site 14	0.0	0.9	90.5	0.6	5.6	0.3	2	**15408**	**16128**
Site 15	0.0	0.5	89.6	0.2	8.4	0.1	1.1	**22032**	**23520**
Site 16	0.0	0.6	94.1	0.3	4.6	0.2	0.3	**27120**	**28968**
Site 17	0.0	1.2	93.6	0.3	4.3	0.2	0.4	**27336**	**28824**
Site 18	0.0	1.4	89.5	0.2	6.7	0.2	2.1	**15744**	**16608**
Site 19	0.0	0.6	90.6	0.5	5.6	0.2	2.5	**23232**	**24144**
Site 20	0.0	0.9	92.1	0.4	4.9	0.7	1	**32904**	**34488**
Site 21	0.0	0.6	92	0.3	6.4	0.2	0.5	**30528**	**32592**
Site 22	0.0	0.7	84	1.3	6.9	0.4	6.7	**10752**	**10896**
Site 23	0.0	0.4	93.4	0.4	4.8	0.2	0.7	**22656**	**24072**
Site 24	0.0	2.2	90.8	0.2	5.7	0.2	0.7	**9672**	**10272**
Site 25	0.0	2.3	91.9	0.3	4.5	0.5	0.5	**23160**	**24720**
Site 26	0.0	0.5	92.9	0.3	5.5	0.3	0.4	**22440**	**23664**
Site 27	0.1	0.5	93	0.4	5.1	0.3	0.5	**17496**	**18528**
Site 28	0.0	0.7	93.5	0.4	4.8	0.2	0.5	**13584**	**14352**
Site 29	0.0	0.9	92.3	0.6	4.7	0.2	1.3	**11208**	**11856**
Site 30	0.0	1	91.2	0.2	6.6	0.2	0.8	**21480**	**22728**
Site 31	0.0	0.9	93.6	0.4	4.4	0.3	0.4	**16416**	**16944**
Site 32	0.0	0.4	89.8	0.1	8.2	0.1	1.3	**16464**	**17352**
Site 33	0.0	0.7	93.4	0.4	4.2	0.2	1.1	**21864**	**22848**
Site 34	0.0	0.7	90.6	0.1	6.8	0.3	1.5	**17088**	**18048**
Site 35	0.0	4.2	78.9	0.7	13.9	0.7	1.6	**13656**	**14088**
Site 36	-	-	-	-	-	-	-	**-**	**-**
Site 37	5.4	2.7	86.9	0.4	3.4	0.4	0.8	**44088**	**45816**
Site 38	0.0	0.8	90.4	0.5	6.4	0.3	1.6	**8976**	**9576**
Site 39	0.0	1.9	92.4	0.3	4.7	0.3	0.4	**23664**	**24936**
Site 40	0.0	0.7	94.9	0.2	3.5	0	0.7	**10248**	**11040**
Site 41	0.0	2	94.5	0.3	2.9	0.2	0.2	**30768**	**32424**
Site 42	0.0	0.7	91.1	0.2	6.9	0.2	1	**14592**	**15624**
Site 43	0.0	1.4	91.7	0.5	5.1	0.9	0.4	**31248**	**33696**

Table 48 – GPRS ATC Classification split 2006

2007	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	0.6	92.8	0.2	4.8	0	1.6	**11976**	**12696**
Site 2	0.0	0.7	92.9	0.2	6.1	0.0	0.2	**13824**	**14904**
Site 3	0.0	0.4	94.4	0.2	4.5	0.0	0.5	**13272**	**14016**
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	**10368**	**10848**
Site 5	0.0	0.9	92.6	0.3	5.8	0.3	0.0	**7800**	**8472**
Site 6	0.0	1.3	88.3	0.3	7.4	0.8	1.9	**14952**	**15576**
Site 7	0.0	0.7	93.8	0.1	4.5	0.1	0.8	**20424**	**21504**
Site 8	0.0	3.2	63.8	1.1	29.8	1.1	1.1	**2280**	**2880**
Site 9	0.0	0.5	92	0.2	6.6	0.4	0.4	**13536**	**13944**
Site 10	0.3	0.6	92.9	0.2	4.8	0.2	0.9	**21432**	**22584**
Site 11	0.0	0.6	89.4	0.6	6.5	0	2.9	**4056**	**4248**
Site 12	0.0	0.7	93.9	0.1	4.9	0.2	0.1	**19896**	**21504**
Site 13	0.0	0.6	93.6	0.4	4.6	0.4	0.2	**13080**	**14856**
Site 14	0.0	1.1	90.3	0.3	5.7	0.3	2.2	**15072**	**15672**
Site 15	0.0	0.5	83.3	0.3	14.4	0.3	1.2	**22368**	**23976**
Site 16	0.0	0.7	93.8	0.2	4.8	0.2	0.3	**27600**	**29304**
Site 17	0.0	1.3	93.7	0.3	4.1	0.2	0.4	**27360**	**28728**
Site 18	0.0	1.6	89.3	0.1	6.4	0.4	2.1	**16200**	**17112**
Site 19	0.0	0.7	89.9	0.1	5.7	0.2	3.3	**22704**	**23472**
Site 20	0.0	1.1	92.6	0.3	4.6	0.5	0.9	**32976**	**34896**
Site 21	0.0	0.8	91.8	0.2	6.5	0.2	0.5	**30984**	**33000**
Site 22	0.0	0.7	83.3	0.2	7	0.4	8.4	**10896**	**11040**
Site 23	0.0	0.5	93.1	0.2	5	0.2	0.9	**22344**	**23568**
Site 24	0.0	2.2	90.8	0.2	5.7	0.2	0.7	**9696**	**10296**
Site 25	0.0	1.0	91.4	0.2	6.2	0.4	0.8	**12000**	**12600**
Site 26	0.0	0.5	92.6	0.3	5.7	0.3	0.5	**22584**	**23808**
Site 27	0.0	0.9	92.6	0.2	5.5	0.2	0.6	**22320**	**23760**
Site 28	0.0	0.9	93.3	0.2	4.9	0.2	0.5	**13656**	**14424**
Site 29	0.0	0.8	92.2	0.2	4.9	0.2	1.7	**11328**	**12000**
Site 30	0.0	1	93.9	0.2	4.1	0.1	0.8	**22344**	**23712**
Site 31	0.0	1	93.3	0.3	4.6	0.3	0.4	**16056**	**16584**
Site 32	0.0	0.5	94.3	0.2	3.8	0	1.4	**15984**	**16896**
Site 33	0.0	0.7	93.1	0.1	4.4	0.2	1.5	**21312**	**22272**
Site 34	0.0	0.8	92.9	0.2	4.3	0.2	1.7	**15144**	**16032**
Site 35	0.0	3.6	89.2	0.2	5.3	0.2	1.5	**12696**	**13152**
Site 36	-	-	-	-	-	-	-	**-**	
Site 37	0.0	2.6	92	0.5	3.8	0.5	0.7	**47592**	**49728**
Site 38	0.0	0.8	90.6	0	6.5	0	2.1	**9240**	**9864**
Site 39	6.0	2.1	86.1	0.2	4.6	0.3	0.7	**23280**	**24384**
Site 40	0.0	0.7	94.8	0	3.8	0	0.7	**10200**	**10968**
Site 41	0.0	2.3	94.5	0.2	2.7	0.2	0.2	**30720**	**32280**
Site 42	0.0	0.8	92.6	0.2	5.2	0.2	1.1	**14904**	**15936**
Site 43	0.0	1.5	91.2	0.5	5.6	0.9	0.4	**30648**	**32976**
Site 44	0.0	0.9	91.4	0.2	6.1	0.4	0.9	**10944**	**11544**

Table 49 – GPRS ATC Classification split 2007

2008	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	0.9	93.4	0.2	4.1	0	1.4	**10584**	**11232**
Site 2	0.0	0.7	92.2	0.2	6.6	0.0	0.3	**14472**	**15648**
Site 3	0.0	0.4	91.4	0.2	7.4	0.0	0.6	**12048**	**12720**
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	**9936**	**10392**
Site 5	0.0	0.9	92.5	0.3	5.9	0.3	0.0	**7656**	**8304**
Site 6	0.0	1.2	88.6	0.3	7.4	0.8	1.7	**15528**	**16392**
Site 7	0.0	0.8	93.2	0.1	4.8	0.1	1	**20064**	**21264**
Site 8	0.0	4.6	62.4	0.9	30.3	1.8	0	**2616**	**3336**
Site 9	0.0	0.6	92.4	0.2	6.2	0.4	0.4	**12864**	**13272**
Site 10	0.0	0.3	93.7	0.7	4.6	0.2	0.5	**21312**	**22560**
Site 11	0.0	0.6	89.1	0	6.9	0	3.4	**4176**	**4344**
Site 12	0.0	0.6	94.2	0.1	4.8	0.1	0.1	**19440**	**21000**
Site 13	0.0	0.6	94.2	0.2	4.5	0.2	0.4	**12864**	**14616**
Site 14	0.0	0.9	90.9	0.3	5.9	0.1	1.9	**16368**	**17328**
Site 15	0.0	0.6	91.9	0.2	6.1	0.1	1.1	**22512**	**24192**
Site 16	0.0	0.7	93.8	0.2	4.8	0.2	0.4	**26976**	**28872**
Site 17	0.0	0.7	93.3	0.2	5.3	0.2	0.4	**27048**	**28680**
Site 18	0.0	0.4	91.2	0.3	6.3	0.2	1.7	**15744**	**16728**
Site 19	0.0	0.8	89.7	0.1	5.7	0.1	3.6	**18216**	**18840**
Site 20	0.0	1.1	92.9	0.3	4.3	0.5	0.9	**31560**	**33144**
Site 21	0.0	0.8	91.8	0.2	6.7	0.2	0.3	**30744**	**32976**
Site 22	0.0	0.7	83	0.2	6.9	0.4	8.7	**10728**	**10824**
Site 23	0.0	0.5	93.3	0.2	4.9	0.2	0.9	**22200**	**23544**
Site 24	0.0	4	89.3	0.2	5.5	0.2	0.7	**9672**	**10344**
Site 25	0.0	0.8	91.8	0.2	6.0	0.3	0.8	**14352**	**15192**
Site 26	0.0	0.5	92.8	0.2	5.6	0.3	0.5	**22440**	**23904**
Site 27	0.0	0.7	92.4	0.2	5.7	0.4	0.6	**19920**	**21288**
Site 28	0.0	0.7	93.3	0.4	4.9	0.2	0.5	**13248**	**14088**
Site 29	0.0	0.9	92.3	0.2	4.7	0.2	1.7	**11160**	**11832**
Site 30	0.0	1	93.8	0.2	4.2	0.1	0.8	**21936**	**23376**
Site 31	0.0	1.1	93.3	0.3	4.7	0.2	0.5	**15360**	**15888**
Site 32	0.0	0.5	94.2	0.2	3.8	0	1.4	**15792**	**16704**
Site 33	0.0	0.7	93.3	0.1	4.4	0.2	1.3	**21408**	**22488**
Site 34	0.0	0.7	92.9	0.1	4.4	0.1	1.7	**16824**	**17928**
Site 35	0.0	3.3	89.1	0.2	5.7	0.4	1.4	**12288**	**12744**
Site 36	-	-	-	-	-	-	-	**-**	**-**
Site 37	0.0	1.7	92.5	0.6	3.9	0.5	0.8	**45960**	**47712**
Site 38	0.0	0.8	90.3	0.5	6.3	0.3	1.8	**9144**	**9792**
Site 39	0.0	1.7	91.8	0.2	5.2	0.3	0.8	**23208**	**24360**
Site 40	0.0	0.7	94.7	0	3.9	0	0.7	**9936**	**10680**
Site 41	0.0	1	95	0.2	3.4	0.2	0.2	**29856**	**31512**
Site 42	0.0	0.8	92.6	0.2	5.1	0.2	1.1	**14976**	**16056**
Site 43	0.8	1.5	90.2	0.5	5.6	1	0.4	**29784**	**32232**
Site 44	0.0	0.9	91.5	0.2	6.1	0.4	0.9	**13344**	**14184**

Table 50 – GPRS ATC Classification split 2008

2009	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	1	94.1	0.2	3.5	0.2	1	**11808**	**12552**
Site 2	0.0	0.7	92.5	0.2	6.1	0.0	0.3	**14448**	**15624**
Site 3	0.0	0.4	82.5	0.2	16.2	0.2	0.6	**12888**	**13656**
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	**9864**	**10368**
Site 5	0.0	1	93	0.3	5.4	0.3	0.0	**7152**	**7680**
Site 6	0.0	1.3	89.6	0.2	7.2	0.7	1.0	**14232**	**14880**
Site 7	0.0	0.7	93.6	0.1	4.6	0.1	0.7	**19248**	**20376**
Site 8	0.0	5.3	61.7	1.1	29.8	2.1	0.0	**2256**	**2880**
Site 9	0.0	0.6	92.8	0.2	5.8	0.4	0.4	**12912**	**13368**
Site 10	0.0	0.6	93.9	0.8	4.3	0.2	0.2	**21624**	**22968**
Site 11	0.0	0.6	90.2	0.0	6.3	0.0	2.9	**4200**	**4368**
Site 12	0.0	0.7	94.3	0.1	4.6	0.1	0.1	**19776**	**21456**
Site 13	0.0	0.6	94.4	0.2	4.3	0.2	0.4	**12792**	**14568**
Site 14	0.0	1	91.8	0.3	5.4	0.2	1.3	**14952**	**15696**
Site 15	0.0	0.8	91.8	0.1	6.1	0.2	0.9	**20544**	**21864**
Site 16	0.0	0.8	93.9	0.2	4.6	0.2	0.3	**25656**	**27264**
Site 17	0.0	0.8	93.4	0.2	5.1	0.2	0.3	**26640**	**28104**
Site 18	0.0	1.8	89.8	0.2	6.5	0.5	1.3	**14760**	**15528**
Site 19	0.0	0.8	90.3	0.1	5.4	0.2	3.3	**21936**	**22776**
Site 20	0.0	1.1	93.3	0.3	3.9	0.4	0.9	**31680**	**33216**
Site 21	0.0	0.9	92	0.3	6.5	0.2	0.3	**27768**	**29616**
Site 22	0.0	0.7	84.7	0.2	6.7	0.2	7.4	**10320**	**10416**
Site 23	0.0	0.6	93.8	0.2	4.5	0.1	0.8	**22320**	**23808**
Site 24	0.0	2.3	91.2	0.0	5.5	0.3	0.8	**9600**	**10248**
Site 25	0.0	0.8	92.2	0.2	5.6	0.3	0.8	**14232**	**15096**
Site 26	0.0	0.4	93.3	0.2	5.4	0.2	0.4	**21768**	**23136**
Site 27	0.0	0.3	82.2	1.0	15.6	0.3	0.6	**22464**	**24000**
Site 28	0.0	0.4	93.8	0.5	4.6	0.4	0.4	**13608**	**14424**
Site 29	0.0	0.8	92.4	0.2	4.7		1.7	**11280**	**11928**
Site 30	0.0	1	94.1	0.2	3.9	0.1	0.8	**22224**	**23664**
Site 31	0.0	1.1	93.3	0.3	4.7	0.2	0.5	**15840**	**16392**
Site 32	0.0	0.4	94.3	0.1	3.9	0.0	1.2	**16152**	**17088**
Site 33	0.0	0.7	93.2	0.1	4.5	0.2	1.3	**21528**	**22584**
Site 34	0.0	0.7	93	0.1	4.4	0.1	1.6	**16872**	**17952**
Site 35	0.0	3.1	90.7	0.0	4.8	0.2	1.2	**12432**	**12888**
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.6	92.8	0.9	3.5	0.5	0.8	**47064**	**48888**
Site 38	0.0	0.5	90.8	1.6	5.8	0.3	1.0	**9144**	**9816**
Site 39	0.0	1.3	92.5	0.2	4.9	0.3	0.8	**22944**	**24096**
Site 40	0.0	0.7	94.6	0.0	4.0	0.0	0.7	**9720**	**10464**
Site 41	0.0	0.6	95.6	0.3	3.0	0.2	0.3	**30336**	**31992**
Site 42	0.0	0.8	92.7	0.2	5.0	0.2	1.1	**14832**	**15864**
Site 43	0.0	1.4	91.5	0.5	5.3	0.8	0.4	**29232**	**31488**
Site 44	0.0	0.9	91.9	0.2	5.8	0.4	0.9	**13272**	**14112**

Table 51 – GPRS ATC Classification split 2009

2010	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	1	94.1	0.2	3.6	0.2	0.8	**11856**	**12600**
Site 2	0.0	0.7	92.6	0.2	6.2	0.0	0.4	**13536**	**14616**
Site 3	0.0	0.6	94.0	0.2	4.7	0.0	0.6	**12792**	**13608**
Site 4	0.0	0.7	94.0	0.0	4.5	0.0	0.7	**10080**	**10704**
Site 5	0.0	1.0	92.7	0.3	5.6	0.3	0.0	**7224**	**7776**
Site 6	1.0	2.3	87.9	0.2	7.5	0.4	0.6	**11544**	**12264**
Site 7	0.0	0.8	92.8	0.1	4.7	0.1	1.4	**20832**	**22104**
Site 8	0.0	4.6	62.1	1.1	29.9	2.3	0	**2088**	**2664**
Site 9	0.0	0.8	92.3	0.2	6	0.4	0.4	**12768**	**13008**
Site 10	0.0	1.4	93.2	0.7	4.3	0.2	0.2	**20856**	**22224**
Site 11	0.0	0.6	89.6	0	6.9	0	2.9	**4152**	**4344**
Site 12	0.0	0.8	94.1	0.1	4.7	0.1	0.1	**18720**	**20256**
Site 13	0.0	0.6	94.2	0.2	4.6	0.2	0.2	**12096**	**13776**
Site 14	0.0	1	91.8	0.3	5.6	0.3	1	**14640**	**15432**
Site 15	0.0	0.8	92	0.1	6	0.5	0.6	**20784**	**22200**
Site 16	0.0	0.8	94.1	0.2	4.6	0.2	0.2	**25176**	**26760**
Site 17	0.0	0.8	93.4	0.2	5.3	0.2	0.2	**28488**	**30192**
Site 18	0.0	1.6	89.8	0.2	6.5	0.6	1.3	**14784**	**15648**
Site 19	0.0	0.8	90.1	0.1	5.6	0.2	3.1	**20136**	**20952**
Site 20	0.0	1.2	93.1	0.3	4.2	0.4	0.9	**30840**	**32544**
Site 21	0.0	0.8	92	0.2	6.5	0.2	0.3	**28968**	**31128**
Site 22	0.0	0.8	86.2	0	6.1	0.4	6.5	**5928**	**6048**
Site 23	0.0	0.7	93.5	0.2	4.6	0.2	0.8	**21792**	**23208**
Site 24	0.0	1.9	91.1	0	5.9	0.3	0.8	**8880**	**9480**
Site 25	0.0	0.9	91.8	0.2	5.9	0.4	0.9	**13488**	**14304**
Site 26	0.0	0.5	93	0.2	5.6	0.2	0.5	**20976**	**22200**
Site 27	0.0	0.7	93.3	0.7	4.5	0.4	0.4	**19344**	**20568**
Site 28	0.0	0.4	93.8	0.6	4.4	0.4	0.4	**12456**	**13224**
Site 29	0.0	0.9	92.2	0.2	4.8	0.2	1.6	**10488**	**11088**
Site 30	0.0	1	93.9	0.2	4.2	0.2	0.6	**14952**	**16008**
Site 31	0.0	1.1	93.1	0.3	4.8	0.2	0.5	**15336**	**15840**
Site 32	0.0	0.5	94.2	0.2	3.9	0	1.2	**15456**	**16368**
Site 33	0.0	0.8	92.9	0.1	4.6	0.2	1.3	**20280**	**21216**
Site 34	0.0	0.9	92.3	0.8	4.2	0.8	0.9	**15360**	**16344**
Site 35	0.0	2	91.8	0	5	0.2	1	**12024**	**12576**
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.6	92.7	0.8	3.6	0.5	0.7	**45648**	**47688**
Site 38	0.0	0.6	87.7	1.5	8.6	0.3	1.2	**7776**	**8352**
Site 39	0.0	1.3	92.1	0.2	5.2	0.3	0.9	**22248**	**23400**
Site 40	0.0	0.8	94.6	0	3.8	0	0.8	**8928**	**9624**
Site 41	0.0	0.6	95.5	0.3	3.1	0.2	0.4	**29136**	**31008**
Site 42	0.0	0.8	93.1	0.2	4.8	0.2	1	**14520**	**15600**
Site 43	0.0	1.3	91.3	0.5	5.5	1	0.4	**27264**	**29544**
Site 44	0.0	1.0	91.5	0.2	6.0	0.4	1.0	**12456**	**13272**

Table 52 – GPRS ATC Classification split 2010

2011	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1		1	94.2	0.2	3.8	0.2	0.6	**12000**	**12768**
Site 2		0.7	92.5	0.2	6.4	0.0	0.3	**14376**	**15456**
Site 3		0.4	94.1	0.2	4.8	0.0	0.6	**12984**	**13800**
Site 4		0.7	94.1	0.0	4.7	0.0	0.5	**9720**	**10272**
Site 5		1.0	93.5	0.0	5.5	0.0	0.0	**7440**	**8016**
Site 6		1.7	89.9	0.2	7.4	0.6	0.3	**15888**	**16824**
Site 7		0.8	93.5	0.1	4.8	0.1	0.6	**20832**	**22320**
Site 8		4.7	62.4	0	30.6	2.4	0	**2040**	**2616**
Site 9		0.7	92.1	0.2	6.2	0.4	0.4	**10848**	**11280**
Site 10		0.4	94	0.7	4.4	0.2	0.2	**19440**	**20688**
Site 11		0.6	90	0	6.5	0	2.9	**4080**	**4272**
Site 12		0.8	94.2	0.1	4.6	0.1	0.1	**18072**	**19560**
Site 13		0.6	94.1	0.2	4.5	0.4	0.2	**12216**	**13896**
Site 14		0.9	92	0.3	5.6	0.3	0.9	**16200**	**17160**
Site 15		0.9	91.9	0.1	6.2	0.4	0.5	**22536**	**24216**
Site 16		0.7	94	0.2	4.7	0.2	0.2	**26208**	**27864**
Site 17		0.7	93.4	0.2	5.4	0.2	0.2	**29472**	**31368**
Site 18		1.6	90.1	0.1	6.5	0.6	1	**16320**	**17400**
Site 19		0.8	90.2	0.1	5.7	0.2	2.9	**21192**	**22128**
Site 20		1.2	92.9	0.3	4.3	0.4	0.9	**30888**	**32664**
Site 21		0.8	91.8	0.2	6.7	0.2	0.3	**30240**	**32592**
Site 22		0.5	87.9	0	5.8	0.3	5.6	**9504**	**9720**
Site 23		0.7	93.5	0.1	4.7	0.2	0.8	**20568**	**21888**
Site 24		2.7	90.1	0	6.1	0.3	0.8	**8976**	**9624**
Site 25		0.9	91.6	0.2	6.0	0.4	0.9	**13128**	**13944**
Site 26		0.5	92.6	0.2	5.9	0.2	0.5	**19800**	**21024**
Site 27		0.4	93.8	0.6	4.6	0.2	0.4	**19392**	**20712**
Site 28		0.4	93.6	0.6	4.6	0.4	0.4	**12360**	**13152**
Site 29		1	92.1	0.2	5	0.2	1.4	**9984**	**10608**
Site 30		0.9	93.9	0.2	4.1	0.1	0.7	**20424**	**21744**
Site 31		1.4	92.6	0.3	5.1	0.2	0.5	**15600**	**16200**
Site 32		0.6	94.3	0.1	3.9	0	1	**16080**	**17040**
Site 33		0.8	93.3	0.1	4.5	0.2	1	**21144**	**22224**
Site 34		0.4	93.8	1.3	4.1	0.1	0.3	**16896**	**18072**
Site 35		1.1	92.3	0.2	5.1	0.4	0.9	**13152**	**13752**
Site 36									
Site 37		2.9	91	1	3.8	0.6	0.8	**45288**	**47328**
Site 38		0.3	77.2	1.3	18.8	0.5	1.8	**9168**	**9864**
Site 39		1.3	92.5	0.2	5	0.3	0.7	**22632**	**23856**
Site 40		0.8	94.7	0	3.9	0	0.5	**9144**	**9840**
Site 41		0.5	95.4	0.3	3.2	0.2	0.4	**27336**	**29016**
Site 42		0.8	93.2	0.2	4.9	0.2	0.8	**15192**	**16344**
Site 43		1.3	91.1	0.5	5.8	0.9	0.3	**28752**	**31296**
Site 44		0.9	91.5	0.2	6.1	0.4	0.9	**12936**	**13800**

Table 53 – GPRS ATC Classification split 2011

To assess if the AADT has changed significantly over the period 2005-2011, data is presented below in table 54

Site	AADT 2005	AADT 2006	AADT 2007	AADT 2008	AADT 2009	AADT 2010	AADT 2011	% Growth 2011 over 2008 Base year	% Growth 2011 over 2009 Base year	% Growth 2011 over 2010 Base year
1	7248	12072	11976	10584	11808	11856	12000	13.38	1.63	1.21
2	10608	14160	13824	14472	14448	13536	14376	-0.66	-0.50	6.21
3	10368	13272	13272	12048	12888	12792	12984	7.77	0.74	1.50
4	8616	10392	10368	9936	9864	10080	9720	-2.17	-1.46	-3.57
5	5472	7728	7800	7656	7152	7224	7440	-2.82	4.03	2.99
6	12552	14616	14952	15528	14232	11544	15888	2.32	11.64	37.63
7	19536	21576	20424	20064	19248	20832	20832	3.83	8.23	0.00
8	1632	2568	2280	2616	2256	2088	2040	-22.02	-9.57	-2.30
9	9288	12984	13536	12864	12912	12768	10848	-15.67	-15.99	-15.04
10	18888	21672	21432	21312	21624	20856	19440	-8.78	-10.10	-6.79
11	2904	4368	4056	4176	4200	4152	4080	-2.30	-2.86	-1.73
12	12864	19440	19896	19440	19776	18720	18072	-7.04	-8.62	-3.46
13	12720	13320	13080	12864	12792	12096	12216	-5.04	-4.50	0.99
14	13344	15408	15072	16368	14952	14640	16200	-1.03	8.35	10.66
15	16392	22032	22368	22512	20544	20784	22536	0.11	9.70	8.43
16	21120	27120	27600	26976	25656	25176	26208	-2.85	2.15	4.10
17	22368	27336	27360	27048	26640	28488	29472	8.96	10.63	3.45
18	11784	15744	16200	15744	14760	14784	16320	3.66	10.57	10.39
19	18240	23232	22704	18216	21936	20136	21192	16.34	-3.39	5.24
20	28392	32904	32976	31560	31680	30840	30888	-2.13	-2.50	0.16
21	23808	30528	30984	30744	27768	28968	30240	-1.64	8.90	4.39
22	8160	10752	10896	10728	10320	5928	9504	-11.41	-7.91	60.32
23	19776	22656	22344	22200	22320	21792	20568	-7.35	-7.85	-5.62
24	-	9672	9696	9672	9600	8880	8976	-7.20	-6.50	1.08
25	-	23160	12000	14352	14232	13488	13128	-8.53	-7.76	-2.67
26	19248	22440	22584	22440	21768	20976	19800	-11.76	-9.04	-5.61
27	18720	17496	22320	19920	22464	19344	19392	-2.65	-13.68	0.25
28	11160	13584	13656	13248	13608	12456	12360	-6.70	-9.17	-0.77
29	9240	11208	11328	11160	11280	10488	9984	-10.54	-11.49	-4.81
30	-	21480	22344	21936	22224	14952	20424	-6.89	-8.10	36.60
31	13896	16416	16056	15360	15840	15336	15600	1.56	-1.52	1.72
32	-	16464	15984	15792	16152	15456	16080	1.82	-0.45	4.04
33	19752	21864	21312	21408	21528	20280	21144	-1.23	-1.78	4.26
34	-	17088	15144	16824	16872	15360	16896	0.43	0.14	10.00
35	-	13656	12696	12288	12432	12024	13152	7.03	5.79	9.38
36	-	-	-	-	-	-	-	-	-	-
37	-	44088	47592	45960	47064	45648	45288	-1.46	-3.77	-0.79
38	-	8976	9240	9144	9144	7776	9168	0.26	0.26	17.90
39	-	23664	23280	23208	22944	22248	22632	-2.48	-1.36	1.73
40	7872	10248	10200	9936	9720	8928	9144	-7.97	-5.93	2.42
41	-	30768	30720	29856	30336	29136	27336	-8.44	-9.89	-6.18
42	-	14592	14904	14976	14832	14520	15192	1.44	2.43	4.63
43	-	31248	30648	29784	29232	27264	28752	-3.46	-1.64	5.46
44	-	-	10944	13344	13272	12456	12936	-3.06	-2.53	3.85

Table 54 AADT Percentage Growth 2005-2011

* Site 25 was counting 4 lanes (dual carriageway) of traffic in 2006. However, due to impending network changes (Carmarthen Road Park & Ride site) the site was relocated to count 2 lanes of outbound traffic only during January 2007. Site 44 was established at the same time on the other side of the dual carriageway to count inbound traffic on the remaining 2 lanes.

It should be noted that gas main replacement works/resurfacing works during 2010/2011 at sites 6 (Neath Road, Hafod) site 22 (High Street) and site 30 (Sketty Park Road) have influenced the growth calculations within table 54 above and should therefore be treated with caution. This said, there are some interesting observations with the flows at site 9 (New Cut Road), site 14 (Bridge Street, Hafod), site 15 (Neath Road) site 18 (Neath Road Hafod), site 34 (Walter Road) and site 38 (Pentregethin Road).

Site 9 leads into the new Quay Parade bridge layout and it would appear that a reduction in flows is now being observed down this route from Dyfatty. Sites 14, site 15 and site 18 which are all within the Hafod area along the Neath Road corridor have, however, indicated an increase in flows using Neath Road as the route into/out of the City Centre. Observations relating to the 2011 AADT at site 38 Pentregethin Road above appear to be borne out with the increase in flow which is probably as a result of gas main replacement works along Carmarthen Road as mentioned above. As noted, the apparent increase in flow is primarily within the LDV category. It will be interesting to observe these trends over the coming years. If the trend of increased usage of the Neath Road corridor continues then this will be an unwelcomed trend. Data from the Hafod DOAS within the Neath Road canyon will be closely monitored.

Guidance within LAQM.TG(09) box 5.3 Section A6 page 5-18 defines a “large” increase in traffic flow to be one greater than 25%. This level of growth has been seen between 2005 and 2006 at several sites but between 2007- 2011, there is no evidence to determine that such an increase has been seen at any of the GPRS ATC’s. Whilst sites 6, 22 and 30 indicate growth rates above 25% the data presented above is scewed by knowledge of gas main/resurfacing works affecting data capture. Site 38 which sows an increase below 25% can be explained by knowledge of traffic diverting from Carmarthen Road to avoid gas main renewal works along this road. The flows around site 38 should have returned to “normal” following completion of works along Carmarthen Road.

The Swansea Metro project aims to transform public transport in Swansea by introducing the new concept StreetCar vehicle, on a route with signalled priority at key sections between Morriston Hospital and Singleton Hospital, via the City Centre.

It now runs on-street, from Morriston Hospital to Singleton Hospital via the City Centre and Oystermouth Road stopping at many key destinations, including:

- Morriston Hospital,
- Woodfield Street, Morriston
- High Street Station,
- Kingsway,
- the new Quadrant Interchange (see section 3.8 below)
- County Hall,
- University and Singleton hospital**.**

Signalled priority will be provided at key locations, including:

- Martin Street roundabout,
- Cwm Level roundabout,
- Normandy Road roundabout,
- the proposed Landore Express Route
- and in the City Centre, with the detailed design being carried out in-house

In order to enable the Swansea Metro to run, considerable works to the existing road network were required. Some of these works required at Cwm Level and Normandy Road roundabouts lie within the existing Hafod Air Quality Management Area. The road network surrounding these key roundabouts has been altered to provide priority to the Metro service by way of signal controlled access.

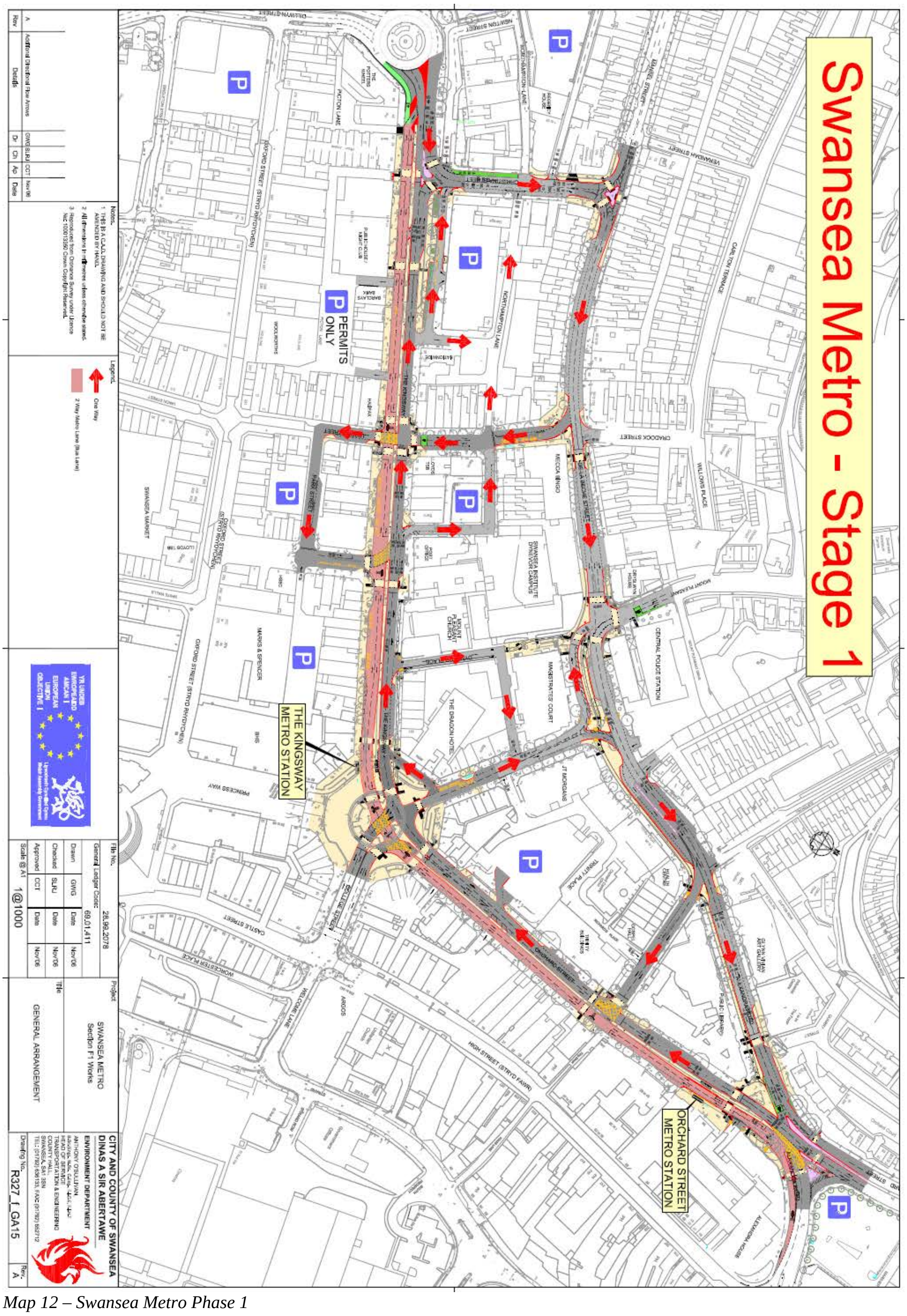
The first phase of these works started within the Kingsway area of the city centre during the summer months of 2006. Plans of the works completed as part of phase 1 can be seen below as maps 12 and 13.

Phase 2 of the Metro scheme (see map 14) commenced during July 2007 to extend the provision from the Kingsway down along Westway, linking into the Quadrant

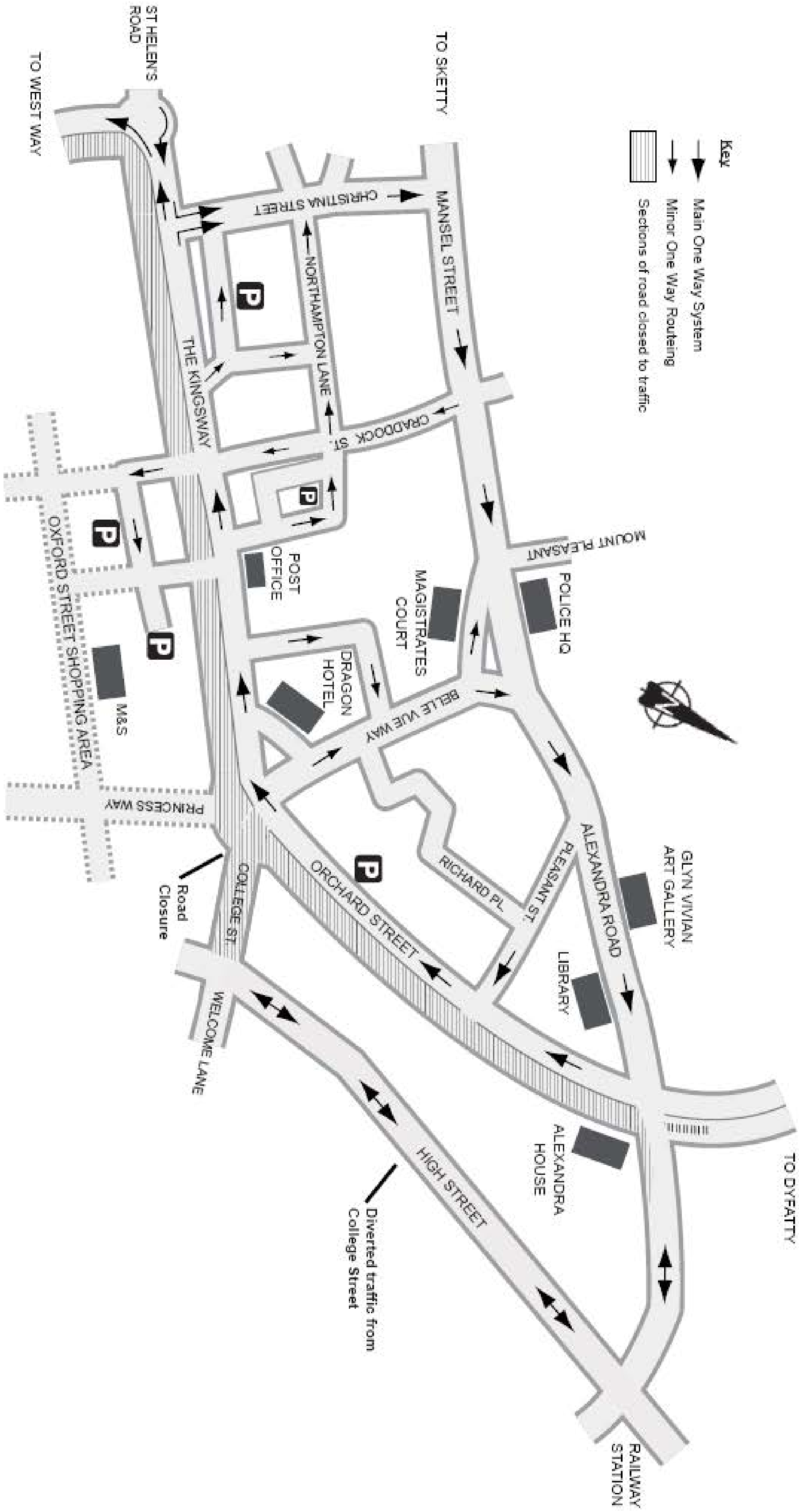
Transport Interchange (see section 3.7 below) and to the new Civic Centre on Oystermouth Road. Phase 2 was completed during late 2008/early 2009.

Phase 2 has seen major changes to the traffic flow within the city centre area. As yet, no GPRS ATC's have been installed along the affected routes to assess any pattern changes but discussions have already taken place and sites identified to enable suitable monitoring of traffic flows. Unfortunately, due to budgetary constraints no orders have been place with the equipment suppliers as yet. Some of the work being undertaken with regard to the passive diffusion tube survey work is aimed at assessing what, if any impact this change in traffic flow within the city centre is having with NO_2 levels. This work is outlined within section 2.3 above.

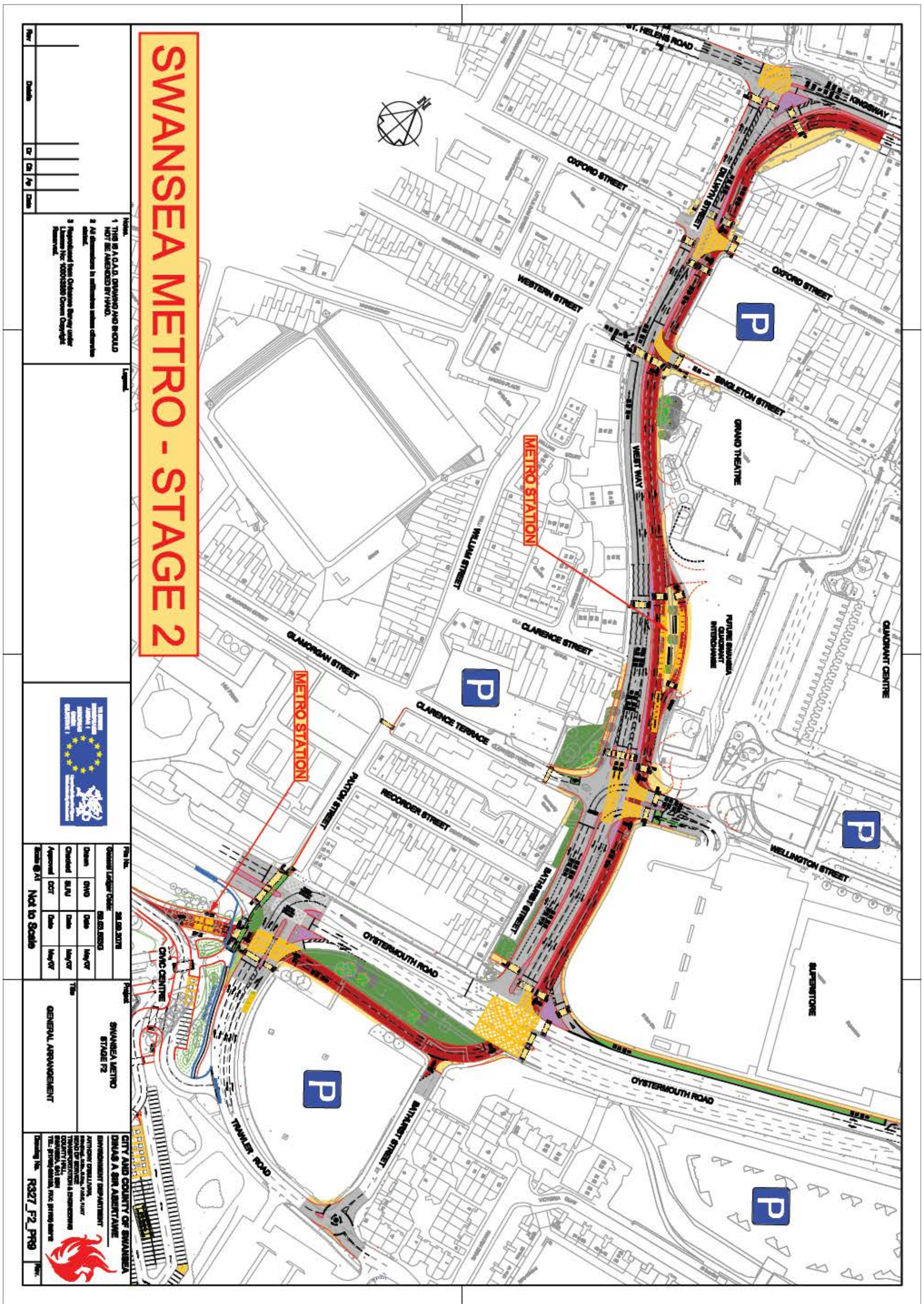
Installation of ATC site 36 (Westway) has been awaiting the completion of the redevelopment of the Quadrant Interchange (Sec 3.7 below) as access and egress roadways from the new interchange will require consideration and monitoring. However, the same budgetary constraints now evident within the authority may see this planned monitoring site delayed for several years or even cancelled.



Map 12 – Swansea Metro Phase 1



Map 13 Swansea Metro Phase 1



Map 14 – Phase 2 Swansea Metro Project

Funding is being sought to enable the installation of GPRS ATC's within the city centre area but with the current budgetary restraints being faced by the authority, this is unlikely to be realised.

The City and County of Swansea confirms that there are no new/newly identified roads with significantly changed traffic flows.

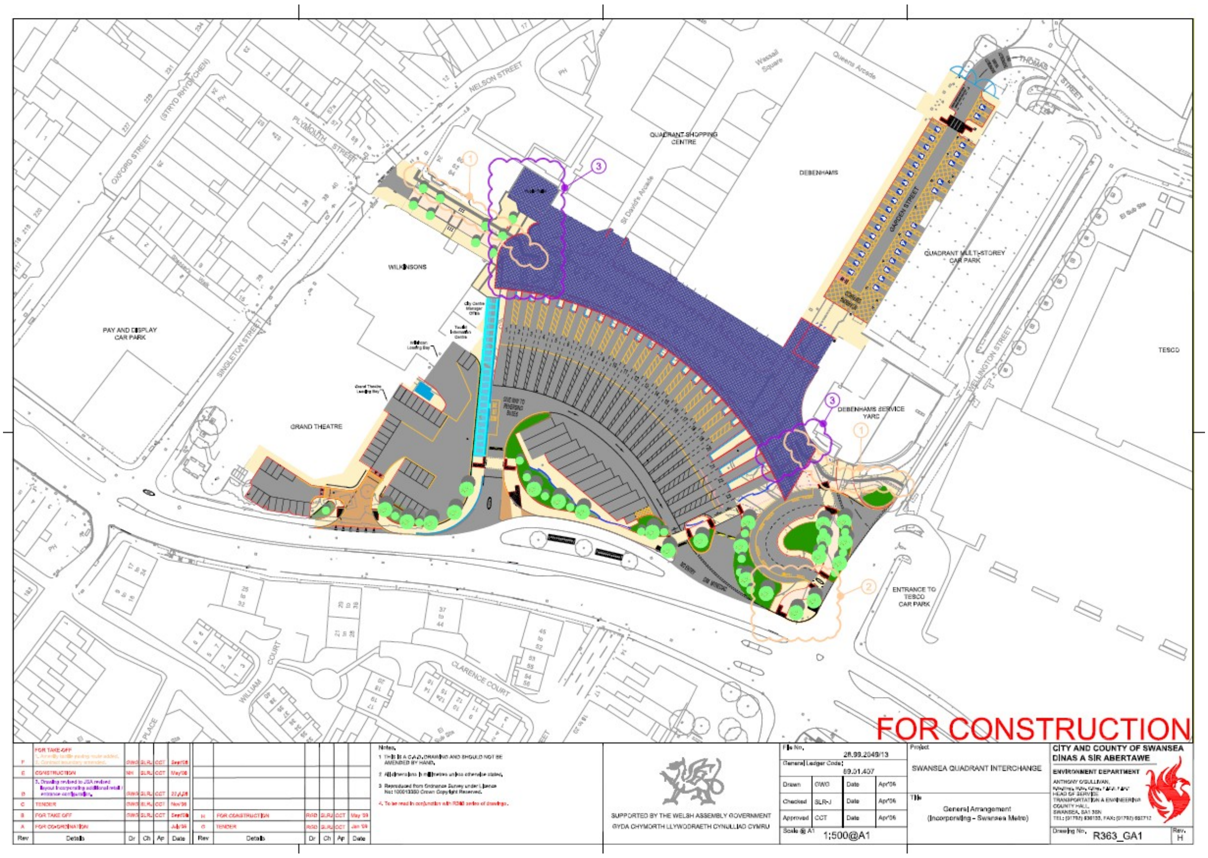
3.7 Bus and Coach Stations

3.7.1 Quadrant bus station

The City and County of Swansea has now completed a scheme to replace the old Quadrant bus station with a modern Transport Interchange to cater for both buses and coaches, including Swansea Metro vehicles, on a larger footprint. The old Quadrant bus station was outdated in terms of passenger convenience, comfort and security. The Council's aspiration was for a modern transport interchange with high standards of cleanliness and security. The refurbishment of the Quadrant bus station was identified as a high priority in the Swansea Local Transport Plan 2000 – 2005 and was completed during November/December 2010.

Sketch 1 indicates a schematic layout of the scheme with artist's impressions of the façade given below as sketches 2-3*.* A plan of the development area is given below as map 15.

Sketch 1 Quadrant Transport Interchange off Westway, Swansea



Map 15 – *Quadrant Transport Interchange off Westway, Swansea*

Blocks of flats can be seen opposite the completed Quadrant Interchange. These blocks tend to be occupied by the elderly with warden accommodation. A basic Screening Assessment had been started during 2008 in front of one of the blocks of flats to assess both PM_{10} and NO_2. The PM_{10} light scattering analyser had suffered numerous breakdowns with the result that little meaningful data is available. Provision of a Thermo PM_{10} FDMS is not feasible due to the practical siting criteria issues to be resolved as well as the costs that would be incurred. Assessment of the new facility is required and will require both traffic counts and PM_{10} measurements to be undertaken. A MetOne EBam PM_{10} analyser was installed on Westway during August 2012 (see Sec 3.5 above) and a PM_{10} assessment will now be made in future reporting. Funding to provide a permanent GPRS ATC (site 36) is still being sought.

Sketch 2 Quadrant Transport Interchange

Sketch 3 Quadrant Transport Interchange

Outline of scheme

The main components of the scheme comprised the following elements:

- 20 bus bays,
- 3 coach stands

- 2 Swansea Metro “stations” on Westway.
- 12 lay-over spaces
- Modern coach station facility to serve the long distance services,
- Enhanced passenger concourse with support facilities.
- Safe access to and from West Way
- New staff and office facilities
- Travel Shop (Information/ticket sales area.)
- Shopmobility Facility. In the Garden Street tunnel area
- Associated Retail Units.
- Enhanced links into the Quadrant shopping area.
- Improved access to the Grand Theatre and Wilkinson’s service areas
- Taxi rank for 9 vehicles
- Short stay parking for 5 cars (Passenger pick-up) adjacent to the coach area
- Passenger drop-off area

Movements of buses in and out of the interchange will be capable of being monitored when GPRS ATC site 36 is installed along Westway.

At present, there is existing relevant exposure within approximately 25m of the curtilage of the development. From guidance contained within LAQM.TG(09) box 5.3 section A7 page 5-19 relevant exposure is required to be assessed either within 10m of any part of the bus station where buses are present or within 20m if the bus/coach station is within a major conurbation. Major conurbation is not defined within box 5.3 section A7 page 5-19 but it is defined as a population greater than 2 million within box 5.3 Sections A3 and A4 pages 5-12 to 5-15. Major conurbation is therefore, in this scenario, taken to be the same meaning given within sections A3 and A4, which in the case of Swansea, with a population of just under a quarter of a million clearly does not apply.

3.7.2 The Swansea Boulevard Project

As part of the delivery of the City Centre Strategic Framework, Consultants were engaged to produce a Concept, Design and Implementation Study in relation to the European Boulevard which was agreed by Cabinet in December 2008.

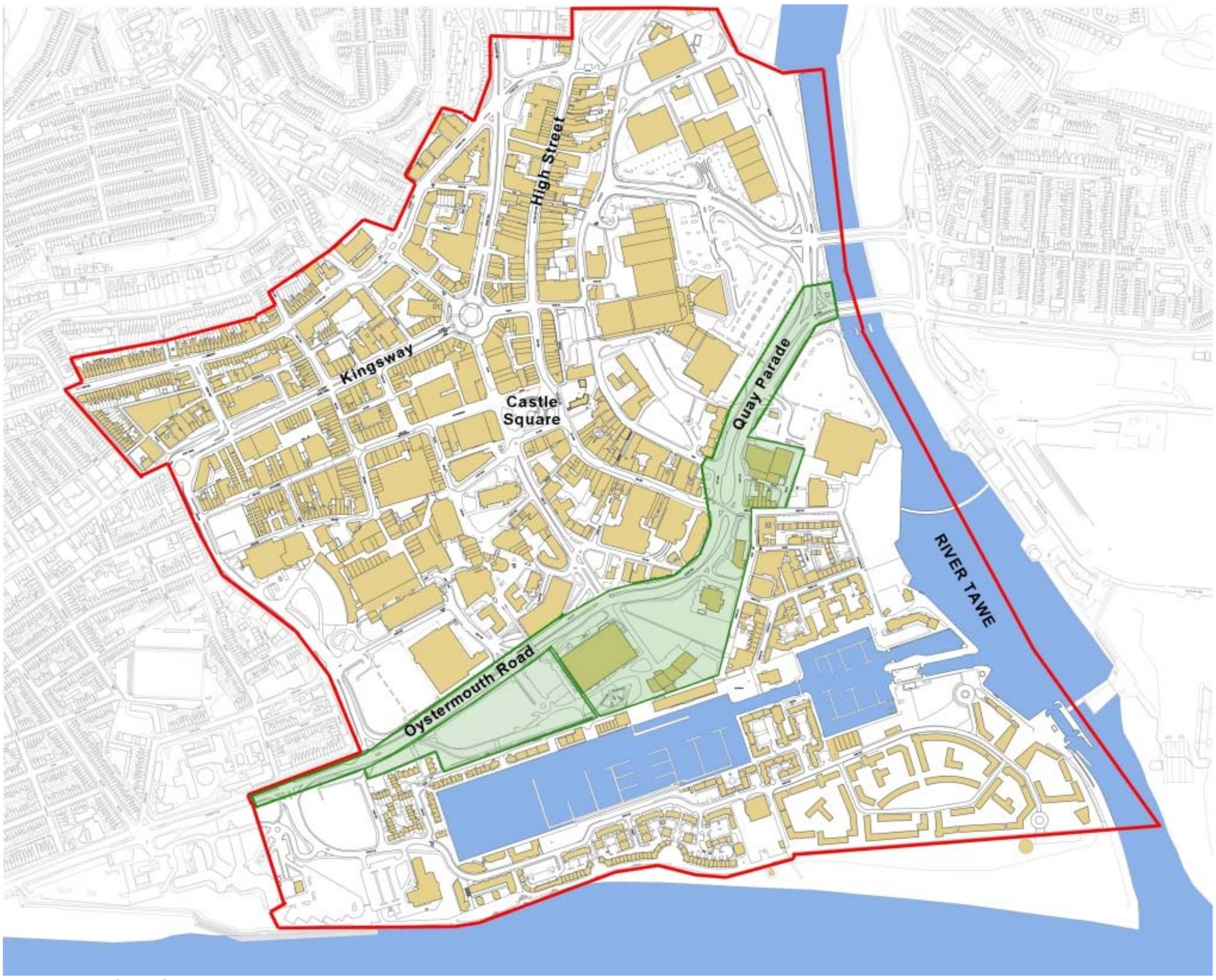
The project is to create a "boulevard" from the river bridges to the Civic Centre which provides a step change in perceptions of this gateway corridor from an urban freeway to a vibrant tree lined city street which allows the connection of the City Centre to the Maritime Quarter. The Boulevard will encourage high quality architectural design, excellent public realm and landscape and provide an effective balance between its role as the key artery into the City Centre and increased pedestrian movement and permeability.

The reconfiguration of the Tawe Bridges was completed in December 2011. This constituted phase 1 of the Boulevard project and was required in order to create additional highway capacity to accommodate pedestrian, cycle and public transport enhancements along the Boulevard.

Phase 2 of the Boulevard scheme is programmed to commence in January 2013 and will cover the section between the Leisure Centre to Wind Street, with Phase 3 following in January 2014 covering Wind Street to the Tawe Bridges.

The works to Phase 2 and 3 will construct the following enhancements:

- upgrading the public realm with high quality materials being used throughout;
- introduction of a bus lane between Princess Way and Wind Street;
- enhanced pedestrian/cycle crossings (toucan);
- widened footways;
- installation of a shared use path on the southern footway;
- trees to be planted in the footways and central reserve;
- lighting and CCTV upgrades;
- telematics upgrade;
- closure of minor junctions and accesses



Swansea Boulevard project

Sketch 4 Swansea Boulevard project

4 Other Transport Sources

4.1 Airports

Swansea does have a small airport located at Fairwood Common, Upper Killay that has previously been used as a “regional airport”. However, guidance within LAQM.TG(09) box 5.4 Section B1 page 5-21 indicates that assessment for NO_2 will only be required should relevant exposure exist within 1000m of the airport boundary and if the total equivalent passenger throughput exceeds 10 million passengers per annum. Freight traffic is minimal.

There are receptor locations within 500m of the airport boundary but clearly the airport does not see passenger numbers in excess of 10 million per annum.

The City & County of Swansea confirm there are no airports meeting the assessment criteria in the Local Authority Area.

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

Landore Diesel Sheds is a major servicing centre primarily for Inter City 125 high-speed trains (HST) and is located within the Swansea Air Quality Management Area 2010. The site operates on a 24 hour seven day a week basis. An aerial view of the site is shown below as map 16 indicating the proximity of domestic dwellings to the site

Site activities can be broadly classified into two categories: maintenance and servicing. Maintenance tends to occur within the sheds themselves. Here, engines are repaired, maintained and tested. It is not uncommon for several HST engine units to be under test at the same time. Exhaust emissions are vented through cowl housings to the roof of the sheds.

Map 16 – Landore Diesel Sheds and Surrounding Area

Maintenance operations involve the routine cleaning and refuelling of the HST units in dedicated sidings. Extensive warm up periods are mandated prior to movement of the HST train back out and onto the main line.

Guidance within LAQM.TG(09) requires the identification of locations where diesel locomotives are regularly stationary for periods of more than 15 minutes[37]. This is clearly the case at Landore Diesel Sheds but the guidance also indicates exposure potential for regular outdoor exposure to members of the public within 15m of the stationary locomotives. The nearest façade of any dwelling is approximately 35m from the servicing bay. There is also a public “open grassed area” within approximately 40 m of the servicing bays.

Observations at this location have indicated very infrequent use by the general public. Bearing in mind that the majority of servicing occurs during the night-time hours it is concluded that there is no relevant exposure from this activity at this location. A similar view has been formed over the use of the main shed complex.

[37] LAQM.TG(09) Box 5.4 Section B2 Approach 1 page 5-22

An identical view has also been formed for the activities currently undertaken at Swansea Central railway Station. Inter City 125 units and other diesel locomotives are left running during periods leading up to the scheduled service departures. However, there is no regular outdoor exposure of members of the public within 15m of the stationary locomotives. It should be noted that a development on the former Unit Superheaters site at The Strand proposes several 5 story block of apartments. These apartments when complete will overlook the main platform area at Swansea Central Railway Station. The impact of the rail activities will be assessed once these apartments are complete and occupied. It is anticipated that completion of the development underway (see Progress Report 2011 Sec 5.2.4 Morfa Road Area)

“Sprinter services” are offered to/from several local stations both on the mainline Swansea – Paddington London line and also the West Wales line. However, these sprinter services are not stationary at these very local stations for periods of 15 minutes or more. Consequently, their impact is minimal

4.2.2 Moving Trains

Guidance within LAQM.TG(09) box 5.4 Section B2 – Approach 2 page 5-23 indicates a number of criteria to determine suitable assessment. The main Swansea to Paddington London rail line is listed within table 5.1 indicating rail lines with heavy traffic of diesel passenger trains. In addition, approach 2 requires identification of whether the background annual mean NO_2 concentration is above 25ug/m^3. In order to answer this question, use has been made of the 1k by 1k background maps from http://laqm.defra.gov.uk/maps/maps2010.html .The text file for NO_2 background concentrations for 2011 has been imported into Arcview 3.3 GIS and examined. If the background NO_2 1k by 1k concentrations are indexed in descending order it can be seen that the maximum 1k by 1k grid square (266500 196500) for 2011 returns a value of 26.14ug/m^3. If this grid point is plotted it can be seen that the centre of the 1k by 1k grid square is just north of the main Swansea to Paddington London line in the Plasmarl area of Swansea. The next highest 1k by 1k grid square (265500 193500) for 2011 is 21.70ug/m^3 and is located just north of Alexandra Road in the city centre and approximately 270m from Swansea Central Railway station.

Local knowledge of the path of the Swansea to Paddington London railway line would also indicate that that there is no potential for **long-term** exposure within 30m of the edge of the tracks.

The above views have been supplemented by examination of the LAQM Support website at http://laqm.defra.gov.uk/supporting-guidance.html which includes an item under Supplementary Guidance - "**Guidance on assessing emissions of railway locomotives".** The link http://laqm.defra.gov.uk/documents/Railway_Locomotives_100209.pdf contains an Adobe PDF document entitled – Guidance on Assessing Emissions from Railway Locomotives dated 10th February 2009. This document details within table 1 the rail lines with a heavy traffic of diesel passenger trains. The Paddington to Swansea line is listed. Table 2 of the document lists 35 local authorities where the 2008 background NO_2 concentration is expected to exceed the threshold for assessment of 25 ug/m^3. The City and County of Swansea were not one of the 35 local authorities identified.

In view of the above, there is no requirement to proceed further with a Detailed Assessment for NO_2 at locations within 30m of the Swansea to Paddington London railway line.

4.3 Ports (Shipping)

Swansea is Associated British Ports (ABP's) most westerly South Wales port and has developed a trade base with North and Western Europe, the Mediterranean and also with Northern Ireland and the Irish Republic. The port's major cargo-handling trade is receiving and shipping steel cargoes for Tata. It is equipped with a wide range of heavy-duty handling equipment offering quayside cranes and a range of forklift trucks with capacities of up to 40 tonnes. Other traffics include containers, forest products, bulk cargoes, liquid bulks and general/project cargoes. The port can accommodate vessels up to 30,000 dwt.

Guidance within LAQM.TG(09) box 5.4 Section B3 Shipping page 5-24 requires the determination on the number of ship movements per year and also to establish if there is relevant exposure either within 250m of the quayside and manoeuvring areas should shipping movements be between 5000 – 15000 per year or exposure within 1km of the quayside and manoeuvring areas should shipping movements exceed 15000 per year. Enquiries with the Port Health Authority indicate that during 2011 there were a total of 477 vessels visiting the port which equates to 954 total shipping movements. If the local tug fleet is also taken into consideration this would still not bring the number of movements to above the 5000 threshold required for assessment.

For sake of completeness, there are residential properties located on Bevans Row, Port Tenant within 230m of the Kings Dock quayside. An ever increasing number of residential flats are being constructed on the nearby SA1 development sites. At present these new residential units are outside of the scope of assessment and are likely to remain so given the decreasing number of shipping movements seen at the port. A decrease in movements has been observed during 2011 as the Swansea-Cork ferry ceased operation from the port.

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been carried out.

There have been no new or proposed installations received by the City & County of Swansea.

For information, during November 2007 the Secretary of State granted planning permission for Prenergy Power Limited to operate a renewable energy power station capable of generating some 350 MW of electricity within Neath Port Talbot.[38] The process will involve the combustion of approximately 2.5 to 3 million tonnes of woodchip per annum. The plant has not been constructed yet.

An environmental statement was provided and dispersion modelling was carried out using ADMS. This work stated that the impacts of carbon monoxide, nitrogen dioxide, PM_{10} and sulphur dioxide would be insignificant in respect of the Air Quality Objectives.

Further dispersion modelling work was required as part of the Environment Agency permit application. Neath Port Talbot council have accepted the conclusions of the Environmental Statement. The location of the Prenergy Power Ltd site is shown below as map 17.

[38] Source Neath Port Talbot Council

Map 17 Location of Prenergy site within Neath Port Talbot

The City & County of Swansea confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced

The City & County of Swansea confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

The City & County of Swansea confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

There are no major fuel (petrol) storage depots within the Local Authority area.

5.3. Petrol Stations

Guidance contained within LAQM.TG(09) indicates that there is some evidence that petrol stations will emit sufficient benzene to put the 2010 5μg/m^3 objective at risk if the throughput exceeds 2000m^3 of petrol , especially if combined with higher levels from a nearby busy road[39]. A busy road is defined as one with more than 30,000 vehicles per day. The guidance goes on to indicate that relevant exposure within 10m of the fuel pumps should also be present if the above criterion is met.

Details from the Authorisations held by the authority have been examined. There are twenty nine authorised petrol filling stations within the authority's area, with fourteen of these having a throughput greater than 2000m^3. Of these fourteen stations, seven are fitted with stage 2 vapour recovery, with the remainder being fitted with stage 1 vapour recovery. Relevant exposure was examined for each location using ArcView GIS ver 3.3, whereby 10m radius were plotted from the actual pumps to access if relevant exposure existed. Of the 14 petrol stations examined, relevant exposure does not exist at any, but, as in the case of previous rounds of review and assessment, two cases deserve explanation.

One petrol filling (Mumbles Road, Blackpill) station meets the above criteria (throughput, traffic flows and relevant exposure) to have warranted further investigation. For the sake of completeness the second station (Sketty Filling Station, Gower Road) partially meets the criteria (throughput and relevant exposure).

During previous assessment works (USA July 2004) it has been established that whilst both of these filling stations have dwellings located within 10m of the fuel pumps, these properties have been purchased by the fuel companies and have been

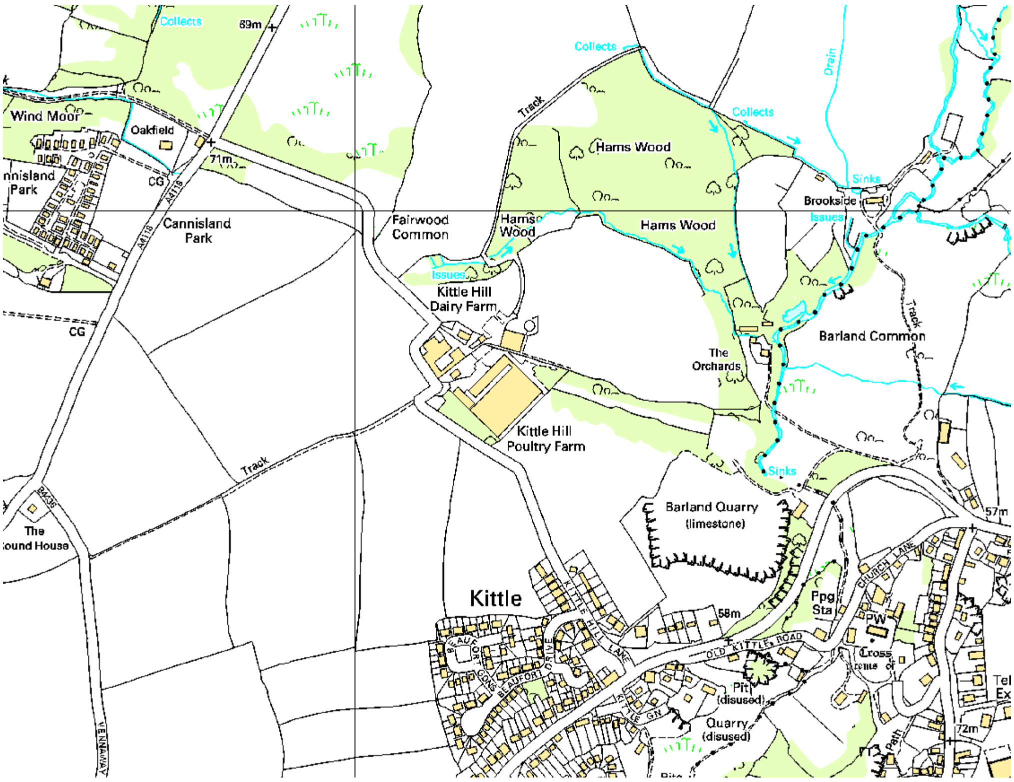
[39] LAQM.TG(09) Box 5.5 Section C3 petrol Stations page 5-40

left vacant. These arrangements were negotiated with the relevant fuel companies many years ago, particularly to resolve late night noise nuisance complaints.

The City & County of Swansea confirms that there are no petrol stations meeting the specified criteria within the local authority area

5.4. Poultry Farms

LAQM.TG(09) contains guidance on assessing potential exceedences of the PM_{10} objectives associated with emissions from poultry farms. Guidance is contained within box 5.5 Section C4 page 5-41. There are two poultry farms located within the authority's area. The first at Kittle Hill Farm is shown below within Maps 18 and 19.



Map 18 – Location of Kittle Hill Poultry Farm, Kittle, Gower, Swansea

Map 19 – Aerial view – Kittle Hill Poultry Farm, Kittle, Gower, Swansea

Previously under the Environment Agency permit application granted during 2007 up to a total of 295,680 chicken laying hens were permitted to be housed, split over 3 sheds containing approx. 100,000 birds each with a deep litter pit system of waste collection. However the Environment Agency during May 2011granted a PPC permit (Ref JP3838KF) to permit up to 400,000 birds to be housed. However, information to hand indicates that the operators only intend to bring in 295,680 birds at present. As indicated within map 19 above, the direction of the mechanical ventilation of the sheds is in a south easterly direction between the sheds and then finally out, over a field adjacent to the premises. The nearest domestic receptor/dwelling is approximately 290m from the sheds. However, there is relevant exposure from a residential property that forms part of the farm itself. There is therefore, relevant exposure within 100m of the sheds housing the birds. There have been previous historical complaints regarding dust from local residents but these were not substantiated. Numerous complaints have also been received regarding noise from the ventilation system.

Whilst there is relevant exposure as defined by LAQM.TG(09) box 5.5 Section C4 page 5-41 at Kittle Hill Farm itself, **the number of housed birds remains below the assessment threshold**. In addition, a separate establishment at Highfield Poultry Farm, Parkmill, Gower, Swansea, now receives birds a few days old which are then taken away to a farm in Pembrokeshire for completion. Map 20 below indicates the proximity of this establishment to local residential properties.

Map 20 – Highfield Poultry farm, Parkmill, Gower.

Previously under the Environment Agency permit application granted during 2007 up to a total of 120,000 birds were permitted to be housed within several sheds that are provided with mechanical ventilation. The current EA PPC permit (Ref VP3039UR) repeats this number of permitted birds at this establishment. However, only 105,000 birds are currently on site. Residential properties are within 80m of the sheds at Highfield Poultry Farm with the proprietor's residence being located within 15m of the sheds**.**

There have been numerous historical complaints regarding noise from the ventilation system. Again, whilst there is relevant exposure as defined within LAQM.TG(09) box 5.5 Section C4 page 5-41 at Highfield Poultry Farm itself, **the number of housed birds falls below the assessment threshold.**

6. Commercial and Domestic Sources

6.1. Biomass Combustion – Individual Installations

6.1.1 Ethnic Quisine.

For completeness, the authority was aware of one A2 process which was permitted during 2005-2006 at Ethnic Cuisine Ltd located on the Winch Wen Industrial Estate in Swansea. The biomass plant was used to treat waste food into bio-fuel, which was thermally treated in a bio-mass burner, with the heat generated being fed into a boiler to produce steam for use in the factory. The system was modular with the main components consisting of the bio-fuel converter, a bio-fuel silo, the bio-mass burner, a boiler to recover heat from the hot flue gases and a cyclone. However, the bio-mass installation suffered an explosion and was later determined to be dangerous due to design flaws and has not been put back into operation.

6.1.2. Swansea Leisure Centre.

There is a wood-chip biomass burner installation at the new LC2 Leisure Centre. However, due to control issues, the burner has never operated.

6.2. Biomass Combustion – Combined Impacts.

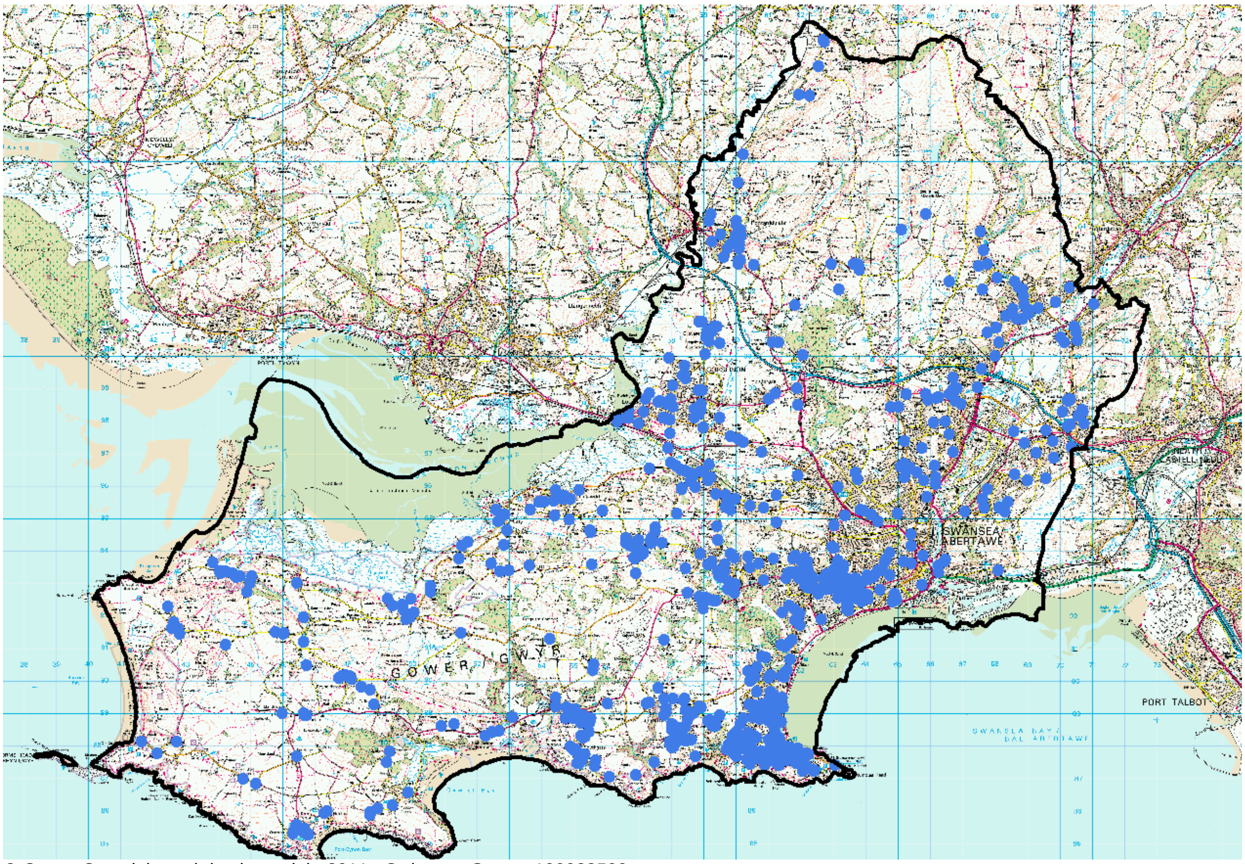
LAQM.TG(09) outlines within Section D.1b of chapter 5 a method to assess the impact of small, domestic biomass combustion. It has been noticed through conversations held with colleagues within Building Control that a record of domestic biomass installations is held where those installations have been undertaken by a HETAS approved installer of an approved HETAS appliance.

HETAS Ltd approval of appliances consists of assessment of a type test report from a Notified Laboratory to the relevant BSEN supported by the manufacturer's production control, followed by periodic surveillance of the product as appropriate. HETAS Ltd also checks manufacturers Installation and Operating Instructions to confirm that they meet UK Building Regulations and conform to UK practice. While the appliance remains in the Guide, this surveillance continues, to ensure that the product remains the same as the original unit tested. Any solid fuel appliance that was approved at the time of manufacture, and which was subsequently installed, maintains its approved status even if at a later date the model is removed from the Guide. New units of the model, produced after removal from the Guide are, however, not approved as they will have been produced at a time when the product surveillance by HETAS Ltd had ceased. It would not, therefore, be possible to ensure that the new units were the same as the unit originally tested.

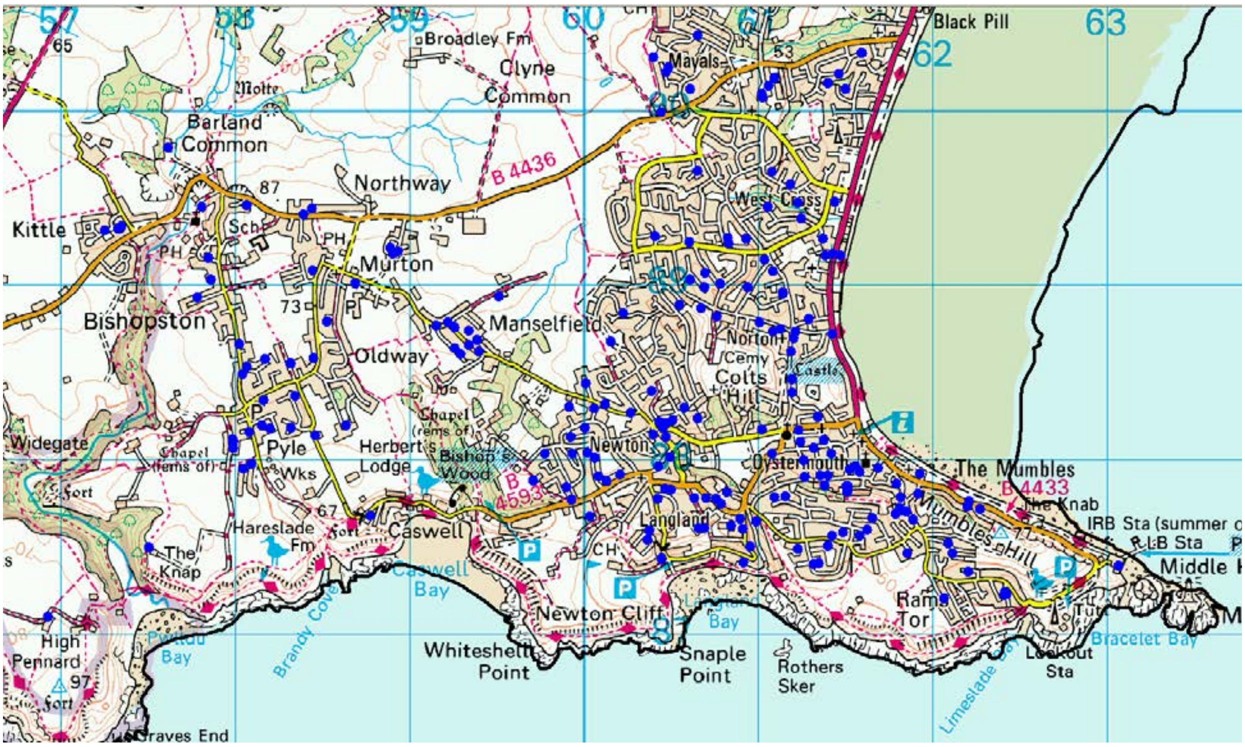
Building Control has supplied a list of notifications received under the above scheme, complete with Ordnance Survey easting and northing coordinates to allow plotting within ArcView 3.3 GIS system. The only problem found is that the description on the registration doesn't specifically state the type of appliance i.e. wood burners. It is thought that wood-burners are the more likely installation to be registered within domestic premises. With this limitation in mind and accepting the scope of description, the complete list has been plotted so that an understanding of the spatial distribution of appliances can be made. It is important to recognise that it is probable that appliances have been purchased and installed by home owners themselves or installers that do not "comply" with the above scheme and that the situation may be different to that presented within map 21 below.

As can be seen from map 21 there are several distinct clusters which, for the purposes of this report are assumed to be primarily wood-burning appliances. The major cluster is within the affluent area(s) of Mumbles, Bishopston, Langland and Mayals of south-west Swansea. The authority has investigated 20 complaints during 2011 relating to nuisance from "wood-burning appliances". Over 50% of the complaints emanated from the above mentioned areas. The majority of the complaints related to smoke nuisance where flue terminals were not extended sufficiently or poorly sited.

For information, map 22 indicates the location of installations within the above areas.

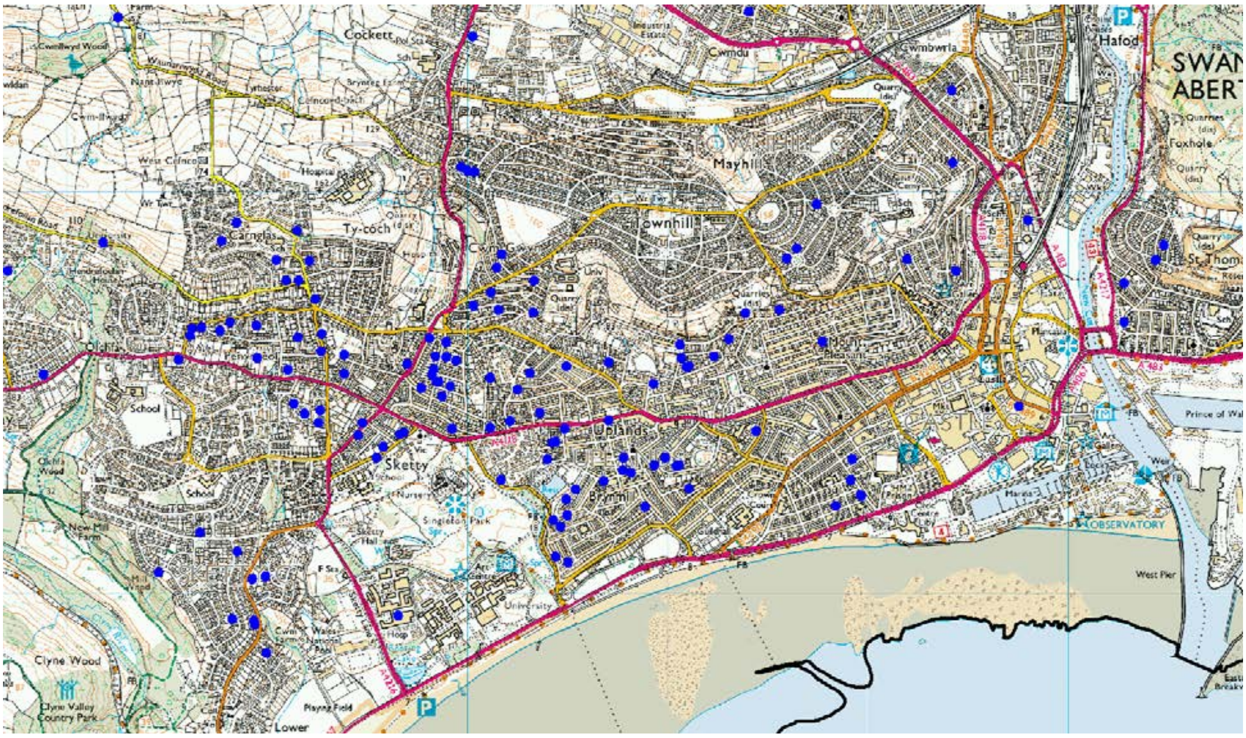


Map 21 – Biomass Combustion



Map 22

From map 21 another cluster of installations can be seen within what appears at first to be the city centre. However, map 23 indicates that the vast majority of this cluster is within areas just outside of the city centre, primarily within Tycoch, Sketty, Brynmill and Uplands.



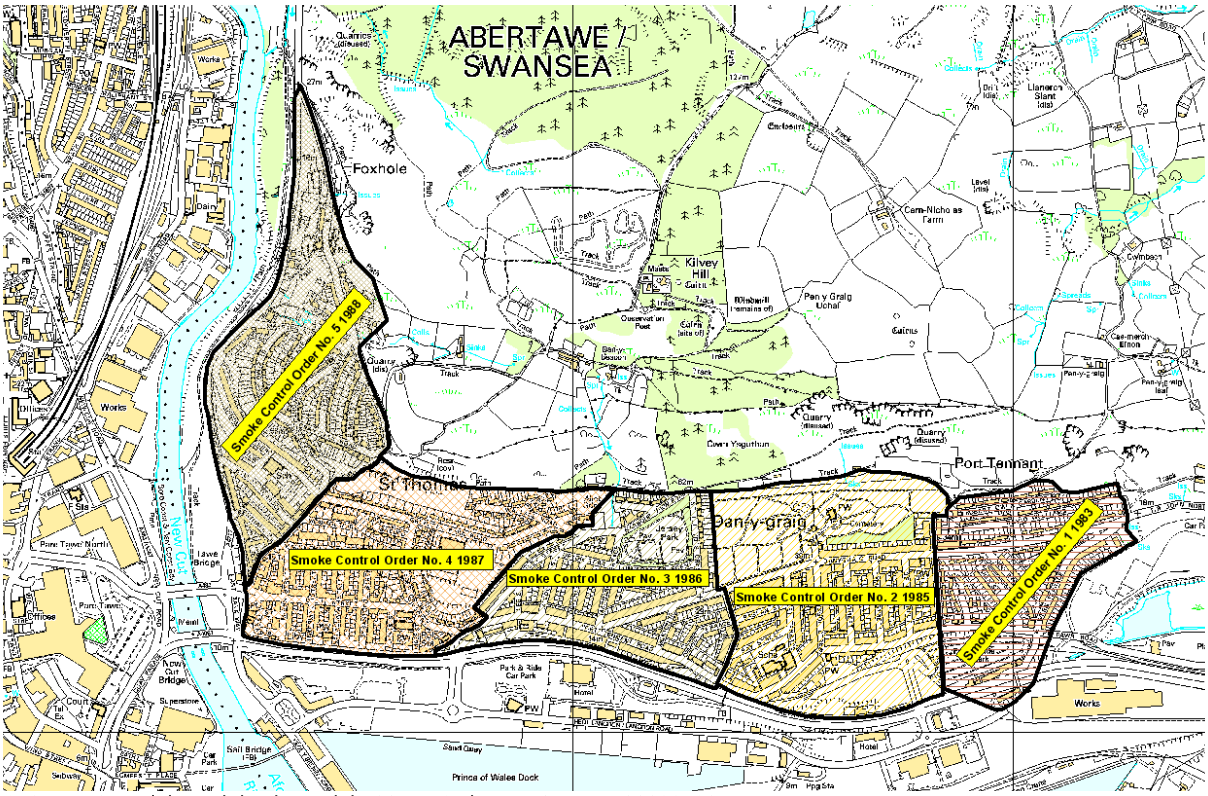
Map 23 © Crown Copyright and database right 2011. Ordnance Survey 100023509

It is clear from the basic spatial picture presented above that in order to undertake the screening as required by LAQM.TG(09) Box D.1b that details need to be clarified on the type of installation. However, the number of installations within individual 500m by 500m squares is not thought likely to lead to unacceptably high PM_{10} concentrations. This view is supported by comments within LAQM.TG(09) box D.1b (PM_{10} Overview) but it is recognised that more details are required to undertake the screening method as described within LAQM.TG(09). Discussions will continue with Building Control to establish a method of appliance identification within the installation notifications that are received by the authority.

6.3. Domestic Solid-Fuel Burning

Swansea City Council, the predecessor to the City and County of Swansea, declared 5 Smoke Control Areas within the Port Tennant and St.Thomas areas between 1983 and 1988 – these Orders can be seen below within map 24.

Whilst these orders limited the burning of solid fuel in approved appliances to smokeless solid fuels, the tradition of burning solid fuel has dramatically declined within Swansea over the last two decades, not solely because of the declaration of the Smoke Control Areas but as part of the national trend away from coal to natural gas consumption as a domestic fuel. This trend continues to this day. Therefore, despite smokeless solid fuel having a similar sulphur content to coal, the burning of such fuels in any approved appliances that may remain in these areas is thought to be minimal.



Map 24 – City & County of Swansea Smoke Control Orders 1-5

Guidance within LAQM.TG(09) requires the identification of significant areas of domestic coal burning. Significant areas of domestic coal burning are given as a density of premises burning coal exceeding 50 per 500 by 500 meter area[40]. Local knowledge would indicate that there are no longer any areas within Swansea that have this density of domestic coal burning. This situation has not altered from the previous Updating and Screening Assessments submitted. However, the approach within LAQM.TG(09) box 5.8 section D2 page 5-51 then presents a conflicting "Question" which asks "Does the density of coal burning premises exceed **100** per 500 by 500m area". This would appear to be an artefact from previous technical guidance.

The actual number of properties within the City and County of Swansea's area that burn solid fuel as the primary fuel for central heating is given as 4,398 within the 1997 Welsh Household Information Survey published in 2000. This equates to 4.9% of properties within Swansea. For completeness, the number of properties burning fuel oil as their primary source of heating is given as 1,759, which equates to 2% of properties. The figures for the whole of Wales are 7.4% and 5.3% respectively. In reality, the number of properties that burn solid fuels has in all probability, reduced significantly from those published in the Welsh Household Information Survey.

[40] LAQM.TG(09) box 5.8 section D2 page 5-51

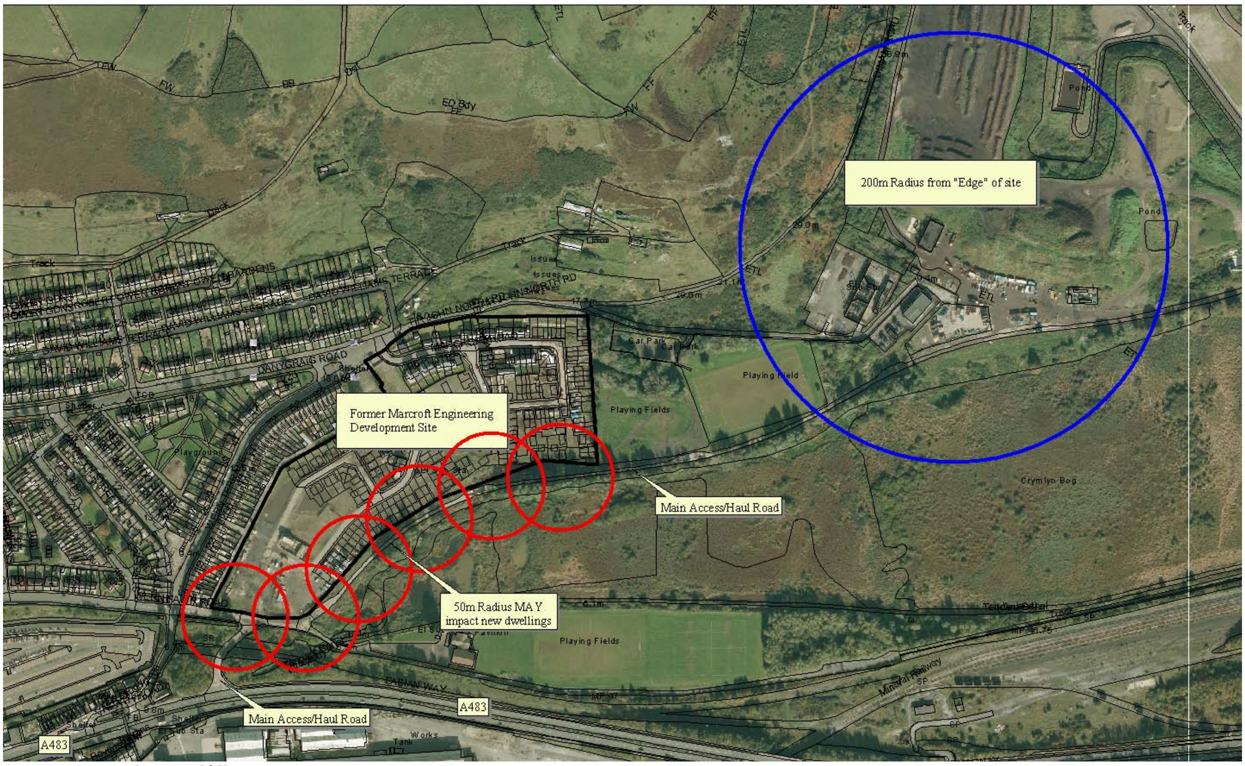
7. Fugitive or Uncontrolled Sources

Guidance within LAQM.TG(09) box 5.10 Section E page 5-53 indicates an approach to adopt to assess fugitive sources of PM_{10} from a number of sources including quarrying, landfill sites, coal and material stockyards, or materials handling. Where dust is emitted, a proportion, (typically about 20%) will be present as PM_{10}. The guidance indicates that relevant exposure “near” to the sources of dust emission be established. Near is defined as within 1000m if the 2004 objective PM_{10} annual mean background concentration taken from background maps is greater than or equal to 28μg/m^3, within 400m if the 2004 objective PM_{10} annual mean background concentration taken from background maps is greater than or equal to 26μg/m^3, and within 200m for any background.

Based on the 1k by 1k grid squares background PM_{10} maps downloaded for 2011 from http://laqm.defra.gov.uk/maps/maps2010.html , and after indexing the field Total_PM_{10} it can be seen that the maximum 1k by 1k grid square (266500 195500) background concentration is 15.17ug/m^3. Therefore, “near” is taken to be the latter distance i.e. 200m.

7.1. Tir John Landfill Site

LAQM.TG(09) Section E.1 of box 5.10 expands on the issue of relevant exposure if exposure is within 50m of an offsite road used to access the facility. These sections of road which may extend up to 1000m from the site entrance are considered to be near, as long as the background concentration is above 25ug/m^3 and there are visible deposits on the road. Map 25 below shows the situation currently at Tir John landfill site. There is very marginal relevant exposure within 50m from the main access road at properties on Wern Terrace, Port Tennant (shown by red circle). In addition, the former Marcroft Engineering site is in the process of being developed for housing. As of June 2012, numerous new properties have been constructed, and can be seen within the Ordnance Survey MasterMap data shown within map 25. It would appear that the majority of the site is complete with only the south west section available for any additional construction. These newly constructed properties to the east of the development are now within the 50m radius from the haul/ access road. Obviously, when the development is completed, dozens of new properties will fall within the 50m radius (red circles) from the access road. At present, as the maximum background PM_{10} concentrations do not exceed 26ug/m3 anywhere within the authority's area and, as there are no visible deposits on the road, these locations can be discounted.

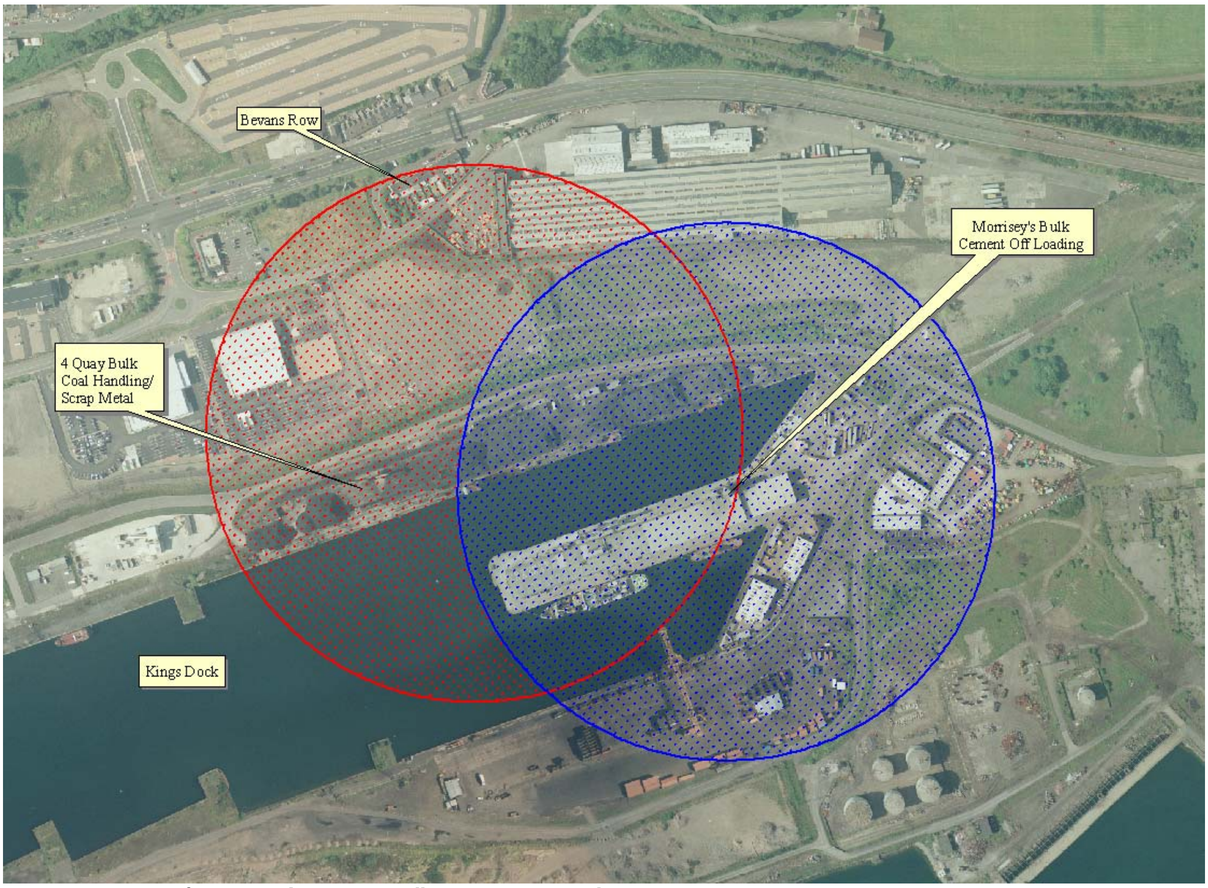


Map 25- Tir John Landfill Site, Port Tennant, Swansea

There are no receptor locations within 200m of the main landfill area (blue circle). The Environment Agency refused to issue a permit for the ongoing use of Tir John to the LAWDC – Swansea Waste Disposal Company as a landfill site. The site therefore ceased operation for several years, pending an appeal by the LAWDC. The LAWDAC subsequently won the appeal and the site is now once again fully operational. However, during 2012 the LAWDAC has been disbanded and the operations at Tir John have been brought back under the direct control of the authority.

7.2. ABP Port of Swansea

There are operations carried out within the ABP Port of Swansea that have the potential for fugitive emissions i.e. 4 Quay bulk coal-handling facility and Morrisey's Cement Bulk off loading facility both located around the Kings Dock. The Port Health Authority regulates both of these operations. Map 26 below identifies both these activities at Kings Dock. 4 Quay handles a bulk coal handling facility on the dock side.

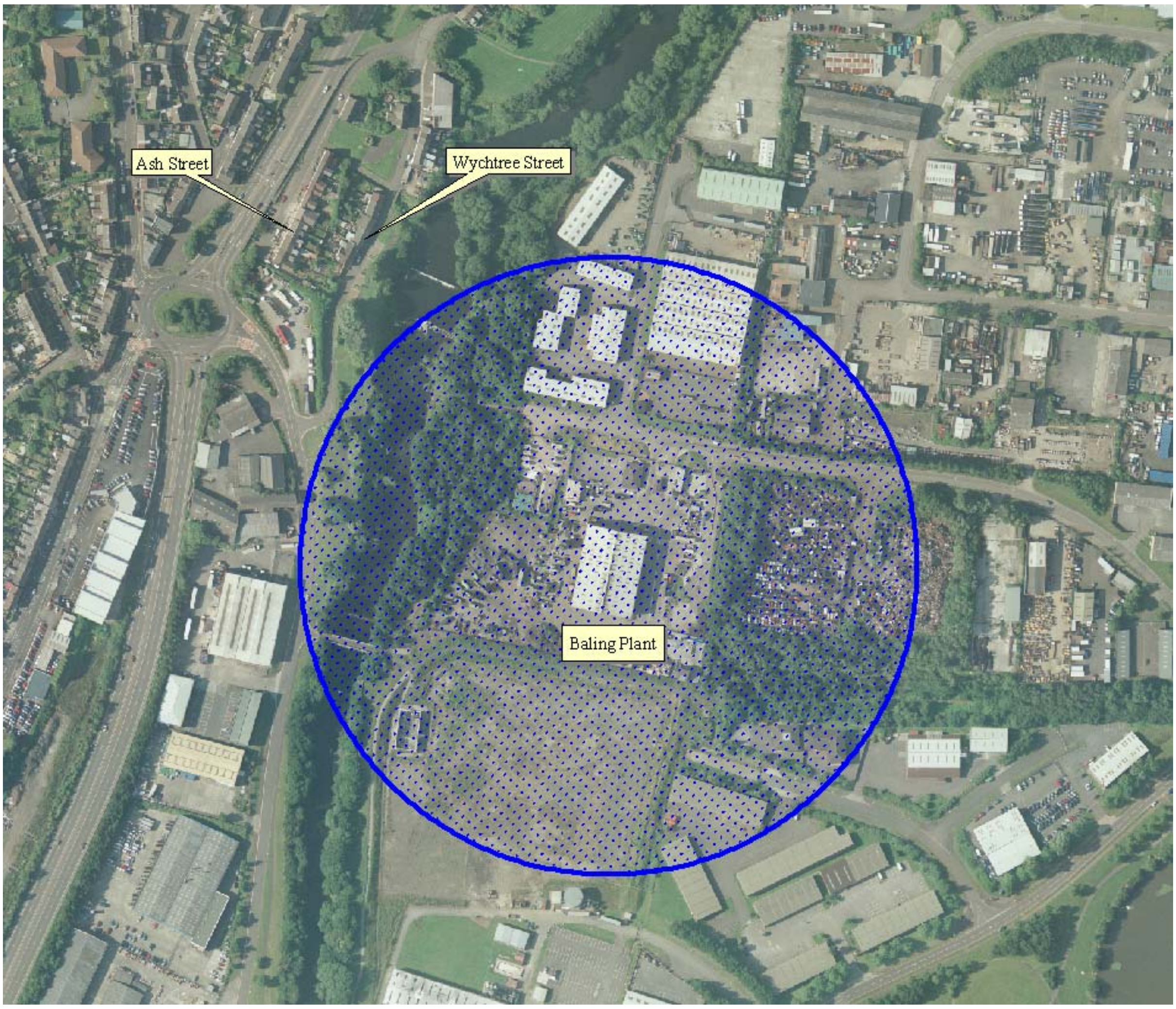


Map 26 – Location of 4 Quay and Morriseys Bulk Cement Kings Dock, Swansea

Lately stockpiles of scrap metal are also handled on 4 Quay. Receptor locations at Bevans Row, Port Tenant are located within 200m of the bulk coal/metal stockpiles (red circle). Litigation several years ago, resulting from an action from residents of the wider Port Tenant community resulted in a High Court judgement ruling in favour of the operators. It is not intended to revisit this issue in the light of the complete lack of dust complaints from Bevans Row. Morrisey's cement bulk off loading facility has been the subject of enforcement actions by the Port Health Authority to affect abatement techniques. Negative pressure systems, combined with a new bagging plant and construction of internal walls within the offload area have now negated the previous substantial fugitive emissions from the offload process. There is no relevant exposure within 200m of the bulk cement offload operations (blue circle).

7.3. Waste Management Facility – Baling Plant

The LAWDAC operated the Baling Plant off Ferryboat Close, Morriston Enterprise Park until the authority disbanded the LAWDAC during 2012 and took back complete operational control of the facility during 2012. The facility handles all domestic waste arising within Swansea as well as being the main recycling centre within Swansea. Domestic waste is transported into the Baling plant pending its bulk transportation to Tir John Landfill site. Map 27 shows the proximity of the facility to the nearest receptor locations.



Map 27 – Baling Plant, off Ferryboat Close, Morriston Enterprise Park

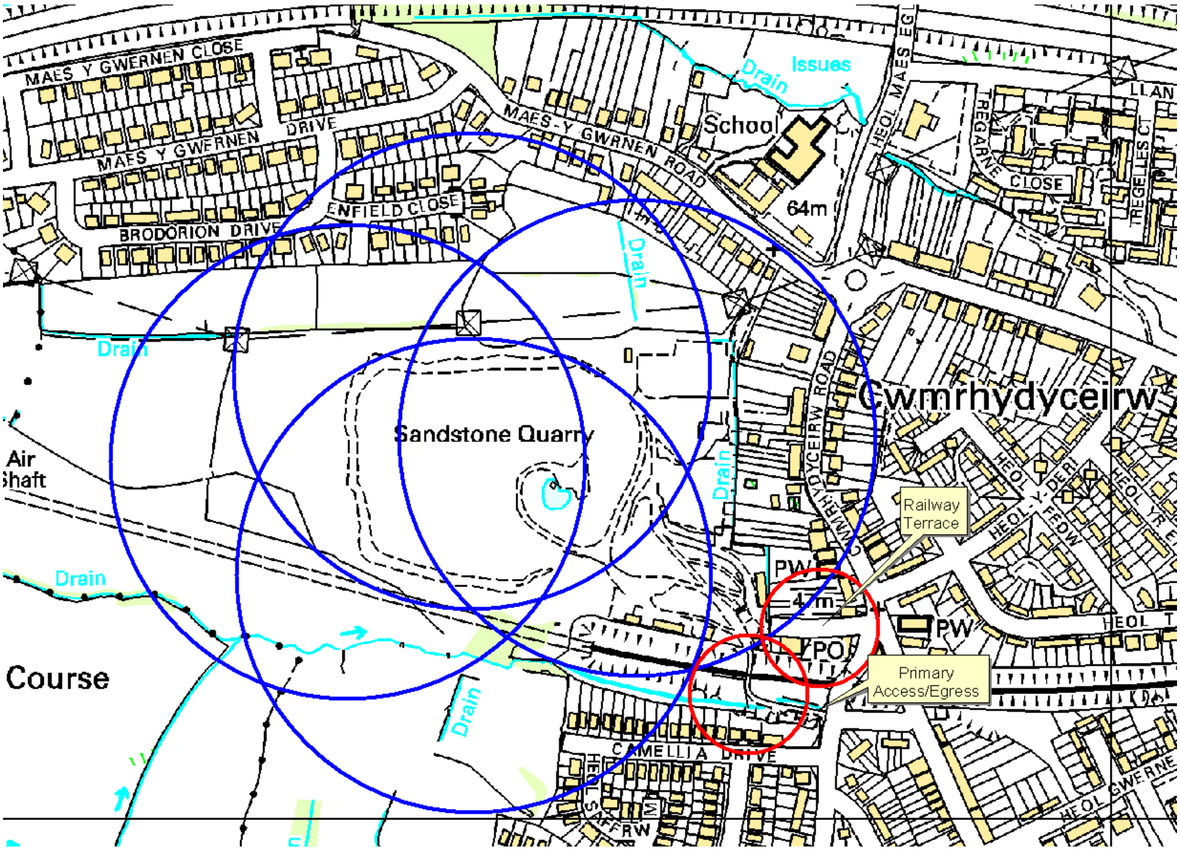
There have been numerous complaints of odour spanning several years, resulting mainly from the composting activities at the facility, but no substantive dust complaints. In any case, with reference to LAQM.TG(09) box 5.10, there are no receptors within 200m of the centre of the facility (blue circle).

7.4. Waste Management Facility – Cwmrhydyceirw Quarry

Cwmrhydyceirw Quarry has previously been used as a landfill site up until the late 1990's for low grade industrial as well as domestic waste arising. However, following the refusal of the Environment Agency to issue a permit for its operation, the facility closed. The facility remained dormant with low maintenance aftercare operations being undertaken until the site was purchased by new operators. Following protracted negotiations between the Environment Agency and the new owners, a permit has now been issued for deposits of waste to recommence following extensive preparatory works. These preparatory works include the excavation of previously deposited material, construction of suitable lined cells with the excavated waste being replaced within the new lined cells. Following completion of the new cells, new waste will be permitted to be deposited.

These preparatory works obviously have the potential to emit substantial fugitive emissions as well as odour nuisance. Discussions have commenced with the operators to establish what monitoring and local liaison is required with local residents. Receptor locations are within 200m. Map 28 below indicates the proximity of dwellings to the facility. 200m radiuses (blue circles) have been taken from the boundary of each side of the facility. Properties at Brodorion Drive, Enfield Close, Maes-y-Gwernen Drive, Cwmrhydyceirw Road, Railway Terrace, Camellia Drive and Heol Saffrwm are within 200m of the operations. For sake of completeness, the main access and egress from the site is from a lane just north of Camellia Drive. There is another access route into the site via Railway Terrace but, at this stage it is not envisaged that this route will be used due to terraced dwellings fronting directly onto this access route. 50m radius are indicated from these access/egress roads (red circles) but as the background PM_{10} levels (against the 2004 objective) are below 25ug/m^3 they are not considered to be "near".[41]

[41] LAQM.TG(09) Box 5.10 Section E.1 Fugitive and uncontrolled sources page 5-53

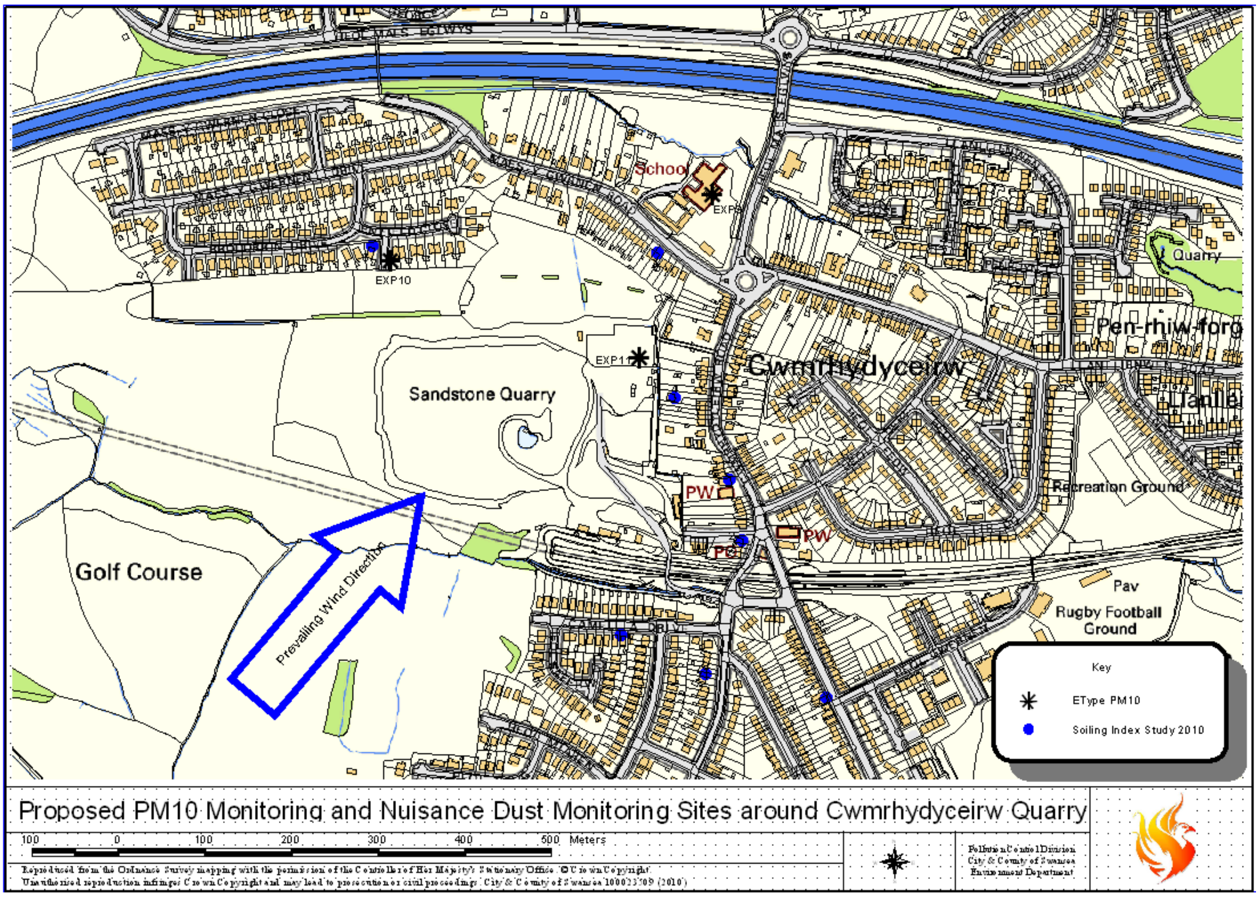


Map 28 – Cwmrhydyceirw Quarry, Cwmrhydyceirw

As stated within previous reporting, it is not proposed to proceed to a detailed assessment at this stage as the timescale of operations (both remediation and active deposition) are not as yet fully known. Any fugitive emissions during excavation and relining are likely to be of a transitional/temporary nature. However, preparatory works commenced during the early stages of 2010 with the sinking of extensive new monitoring boreholes around the site along with trial holes into the previously deposited material. The site has once again become totally inactive during 2011 and into 2012.

The authority have therefore commenced a monitoring program to assess nuisance dust in the immediate vicinity of the quarry as well as the installation of three real time Etype PM_{10} analysers upwind of the quarry to enable a preliminary screening of the operations to be made. Etype analysers have been deployed at Cwmrhydyceirw Primary School and within the curtilage of the site behind properties along Cwmrhydyceirw Road at the site boundary during June 2010. A third is planned at a property at Enfield Close. It should be noted that the Etype analysers are not type approved, have not undertaken equivalency testing and are deployed for the sole purpose of undertaking a preliminary “screening assessment” as part of this authorities undertaking to local residents. These Etype analysers have proven problematic in use elsewhere within Swansea.

In addition to the real-time PM_{10} monitoring, the authority have also established eight “soiling index” dust sites to assess any dust of nuisance value generated by site activities, and offsite vehicular access/egress once preparatory works and landfill operations become established in the coming months. Map 29 below outlines the chosen locations



Map 29 PM_{10} and Soiling Index Dust Sites

7.5. Operational Opencast Coal Mines or Quarries

There are no operational opencast coal mines or quarries within the Swansea area

.

The City & County of Swansea has identified the local development which may impact on air quality in the Local Authority area at some stage in the future

Cwmrhydyceirw Quarry Landfill Site

These will be taken into consideration and an update provided within the next Progress Report scheduled for 2013.

8. Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

Nitrogen Dioxide (Passive Diffusion Tube Data)

Exceedences of the annual mean objective continue to be seen within the existing Swansea Air Quality Management Area 2010 along the Neath Road corridor, Cwm Level Road (Brynhyfryd Cross Roads) and Carmarthen Road (Dyfatty area). Additionally exceedences continue to be seen within the Fforestfach and Sketty areas of the AQMA. Additional monitoring within the AQMA area around the High Street Railway Station has highlighted the potential of exceedence of both the annual mean and 1-hour objectives.

Monitoring from outside of the existing Swansea AQMA 2010 has identified new areas that are failing the annual mean objective. Numerous locations within the city centre are failing the annual mean objective with indications from some other sites within the city centre area that exceedences of the 1-hour objective may potentially be occurring. One site (site 75) within the Uplands area (at the junction of Brynymor Crescent and Uplands Terrace) has indicated exceedence of the annual mean objective during both 2010 and 2011. This site is situated between the city centre and the Sketty area which forms part of the Swansea AQMA 2010. Several sites along Newton Road within the Mumbles area are either indicating a breach of the annual mean objective or the potential to breach the annual mean objective. The situation along Newton Road is exacerbated by tourism traffic during the summer months. During 2010 it was reported that exceedences of the annual mean objective were seen at premises covered by the canopy extending over the commercial and domestic dwellings on one side of the road. During 2011 however, exceedences of the annual mean objective have been seen at premises on the other side of the road. Other sites along Newton Road (on both sides of the road) have indicated the potential to exceed the annual mean objective during 2011.The situation along Newton Road is discussed and outlined within section 2.2.3, plan1 and photos 6 and 7.

One site on Woodfield Street in Morriston has indicated failure of the annual mean objective (sites 41) during 2010 and 2011, along with site 285 on Martin Street, Morriston indicating the potential to exceed the annual mean objective. The sites at Nantyffin Road Llansamlet (site 50) and another in Ynystawe at a property (site 45) overlooking junction 45 of the M4 have shown compliance with the annual mean objective during 2011.

Exceedences have also been observed during 2011 within the St Thomas area at site 35 (Delhi Street) and also site 291 (Vale of Neath Road) with site 38 (SA1 junction at Port Tenant Road) indicating the potential to exceed the annual mean during 2011.

In addition, additional monitoring undertaken outside of the exiting Swansea AQMA 2010 has identified sites with the potential to exceed the annual mean objective (being within the 37-40ug/m^3 range). These sites will continue to be monitored to establish trends.

Annual mean NO_2 future year projections made for 2012 to 2020 using both the updated January 2012 guidance as outlined within LAQM.TG(09) and a further update note from DEFRA entitled “Note on Projecting NO2 concentrations” [42] dated April 2012 has shown that using both methods to project forwards to 2020 it is clear that whilst the LAQM.TG(09) method indicates full compliance with the annual mean objective being seen as early as 2016, using the revised April 2012 method, paints a totally different picture, as in 2020, widespread exceedences remain, together with indications that additional numerous sites would still exhibit the potential to exceed the annual mean objective. It is thought that the April 2012 method may well paint a more realistic picture.

Nitrogen Dioxide Real Time Continuous Automatic Monitoring Data

Compliance with both the annual mean and hourly objectives were seen at the Swansea AURN and Morriston Groundhog monitoring stations during 2011. However, real-time open path monitoring along Neath Road, Hafod (Hafod DOAS) continues to show exceedence of the annual mean objective with indications that the

[42] http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

hourly objective may also be at risk of being exceeded as an hourly exceedence count of 16 was obtained against the permitted 18. During 2011, the annual mean objective was exceeded at the other open path monitoring location at the St.Thomas DOAS monitoring station along Pentreguineau Road.

Annual mean NO_2 future year projections made for 2012 to 2020 using both the updated January 2012 guidance as outlined within LAQM.TG(09) and a further update note from DEFRA entitled “Note on Projecting NO2 concentrations” [43] dated April 2012 indicate continued full compliance with both objectives at suitable receptor locations at the Swansea AURN and Morriston Groundhog sites. However, using the original LAQM.TG(09) method at the Hafod and St Thomas DOAS sites indicates that the Hafod DOAS will see compliance with the annual mean objective during 2017 with compliance at the St Thomas DOAS being seen as early as 2012. If the further updated note from DEFRA dated April 2012 is used then a different outlook is obtained. Compliance with the annual mean objective at the Hafod DOAS site is not seen even within 2020, with compliance being put back with the annual mean objective at the St Thomas DOAS until 2015. Again, it is thought that the April 2012 method may well paint a more realistic picture.

Sulphur Dioxide Real Time Continuous Automatic Monitoring Data

No exceedences of any of the objectives have been observed within Swansea for several years. Measurements are now only made from the St.Thomas DOAS due to budgetary restraints.

Carbon Monoxide Real Time Continuous Automatic Monitoring Data

No exceedence of the objective has been observed within Swansea since monitoring commenced. Monitoring ceased during 2009/2010 due to budgetary restraints.

[43] http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

Particulate Matter PM_{10}

No exceedences of the annual mean objective were seen at any of the monitoring stations during 2011. Similarly, no breach of the 35 permitted exceedences of the 24 hour objective was seen, nor, where data capture was below 90% did the 90th percentile (given in brackets after the number of exceedences) exceed 50ug/m^3

Projections made to 2015 and 2020 show compliance with the annual mean objectives at all sites – indeed, there is remarkable harmony between the projected PM_{10} concentrations in 2020.

Benzene

No exceedence of the objective has been observed within Swansea since monitoring commenced.

Ozone

Compliance with the UK objective (not set in regulation) have been seen at all monitoring satations during 2011. Ozone is considered as a national rather than local problem. Ozone will continue to be measured for the foreseeable future.

Heavy Metals Monitoring

Monitoring from 4 points around a high level stack release point at the Vale Inco, Clydach nickel refinery during 2011 have shown **nickel** concentrations below the 4th Daughter Directive annual mean target value following improved abatement at the release point. However, compliance with the 4th Daughter Directive was marginal at the YGG Gellionnen site during 2009. As previous years monitoring have shown exceedences at one or more sites, it is envisaged that monitoring will continue at all four sites (two UK network funded, two local authority funded) to assess future trends post improved abatement under different meteorological conditions.

From the data available, it is clear that annual mean concentrations for **arsenic and cadmium** at all monitoring locations fall well below the 4th Daughter Directive Target Values**.**

Additionally, from the data available, it is clear that annual mean concentrations for **lead** at all monitoring locations fall well below the 0.25ug/m^3 required under the Air Quality (Amendment) (Wales) Regulations 2002 to be achieved by the 31st December 2008.

8.2 Conclusions from Assessment of Sources

It is noted that works will be required to assess the potential impact from fugitive or uncontrolled sources of PM_{10} when the proposed landfill operations at Cwmrhydyceirw Quarry become fully known and operations commence. In the meantime a basic monitoring programme will be maintained at those sites around the quarry to primarily to assess the impact on dwelling arising from nuisance dust.

8.3 Proposed Actions

Due to exceedences of the Nitrogen Dioxide annual mean objective being seen outside of the existing Swansea Air Quality Management Area during 2011, the authority will consider amending the Swansea Air Quality Management Area 2010 to include the identified failing areas of Morriston, Uplands, City Centre and St Thomas and will rename it The Swansea (NO_2) Air Quality Management Area 2012.

The authority intends to revise and rethink its risk assessment of the Newton Road monitoring strategy to permit monitoring to be undertaken at first floor level above the canopy and also at first floor level at the flats above the commercial premises on the opposite side of Newton Road. The failing area is relatively small - a section of Newton Road not exceeding 100 meters from its junction with Mumbles Road. Every effort will be made to enable provision of real-time chemiluminescent monitoring from a receptor location along Newton Road. The authority will then reconsider its position in light of the additional monitoring results.

Due to ongoing financial restrictions and the requirement to facilitate additional monitoring in other areas of the authority, the existing passive nitrogen dioxide tube survey will be further revised. Measurements will cease at all sites that consistently return a bias corrected annual mean below 30ug/m^3 except where the site is within, or close to an AQMA and may provide useful information in assessing trends and outcome measures of any action taken within the AQMA. Resources will then be re-allocated as required.

9. References

i. City & County of Swansea Progress Report 2006

ii. City & County of Swansea Updating & Screening Assessment 2006

iii. City & County of Swansea Progress Report 2007

iv. City & County of Swansea Progress Report 2008

v. City & County of Swansea Updating and Screening Assessment 2009

vi. City & County of Swansea Progress Report 2009

vii. City & County of Swansea Progress Report 2010

viii. City & County of Swansea Progress Report 2011

ix. Technical Guidance LAQM.TG(09) and subsequent updates

x. Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138)

xi. Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298)

xii. Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective AEAT/ENV/R/264 Issue 1 May 2008

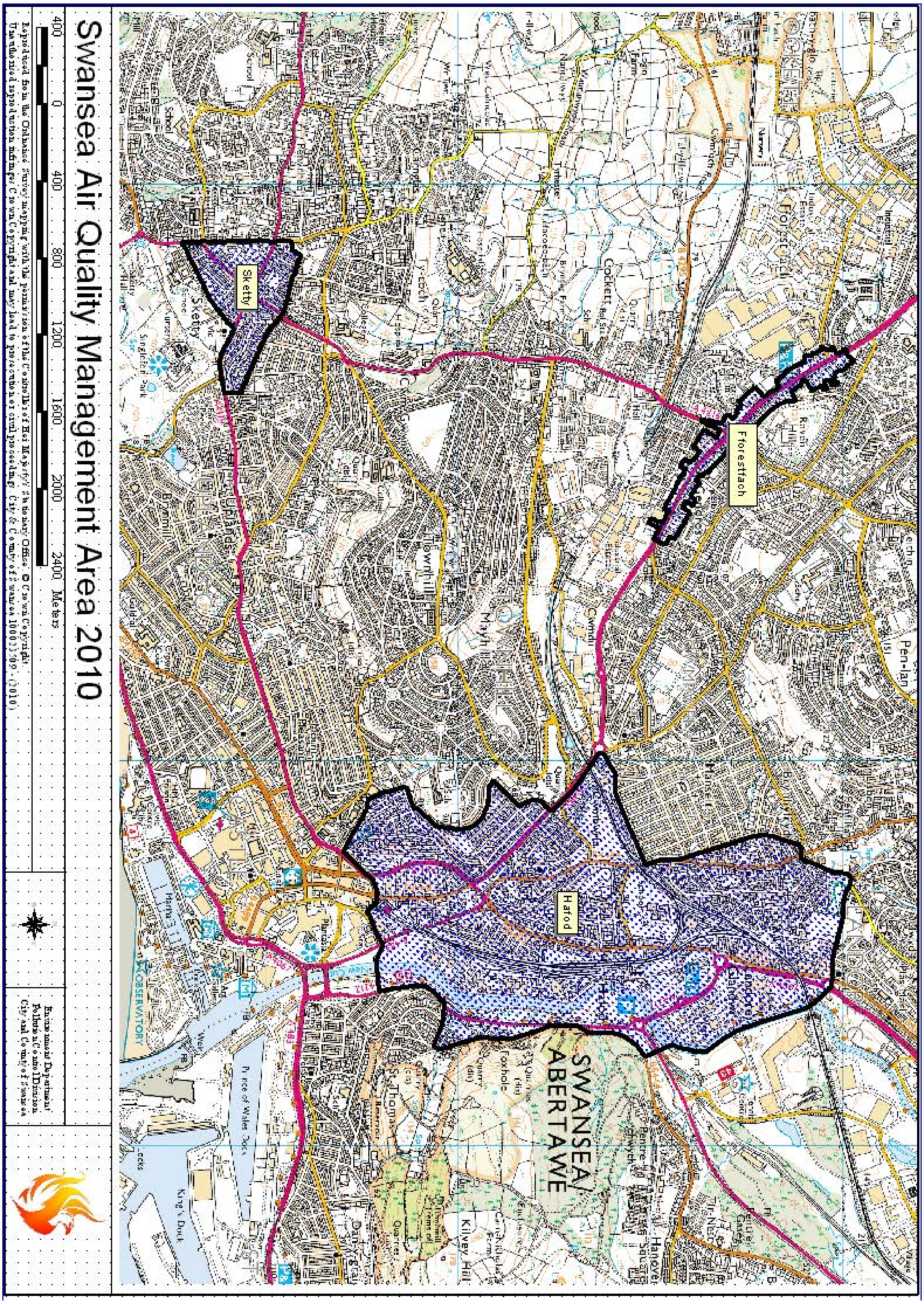
Appendix 1

Hafod AQMA


Hafod Air Quality Management Area
400 0 400 800 1200 Meters
Reproduced from the Ordnance Survey Digital map with the permission of the Controller of H.M.S.O. Crown Copyright.
City and County of Swansea Licence No. 100023509
Pollution Control Division
Environment Department
City & County of Swansea
SWANSEA/ABERTAWE
Hafod
Landore
Glandwr
Manselton
Cwmbwrla
Mayhill
Townhill
Cwmdu
Gendros
Kilvey Hill
St Thomas
Foxhole
Pentre-chwyth
Hanover Square
Bon-y-maen
Tir-Nest
Dan-y-graig
B4489
A4118
B4603
A4067
A4217
A483
B4444
New Cut

Appendix 2

Swansea AQMA 2010


Swansea Air Quality Management Area 2010
Sketty
Fforestfach
Hafod
SWANSEA/ ABERTAWE
400 0 400 800 1200 1600 2000 2400 Meters

Appendix 3

Environmental Scientific Group

WASP Results

Current best 4 from 5 current Z-score average:	0.14

Year	WASP Round	Period	Samples Dispatched	Results Deadline	HSL Calculations (Pre-Sendout) Sample A: Calculated Spiked Value	HSL Calculations (Pre-Sendout) Sample A: Measured Value	Harwell Analysis Tubes A: Result Tube 1	Harwell Analysis Tubes A: Result Tube 2	Harwell Analysis Tubes A: Average	Harwell Analysis Tubes A: Standard Deviation	Harwell Analysis Tubes A: RSD	Harwell Analysis Tubes A: Z-Score	HSL Calculations (Pre-Sendout) Sample B: Calculated Spiked Value	HSL Calculations (Pre-Sendout) Sample B: Measured Value	Harwell Analysis Tubes B: Result Tube 1	Harwell Analysis Tubes B: Result Tube 2	Harwell Analysis Tubes B: Average	Harwell Analysis Tubes B: Standard Deviation	Harwell Analysis Tubes B: RSD	Harwell Analysis Tubes B: Z-Score
2011	115	Sept-Dec																		
	114	Jul-Aug																		
	113	Apr-Jun			1.532	1.524	1.478	1.471	1.475	0.005	0.30%	-0.5	2.304	2.292	2.296	2.254	2.275	0.030	1.30%	-0.1
	112	Jan-Mar			2.10	2.07	2.103	1.090	2.097	0.010	0.50%	0	0.94	0.93	0.952	0.953	0.953	0.027	0.10%	0.2
2010	111	Sept-Dec			1.84	1.85	1.821	1.821	1.821	0.000	0	0.1	1.54	1.57	1.512	1.482	1.497	0.022	1.50%	-0.4
	110	Jul-Aug			0.99	1.00	0.972	0.987	0.980	0.011	1.1	0	2.37	2.47	2.367	2.394	2.381	0.020	0.80%	0.1
	109	Apr-Jun			1.03	1.06	1.053	1.053	1.053	0.000	0	0.3	1.27	1.27	1.265	1.268	1.267	0.003	0.20%	0
	108	Jan-Mar			1.92	1.91	1.921	1.896	1.910	0.018	0.9%	-0.1	1.47	1.47	1.409	1.422	1.420	0.009	0.6%	-0.5
2009	107	Oct-Dec			2.03	2.04	1.905	1.914	1.910	0.007	0.4%	-0.8	2.20	2.20	2.049	2.046	2.048	0.003	0.1%	-0.9
	106*	Jul-Sept			1.84	1.84	1.880	1.439	1.660	0.312	18.8%	-1.3	1.42	1.44	1.880	1.429	1.655	0.319	19.3%	2.1
	106*	Jul-Sept			1.84	1.84	1.880	1.880	1.880	0.000	0.0%		1.42	1.44	1.439	1.429	1.434	0.007	0.5%	
	105	Apr-Jun			1.68	1.69	1.795	1.784	1.790	0.008	0.4%	0.8	0.96	0.96	1.031	1.035	1.033	0.003	0.3%	0.9
	104	Jan-Feb			2.02	2.01	2.017	2.047	2.032	0.022	1.1%	0.0	1.22	1.19	1.269	1.230	1.252	0.024	1.9%	0.2
2008	103	Sept-Dec			1.22	1.22	1.242	1.234	1.238	0.006	0.5%	0.1	0.94	0.95	0.957	0.951	0.954	0.005	0.5%	0.1
	102	Jun-Aug			1.37	1.38	1.470	1.472	1.471	0.043	2.9%	0.5	2.28	2.30	2.435	2.386	2.411	0.035	1.5%	0.4
	101	Apr-Jun			0.92	0.94	0.974	0.991	0.983	0.013	1.3%	0.5	1.86	1.93	1.947	1.958	1.953	0.008	0.4%	0.4
	100	Jan-Mar			1.36	1.37	1.395	1.384	1.390	0.008	0.6%	0.2	1.47	1.45	1.511	1.516	1.514	0.004	0.3%	0.2
2007	99	Oct-Nov			2.15	2.16	2.242	2.235	2.239	0.005	0.2%	0.3	0.84	0.84	0.906	0.901	0.904	0.004	0.4%	0.6
	98	Jul-Sept			1.83	1.85	1.877	1.854	1.866	0.013	0.7%	0.2	1.19	1.20	1.229	1.223	1.226	0.005	0.4%	0.2
	97	Apr-Jun			0.89	0.87	0.920	0.918	0.919	0.002	0.2%	0.2	1.58	1.59	1.619	1.640	1.630	0.015	0.9%	0.2

All Results In ug

*Results disputed. Results in yellow are official results

Appendix 4

Tube bias tri-location studies

• Swansea Roadside AURN tri-location

Tri located tubes were exposed on the sample intake, synchronised for exposure for the monthly period to match the exposure on/off timings as suggested by the Welsh Air Quality Forum exposure calendar (mirrors the old UK monitoring network). All results were entered into the spreadsheet provided by AEA Energy and Environment[44] to determine tube bias as well as checking the accuracy and precision of the diffusion tube measurements. The results can be seen below.

Checking Precision and Accuracy of Triplicate Tubes — AEA Energy & Environment, From the AEA group

	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
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	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	05-Jan-11	02-Feb-11	47.9	53.8	52.2	51	3.1	6	7.6	50.09	99.4	Good	Good
2	02-Feb-11	02-Mar-11	48.5	50.3	54.8	51	3.2	6	8.1	38.87	95.39	Good	Good
3	02-Mar-11	30-Mar-11	54.1	53.7	51.4	53	1.5	3	3.6	48.7	99.55	Good	Good
4	30-Mar-11	04-May-11	32.9	35.3	32.2	33	1.6	5	4.0	35.66	99.76	Good	Good
5	04-May-11	09-Jun-11		21.4	23.8	23	1.7	8	15.2	19.20	99.65	Good	Good
6	09-Jun-11	30-Jun-11	25.2	22.2	19.9	22	2.7	12	6.6	19.11	99.8	Good	Good
7	30-Jun-11	05-Aug-11	27.2		25.6	26	1.1	4	10.2	22.40	99.42	Good	Good
8	05-Aug-11	05-Oct-11	27	27.7	27.9	28	0.5	2	1.2	26.72	98.02	Good	Good
9	05-Oct-11	03-Nov-11	35.2	30.9	27.1	31	4.1	13	10.1	30.10	99.57	Good	Good
10	03-Nov-11	01-Dec-11	46.9	51.21	48.4	49	2.2	4	5.4	41.97	99.25	Good	Good
11	01-Dec-11	11-Jan-12	35.7	36.6	34.2	36	1.2	3	3.0	27.37	99.69	Good	Good
12													
13													

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

Overall survey --> Good precision | Good Overall DC

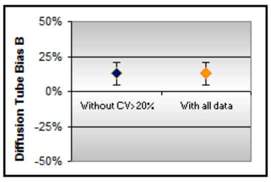
Site Name/ ID: Swansea AURN

Precision: 11 out of 11 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 11 periods of data	
Bias factor A	0.89 (0.83 - 0.96)
Bias B	12% (4% - 20%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	33 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	33 (30 - 35) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.89 (0.83 - 0.96)
Bias B	12% (4% - 20%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	33 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	33 (30 - 35) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Bias correction factor 1 – Swansea Roadside AURN 2011

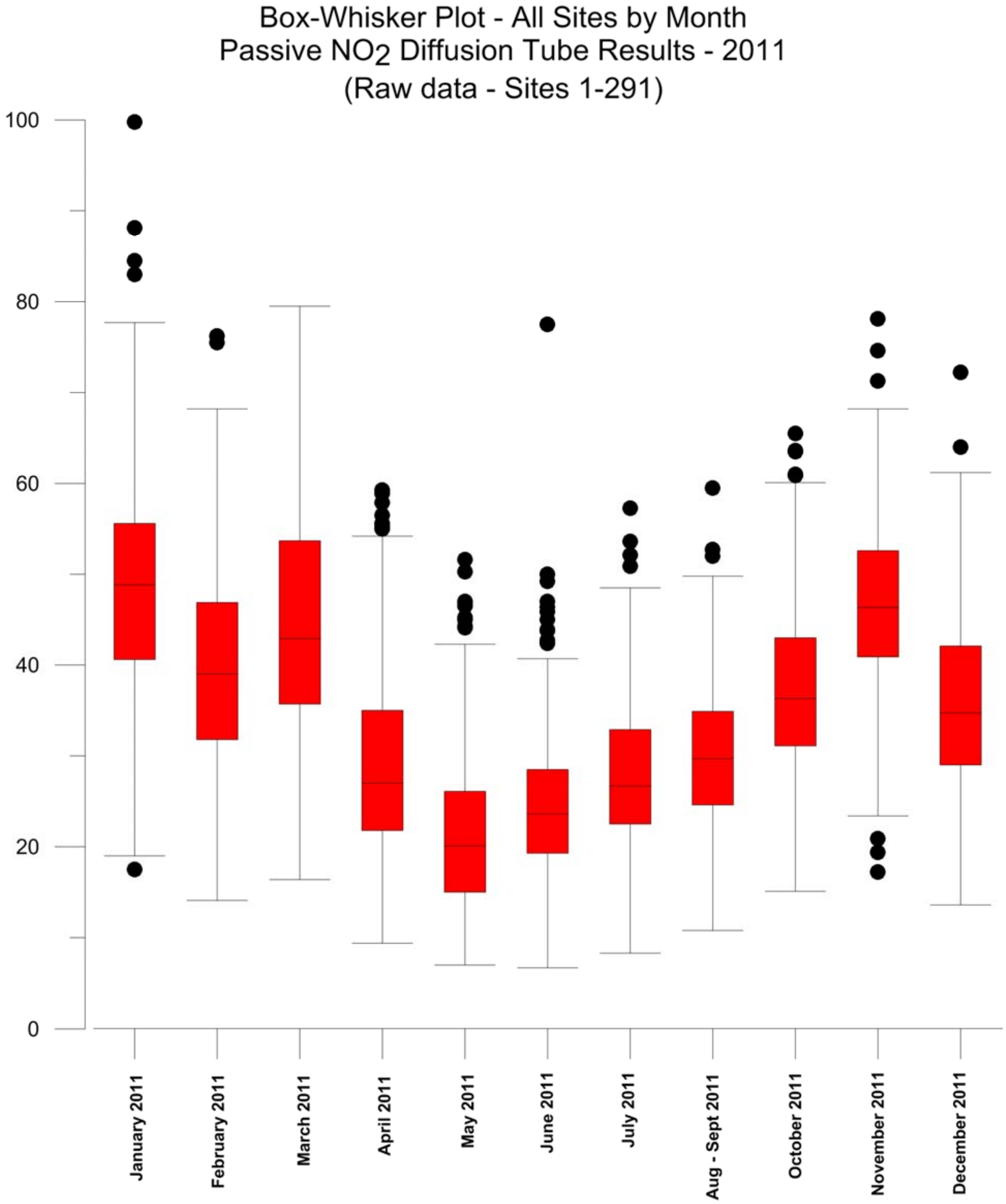
The derived bias correction factor of 0.89 (0.83-0.96) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 12% (4% - 20%)

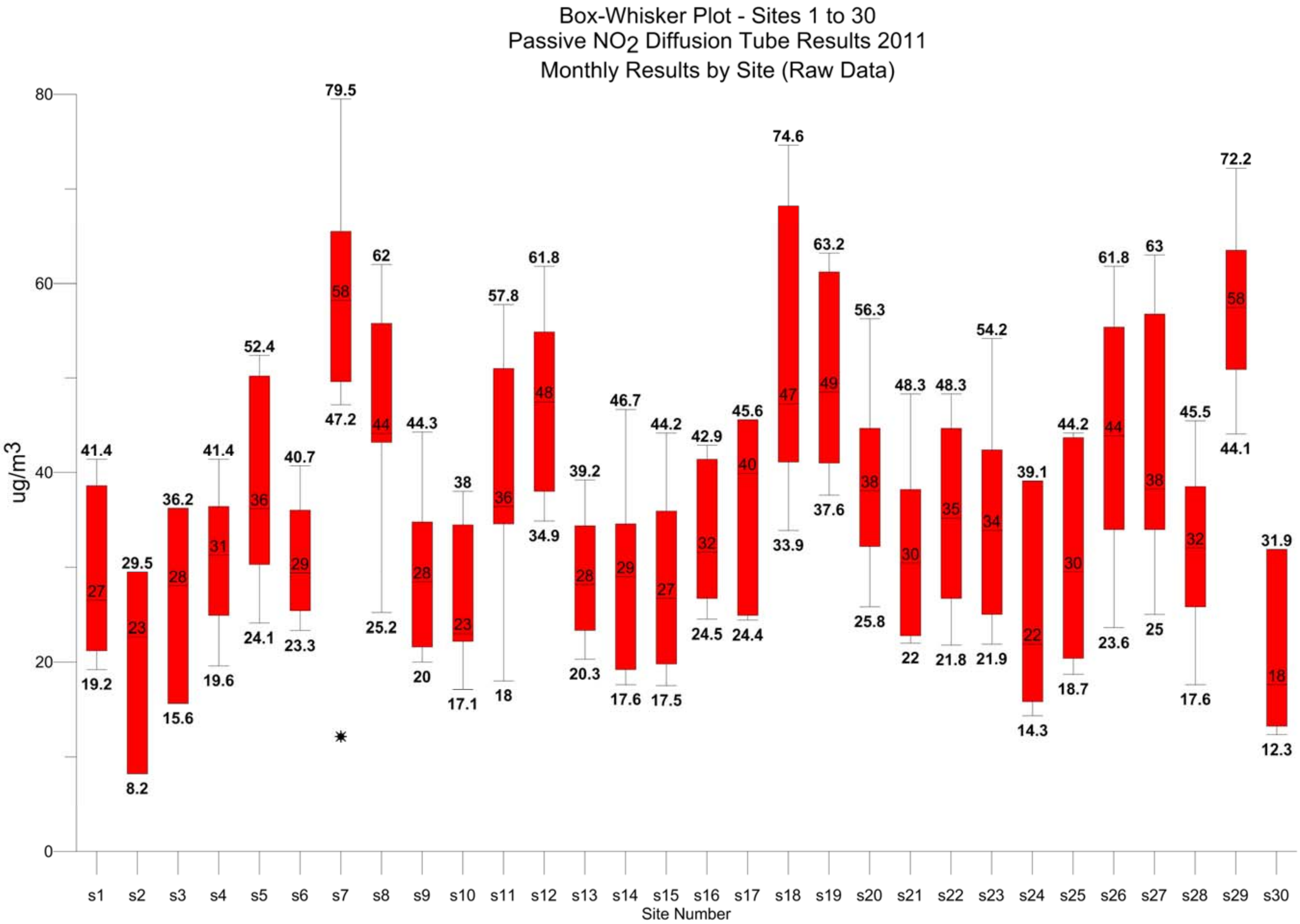
[44] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

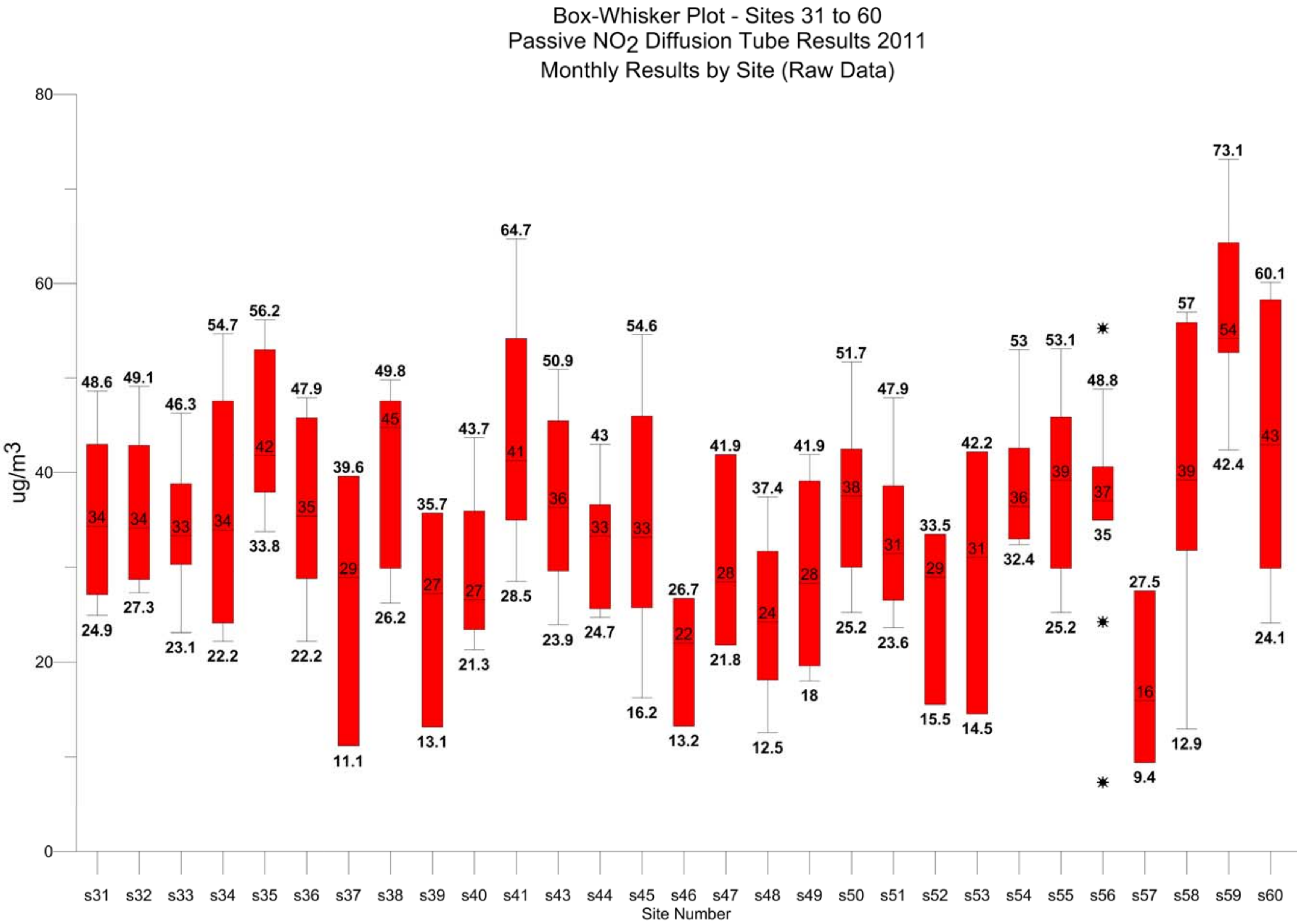
Appendix 5

Nitrogen Dioxide Passive Diffusion Tube Data (RAW - uncorrected)

Box-Whisker Plots


Box-Whisker Plot - All Sites by Month
Passive NO2 Diffusion Tube Results - 2011
(Raw data - Sites 1-291)
100
80
60
40
20
0
January 2011
February 2011
March 2011
April 2011
May 2011
June 2011
July 2011
Aug - Sept 2011
October 2011
November 2011
December 2011


Box-Whisker Plot - Sites 1 to 30
Passive NO_2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
80
60
40
20
0
41.4
27
19.2
29.5
23
8.2
36.2
28
15.6
41.4
31
19.6
52.4
36
24.1
40.7
29
23.3
79.5
58
47.2
62
44
25.2
44.3
28
20
38
23
17.1
57.8
36
18
61.8
48
34.9
39.2
28
20.3
46.7
29
17.6
44.2
27
17.5
42.9
32
24.5
45.6
40
24.4
74.6
47
33.9
63.2
49
37.6
56.3
38
25.8
48.3
30
22
48.3
35
21.8
54.2
34
21.9
39.1
22
14.3
44.2
30
18.7
61.8
44
23.6
63
38
25
45.5
32
17.6
72.2
58
44.1
31.9
18
12.3
s1 s2 s3 s4 s5 s6 s7 s8 s9 s10 s11 s12 s13 s14 s15 s16 s17 s18 s19 s20 s21 s22 s23 s24 s25 s26 s27 s28 s29 s30
Site Number


Box-Whisker Plot - Sites 31 to 60
Passive NO2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
s31 s32 s33 s34 s35 s36 s37 s38 s39 s40 s41 s43 s44 s45 s46 s47 s48 s49 s50 s51 s52 s53 s54 s55 s56 s57 s58 s59 s60
0
20
40
60
80
48.6 34 24.9
49.1 34 27.3
46.3 33 23.1
54.7 34 22.2
56.2 42 33.8
47.9 35 22.2
39.6 29 11.1
49.8 45 26.2
35.7 27 13.1
43.7 27 21.3
64.7 41 28.5
50.9 36 23.9
43 33 24.7
54.6 33 16.2
26.7 22 13.2
41.9 28 21.8
37.4 24 12.5
41.9 28 18
51.7 38 25.2
47.9 31 23.6
33.5 29 15.5
42.2 31 14.5
53 36 32.4
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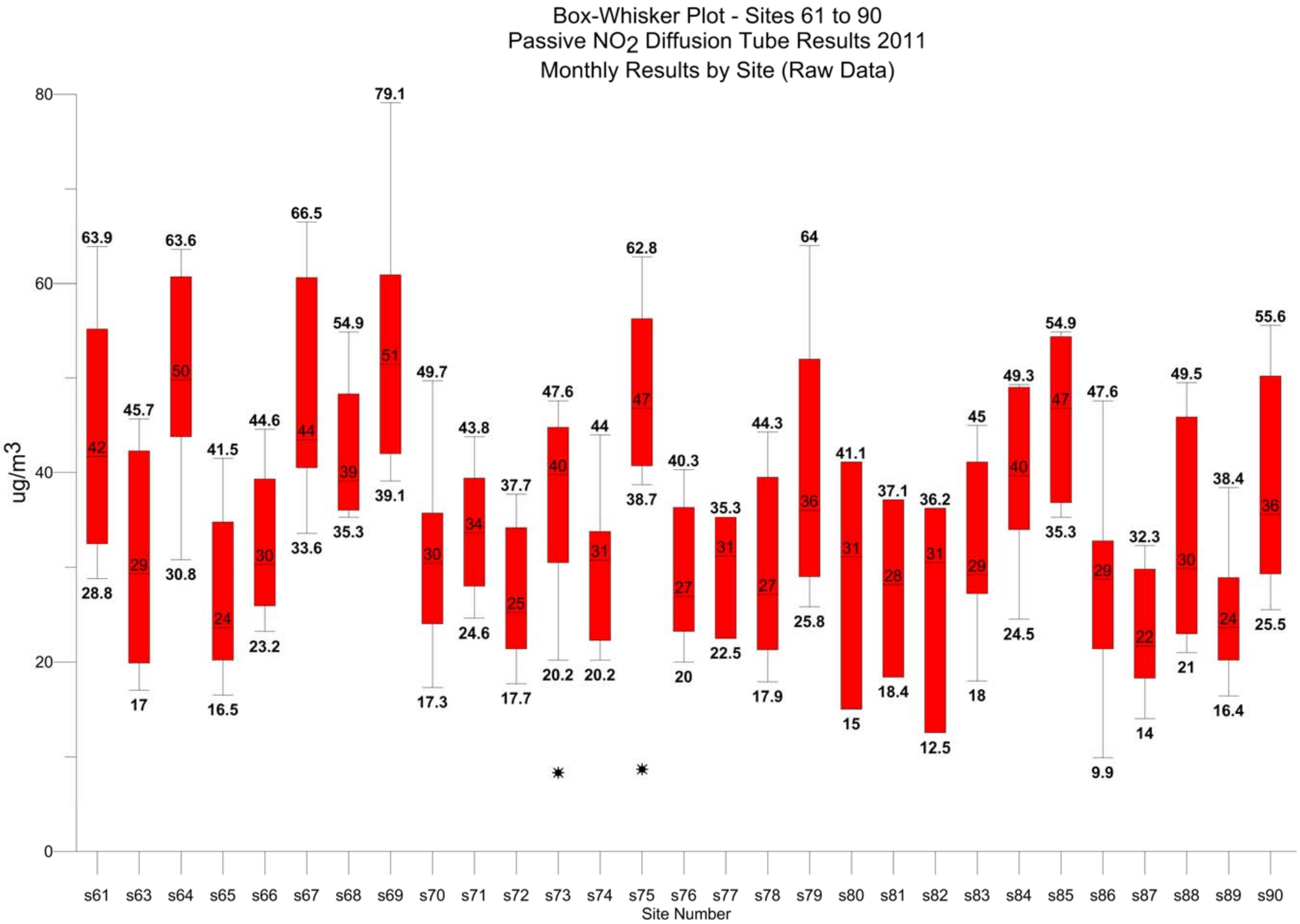
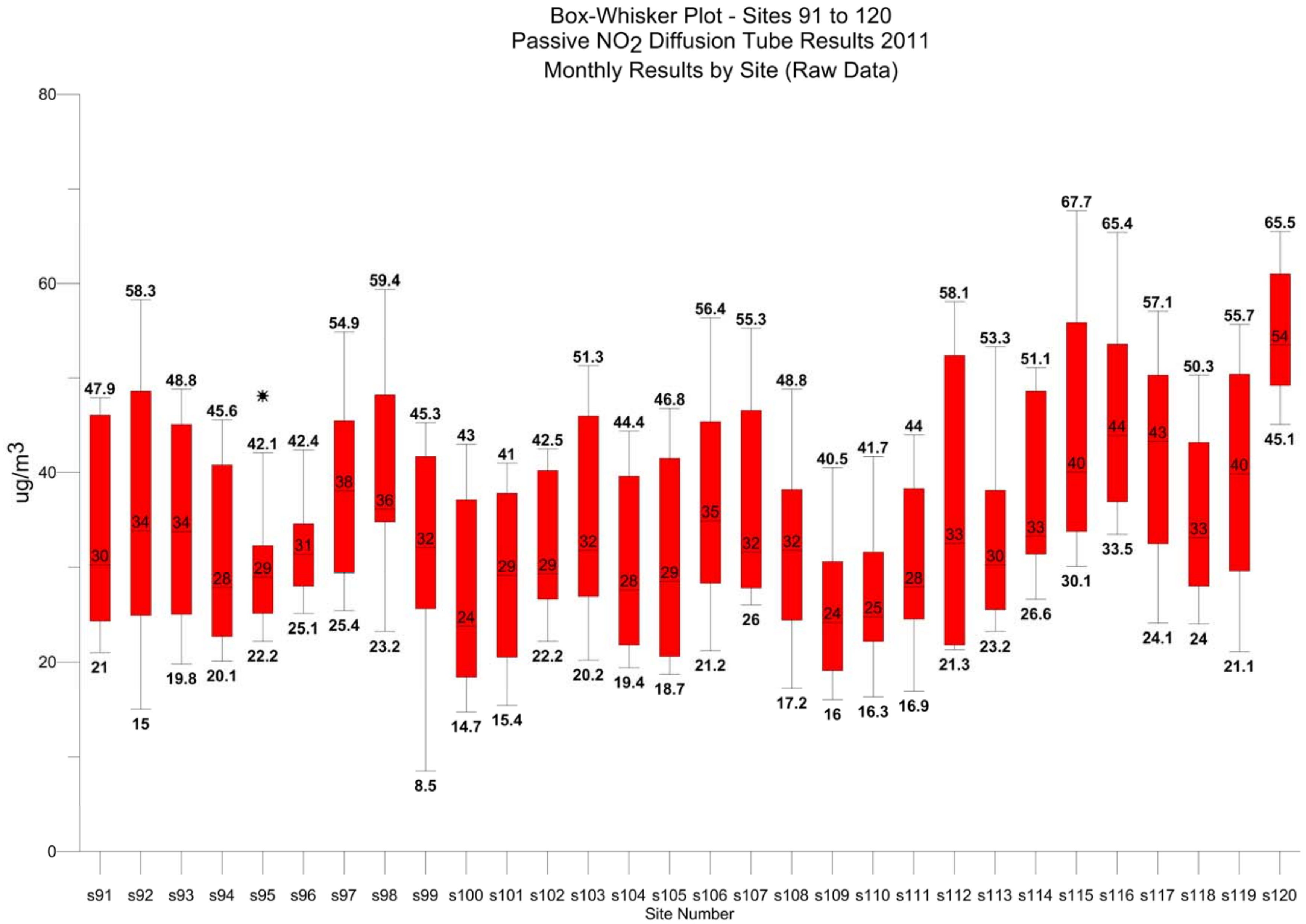
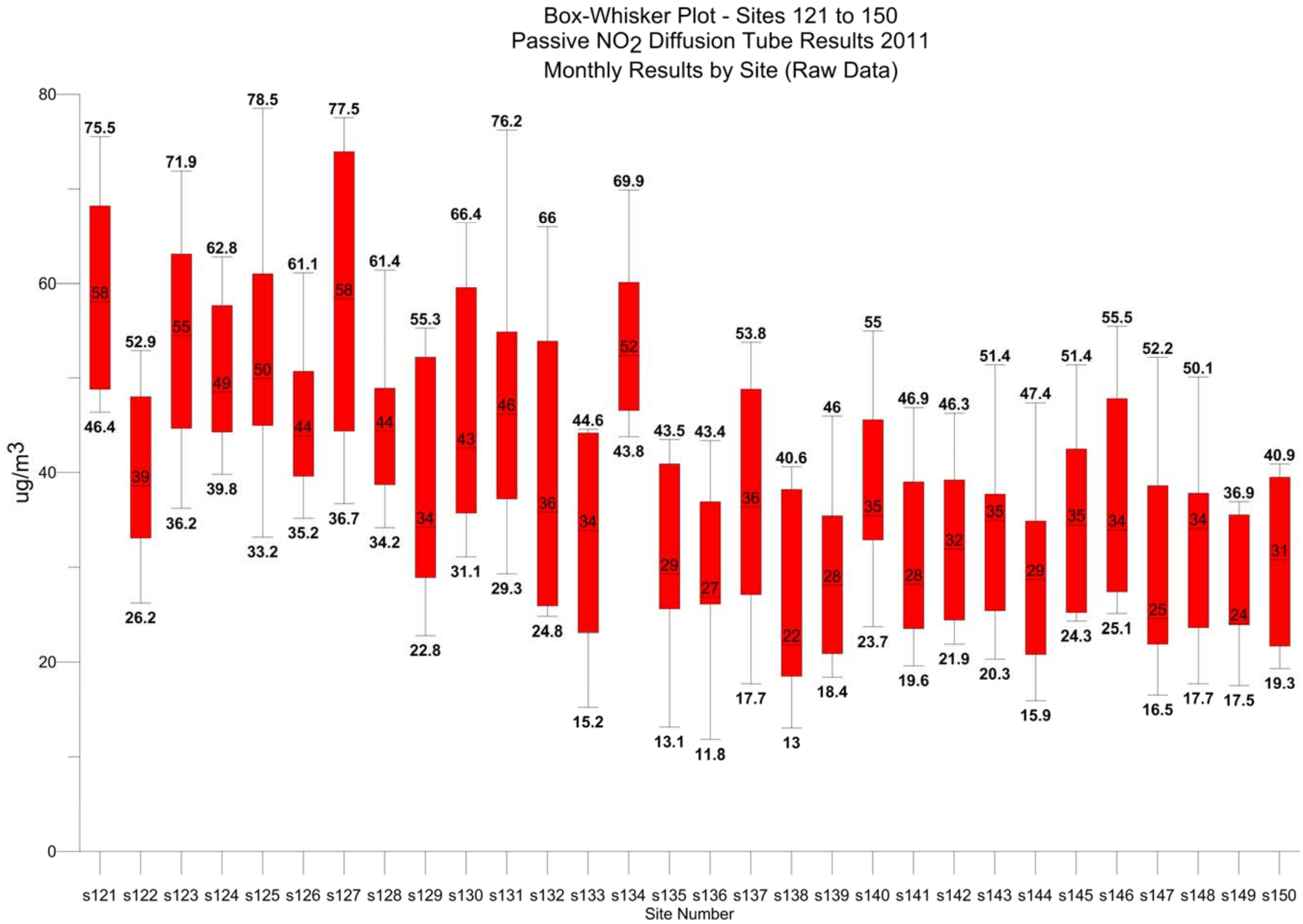
48.8 37 35
27.5 16 9.4
57 39 12.9
73.1 54 42.4
60.1 43 24.1


Box-Whisker Plot - Sites 61 to 90
Passive NO2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
s61 s63 s64 s65 s66 s67 s68 s69 s70 s71 s72 s73 s74 s75 s76 s77 s78 s79 s80 s81 s82 s83 s84 s85 s86 s87 s88 s89 s90
0
20
40
60
80
63.9 42 28.8
45.7 29 17
63.6 50 30.8
41.5 24 16.5
44.6 30 23.2
66.5 44 33.6
54.9 39 35.3
79.1 51 39.1
49.7 30 17.3
43.8 34 24.6
37.7 25 17.7
47.6 40 20.2
44 31 20.2
62.8 47 38.7
40.3 27 20
35.3 31 22.5
44.3 27 17.9
64 36 25.8
41.1 31 15
37.1 28 18.4
36.2 31 12.5
45 29 18
49.3 40 24.5
54.9 47 35.3
47.6 29 9.9
32.3 22 14
49.5 30 21
38.4 24 16.4
55.6 36 25.5



Box-Whisker Plot - Sites 91 to 120
Passive NO2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
0
20
40
60
80
s91 s92 s93 s94 s95 s96 s97 s98 s99 s100 s101 s102 s103 s104 s105 s106 s107 s108 s109 s110 s111 s112 s113 s114 s115 s116 s117 s118 s119 s120
47.9 30 21
58.3 34 15
48.8 34 19.8
45.6 28 20.1
42.1 29 22.2
42.4 31 25.1
54.9 38 25.4
59.4 36 23.2
45.3 32 8.5
43 24 14.7
41 29 15.4
42.5 29 22.2
51.3 32 20.2
44.4 28 19.4
46.8 29 18.7
56.4 35 21.2
55.3 32 26
48.8 32 17.2
40.5 24 16
41.7 25 16.3
44 28 16.9
58.1 33 21.3
53.3 30 23.2
51.1 33 26.6
67.7 40 30.1
65.4 44 33.5
57.1 43 24.1
50.3 33 24
55.7 40 21.1
65.5 54 45.1


Box-Whisker Plot - Sites 121 to 150
Passive NO_2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
0
20
40
60
80
s121 s122 s123 s124 s125 s126 s127 s128 s129 s130 s131 s132 s133 s134 s135 s136 s137 s138 s139 s140 s141 s142 s143 s144 s145 s146 s147 s148 s149 s150
Site Number
75.5 58 46.4
52.9 39 26.2
71.9 55 36.2
62.8 49 39.8
78.5 50 33.2
61.1 44 35.2
77.5 58 36.7
61.4 44 34.2
55.3 34 22.8
66.4 43 31.1
76.2 46 29.3
66 36 24.8
44.6 34 15.2
69.9 52 43.8
43.5 29 13.1
43.4 27 11.8
53.8 36 17.7
40.6 22 13
46 28 18.4
55 35 23.7
46.9 28 19.6
46.3 32 21.9
51.4 35 20.3
47.4 29 15.9
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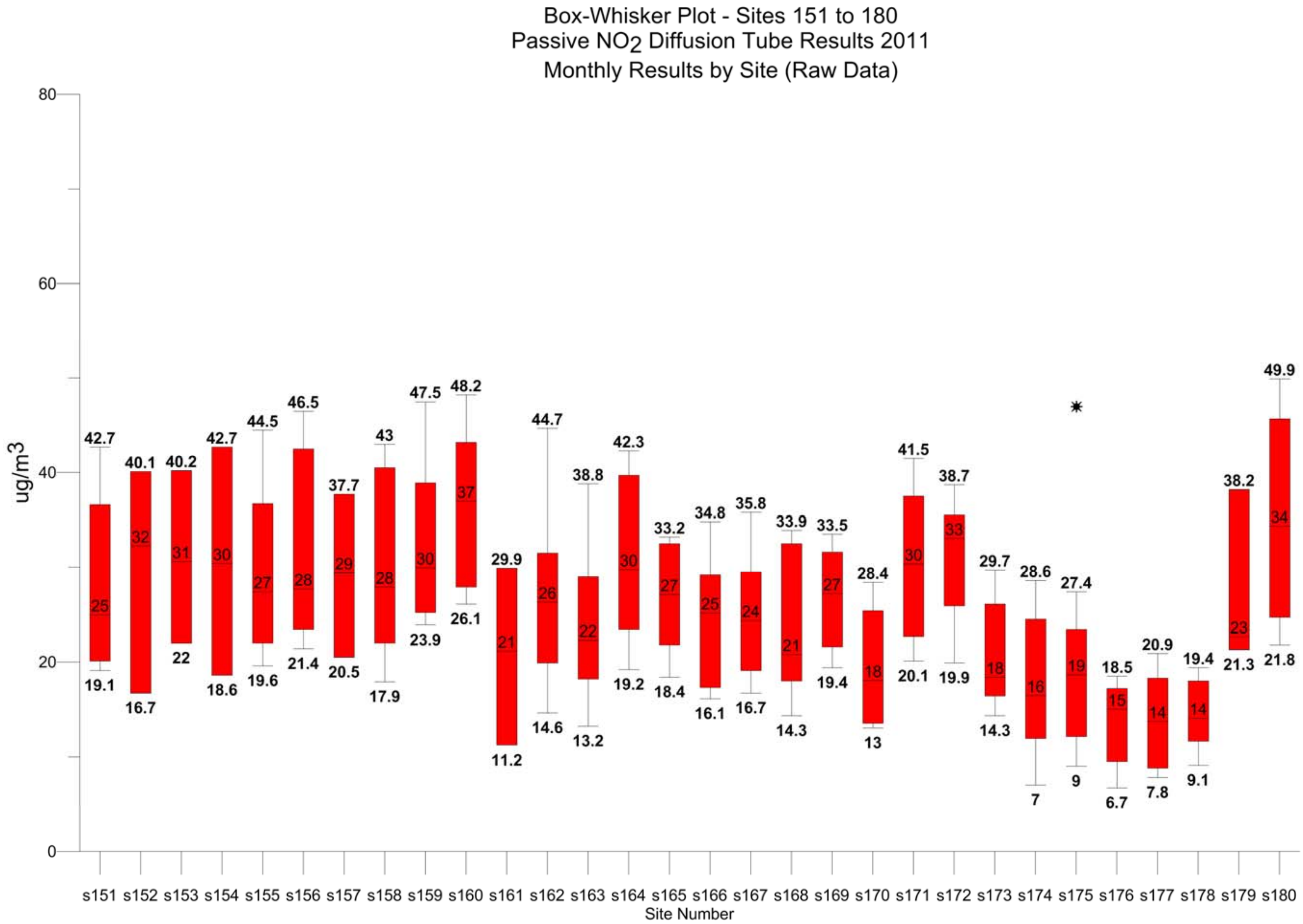
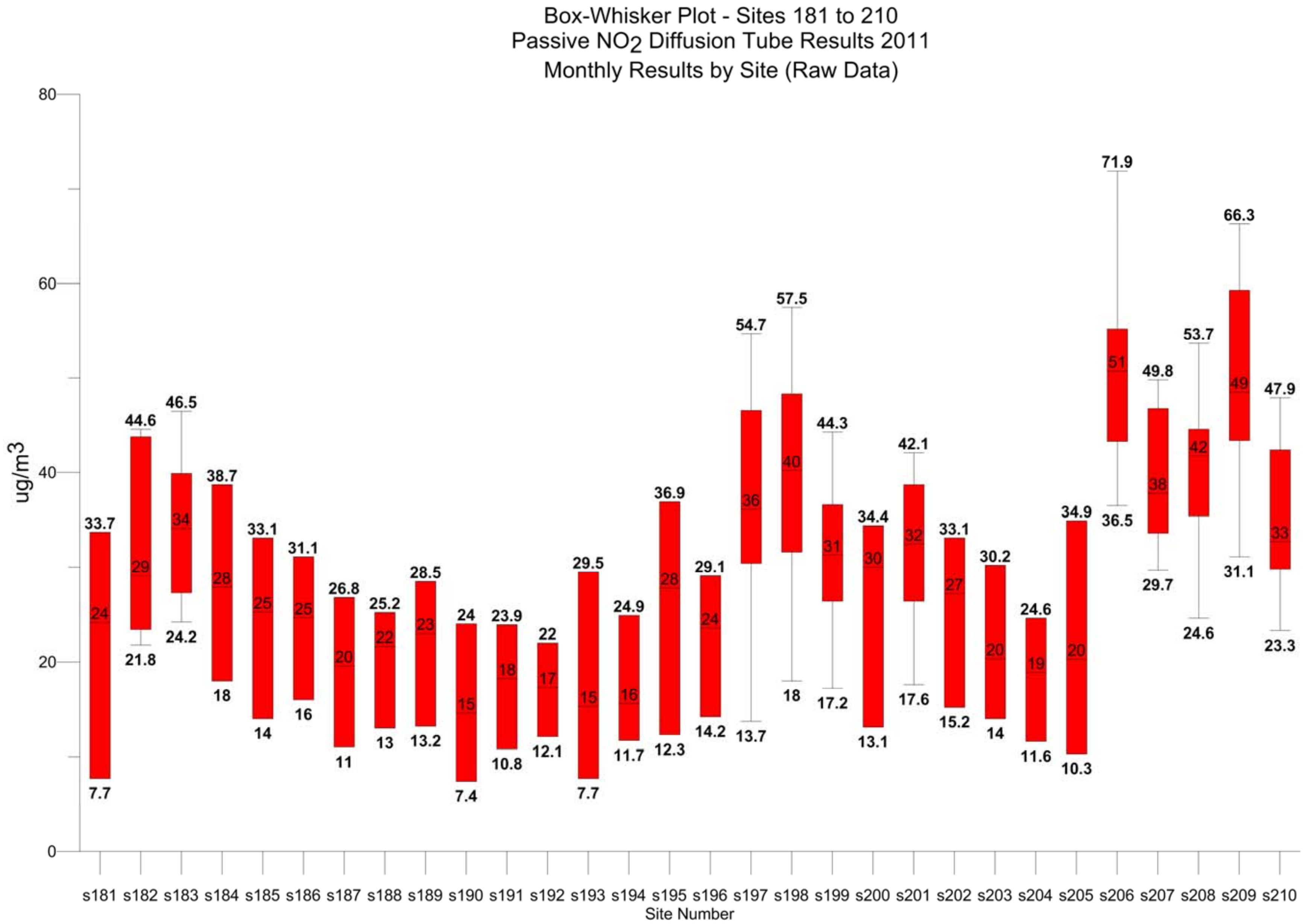
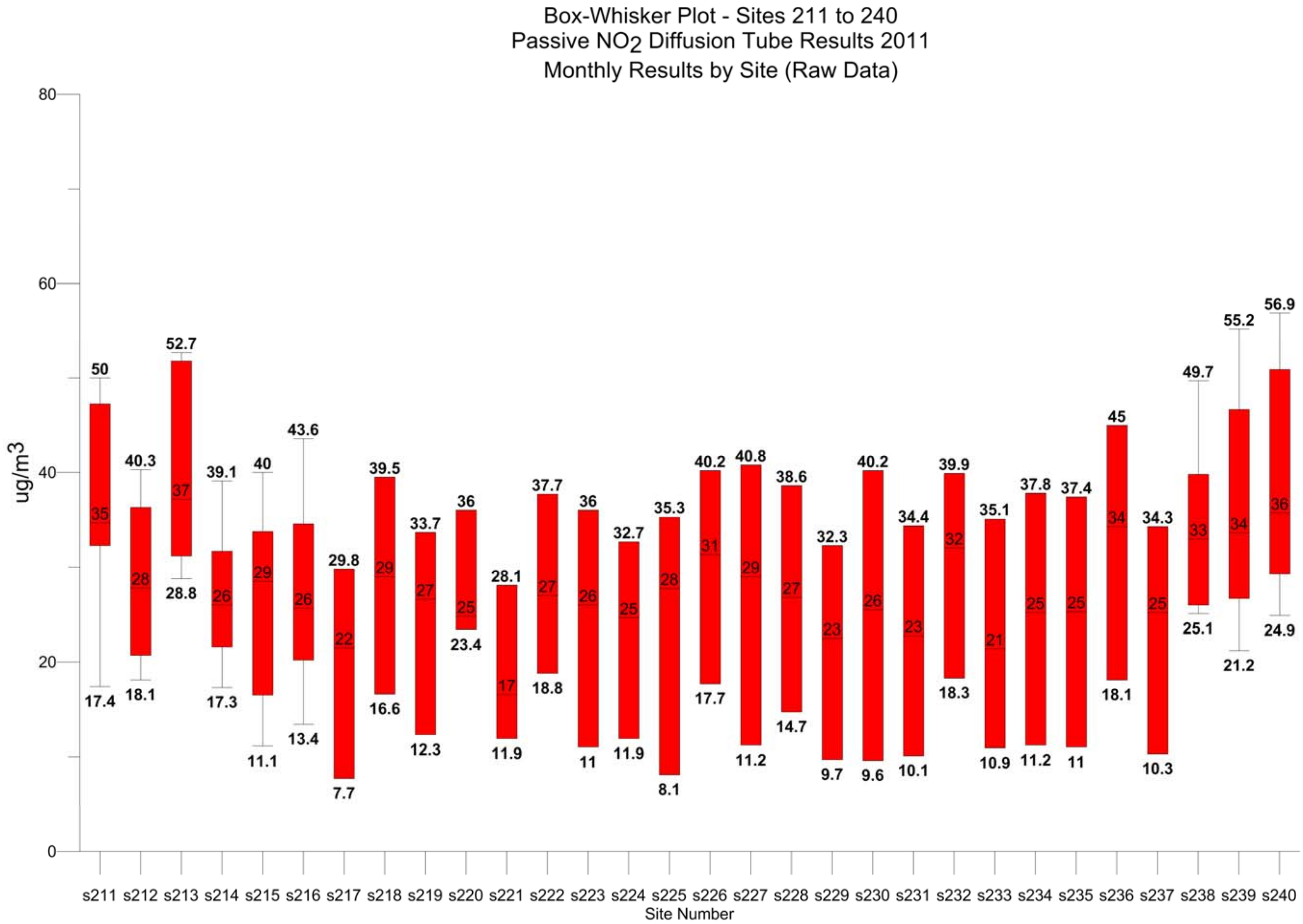
40.9 31 19.3


Box-Whisker Plot - Sites 151 to 180
Passive NO_2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
0
20
40
60
80
42.7 25 19.1
40.1 32 16.7
40.2 31 22
42.7 30 18.6
44.5 27 19.6
46.5 28 21.4
37.7 29 20.5
43 28 17.9
47.5 30 23.9
48.2 37 26.1
29.9 21 11.2
44.7 26 14.6
38.8 22 13.2
42.3 30 19.2
33.2 27 18.4
34.8 25 16.1
35.8 24 16.7
33.9 21 14.3
33.5 27 19.4
28.4 18 13
41.5 30 20.1
38.7 33 19.9
29.7 18 14.3
28.6 16 7
27.4 19 9
18.5 15 6.7
20.9 14 7.8
19.4 14 9.1
38.2 23 21.3
49.9 34 21.8
s151 s152 s153 s154 s155 s156 s157 s158 s159 s160 s161 s162 s163 s164 s165 s166 s167 s168 s169 s170 s171 s172 s173 s174 s175 s176 s177 s178 s179 s180
Site Number


Box-Whisker Plot - Sites 181 to 210
Passive NO2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
s181 s182 s183 s184 s185 s186 s187 s188 s189 s190 s191 s192 s193 s194 s195 s196 s197 s198 s199 s200 s201 s202 s203 s204 s205 s206 s207 s208 s209 s210


Box-Whisker Plot - Sites 211 to 240
Passive NO_2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
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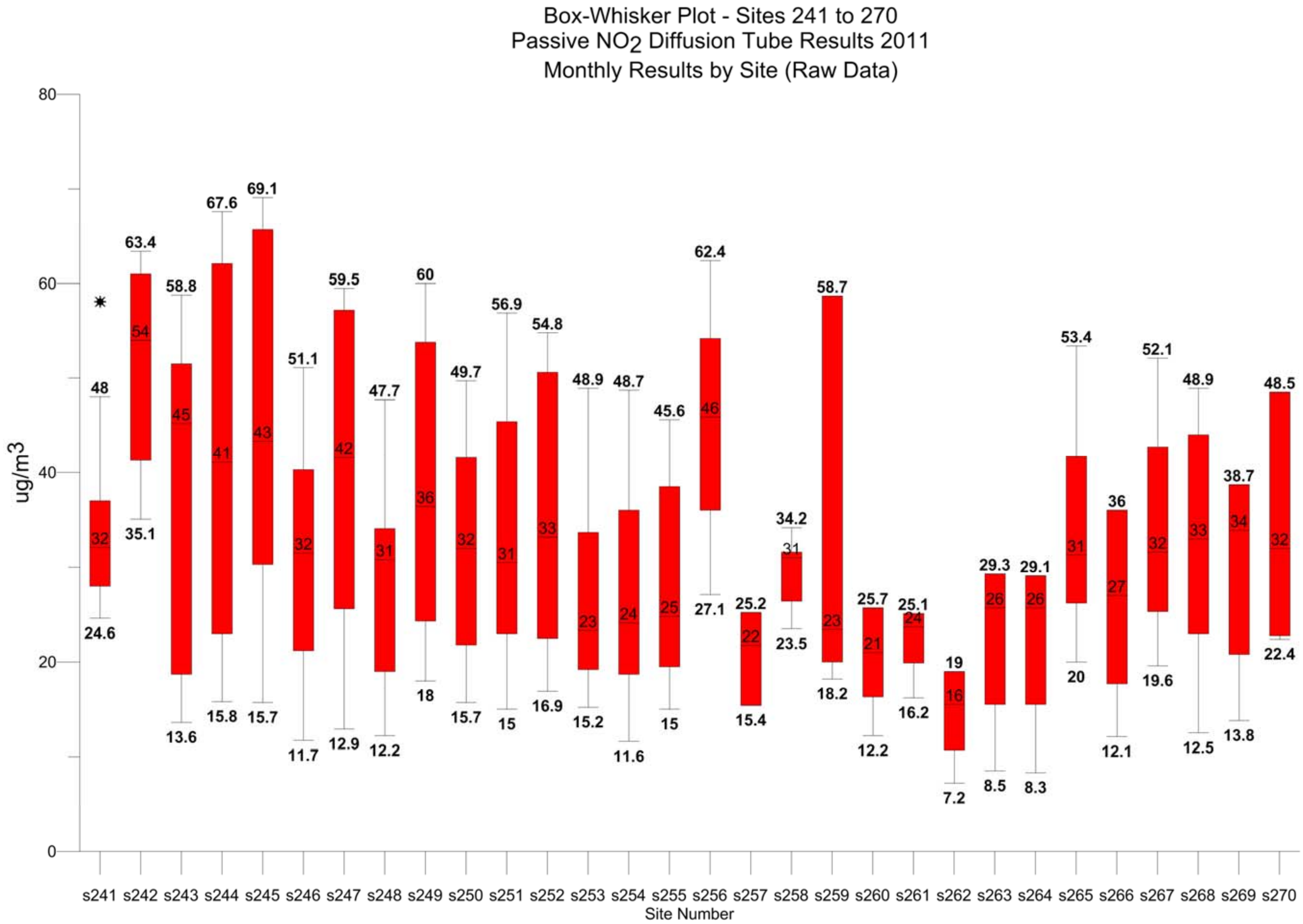
Box-Whisker Plot - Sites 241 to 270
Passive NO_2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
s241 s242 s243 s244 s245 s246 s247 s248 s249 s250 s251 s252 s253 s254 s255 s256 s257 s258 s259 s260 s261 s262 s263 s264 s265 s266 s267 s268 s269 s270
0 20 40 60 80
48 32 24.6
63.4 54 35.1
58.8 45 13.6
67.6 41 15.8
69.1 43 15.7
51.1 32 11.7
59.5 42 12.9
47.7 31 12.2
60 36 18
49.7 32 15.7
56.9 31 15
54.8 33 16.9
48.9 23 15.2
48.7 24 11.6
45.6 25 15
62.4 46 27.1
25.2 22 15.4
34.2 31 23.5
58.7 23 18.2
25.7 21 12.2
25.1 24 16.2
19 16 7.2
29.3 26 8.5
29.1 26 8.3
53.4 31 20
36 27 12.1
52.1 32 19.6
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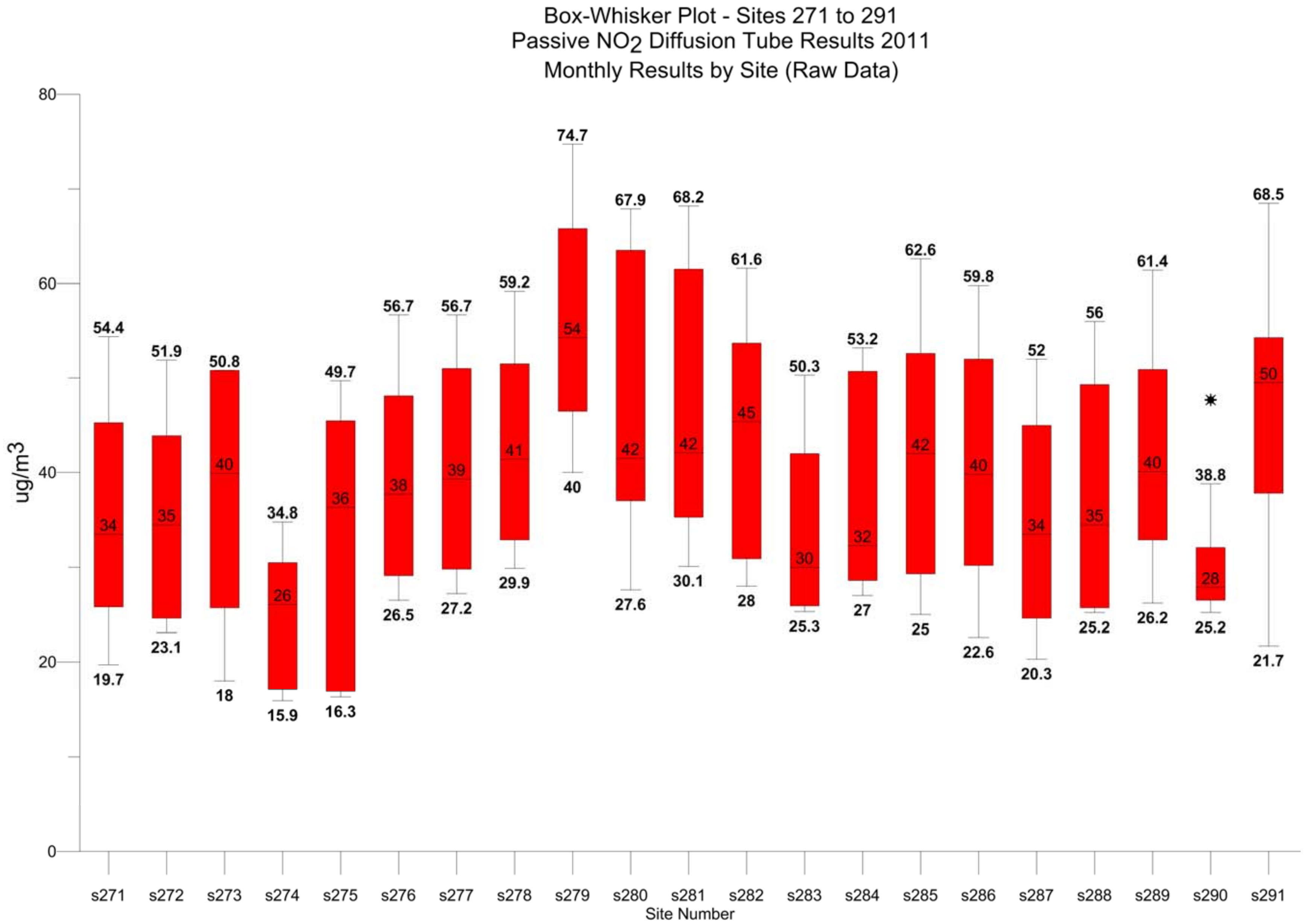
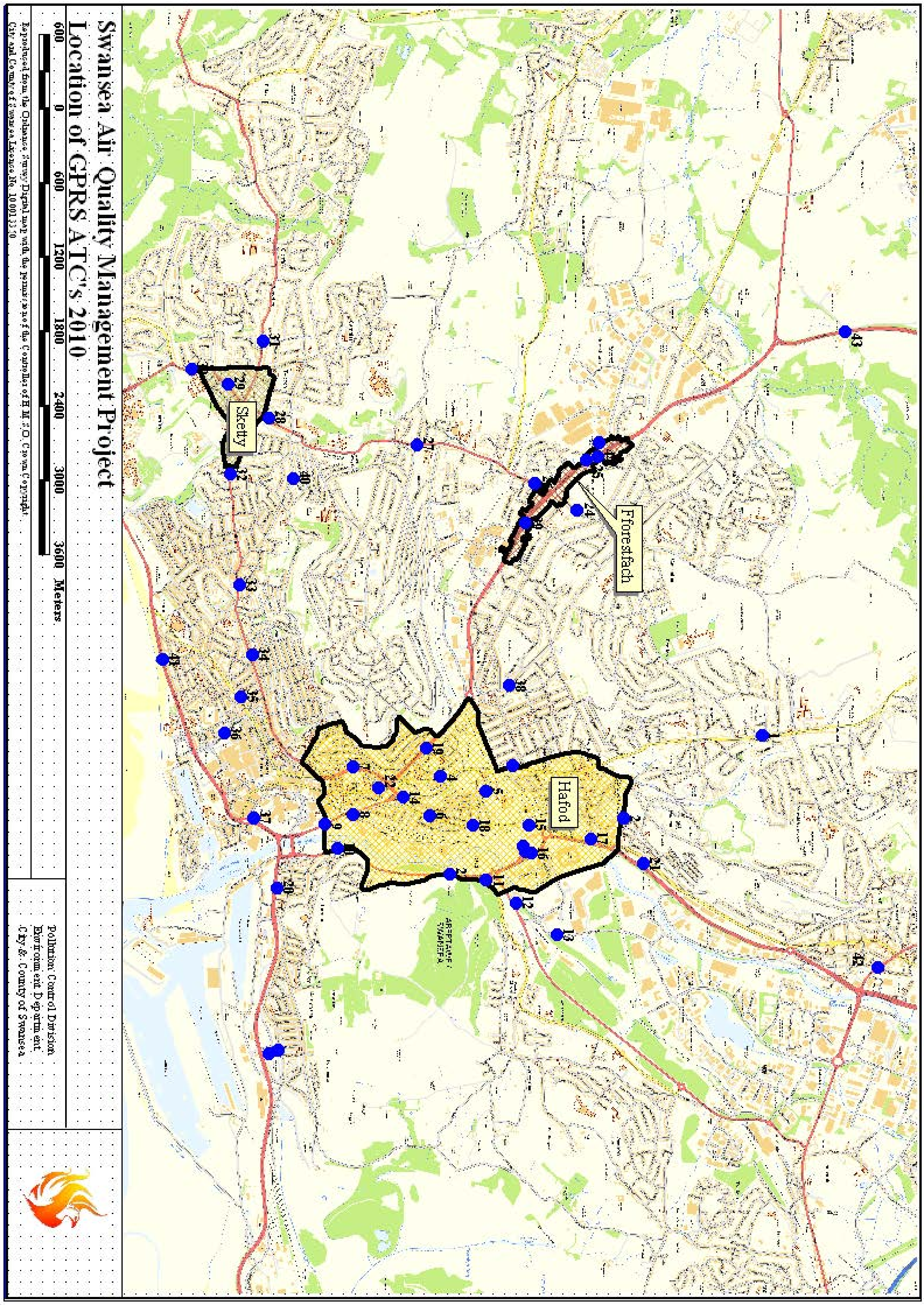
38.7 34 13.8
48.5 32 22.4


Box-Whisker Plot - Sites 271 to 291
Passive NO2 Diffusion Tube Results 2011
Monthly Results by Site (Raw Data)
ug/m3
Site Number
s271 s272 s273 s274 s275 s276 s277 s278 s279 s280 s281 s282 s283 s284 s285 s286 s287 s288 s289 s290 s291
54.4 34 19.7
51.9 35 23.1
50.8 40 18
34.8 26 15.9
49.7 36 16.3
56.7 38 26.5
56.7 39 27.2
59.2 41 29.9
74.7 54 40
67.9 42 27.6
68.2 42 30.1
61.6 45 28
50.3 30 25.3
53.2 32 27
62.6 42 25
59.8 40 22.6
52 34 20.3
56 35 25.2
61.4 40 26.2
38.8 28 25.2
68.5 50 21.7

Appendix 6

Automatic Traffic Counter Locations


Swansea Air Quality Management Project
Location of GPRS ATC's 2010
600 0 600 1200 1800 2400 3000 3600 Meters
Sketty
Fforestfach
Hafod
Pollution Control Division
Environment Department
City & County of Swansea

Appendix 7

AIRBORNE PARTICLES IN SWANSEA, UK:
THEIR COLLECTION AND
CHARACTERISATION

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

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[2]School of Biosciences, Cardiff University, Museum Avenue, Cardiff, CF10 3US, Wales, UK
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Abstract

Urban air particulate matter has previously been associated with a variety of adverse health effects. It is now the smallest particles, ultrafine or nanoparticles, which are linked to the greatest health effects. The physicochemistry of these particles is likely to provide information regarding their toxicity. Therefore, the aim of this study was to further the understanding of the heterogeneous and changing particle concentrations in urban air, in conjunction with gaining an understanding of the physicochemistry of the particles.

A Dekati™ Electrical Low Pressure Impactor was used to collect the particles and real-time data in a busy traffic corridor in Swansea, Wales over a period of ten non-consecutive weeks. Particle concentrations in the street canyon were analysed and particle physicochemistries investigated using a variety of techniques.

Particle number concentrations were found to vary both diurnally and from day to day in the traffic corridor. Of all particles, the nano–fine size fraction was consistently identified in the highest concentrations (maximum: 140,000 particles cm^{-3}). Particle physicochemistry was found to vary as a function of size, with larger particles exhibiting a greater variety of morphologies (and consequently particle types) and associated metals.

Background

Air pollution is not a new problem. Pollution episodes have been noted since Roman times, with evidence of small-scale scientific atmospheric pollutant investigations as early as the seventeenth century (Kretzschmar, 2007). However it took one-off events such as the Meuse Valley fog in Belgium, 1930 (Nemery et al., 2001) and the Great London smog of 1952 (Whittaker et al., 2004; Davis et al., 2002; Elsom, 1987) to incontrovertibly link airborne particle matter to adverse health effects. These events served as a wake-up call, leading to technological improvements, funding and research (Donaldson, 2003). It is now the smallest particles, nano- or ultrafine particles, generally defined as particles with at least one dimension below 100nm (Donaldson et al., 2001; Oberdörster et al., 2005), that are being linked with the greatest health effects in epidemiology studies, in vitro studies and to a large extent, in vivo studies (Donaldson et al., 2001; Brown et al., 2001, Oberdörster et al., 2005). Whilst this association is now well established, the actual causes of adverse health effects continue to be debated, and are not well understood.

Over the range of particle sizes, it is nanoparticles that have consistently been found in the highest concentrations in urban air (Tuch et al., 2003; Ketzel et al., 2004; Mejìa et al., 2007). Concentrations in urban air have repeatedly been found to reach levels of 104-5 particles cm-3 (Kittelson et al., 2004) during peak traffic flow periods. This causes concern that at these high particle levels the human body clearance mechanisms cannot work efficiently at removing particles (Oberdörster, 1995); leading to particles remaining in contact with cell surfaces for longer periods of time. This persistent contact or “particle overload” has been highlighted as a potential contributing factor when assessing the toxicity of airborne particles.

The issue is complicated by the variety of particles that populations are exposed to on a daily basis. Urban air particles are a complicated and heterogeneous mix (e.g. Donaldson et al., 2005), combining a wide range of particle characteristics such as size, morphology, surface reactivity, biopersistence and chemistry in every sample. This emphasises the importance of fully characterising particulates in all investigations (e.g. Harrison and Yin, 2000).

This study used an interdisciplinary approach to investigate particle physicochemistry within a traffic canyon. Particles were collected using a DekatiTM Electrical Low Pressure Impactor (ELPI) into twelve size fractions. The collection was completed at two locations; an urban air traffic canyon and a rural background location. Due to the small masses in each of the collected size fractions, they were then combined into three analysable size fractions (7-615nm, 616- 2.39µm, 2.4µm- 10µm). The three size fractions were physicochemically evaluated using tools including Field Emission- Scanning Electron Microscopy (FE-SEM) and Inductively Coupled Plasma- Mass Spectrometry (ICP-MS).
Methods

Site details

Particle collection was completed at two localities; an urban air site, and a rural control site. Neath Road in Swansea, Wales, UK was the urban collection site. Neath Road is a main commuter traffic route into Swansea City, and a recognised traffic hotspot (Figure 1). The area has been designated an Air Quality Management Area (AQMA) based upon its pollutant concentrations. Traffic levels are high (~18,000 per day) due to the road forming a main commuter zone between Swansea and Neath. Swansea is also an old industrial port city, which has been undergoing a process of urban renewal for a number of years. The locality was therefore expected to consist of a cocktail of particle types that were contributed by the main sources; urban, industrial and marine. Sampling was completed over a period of ten non-consecutive weeks during one season (therefore reducing the impact of seasonal- related meteorological differences) between 05/12/07 and 28/02/08, resulting in both particle collections and real-time particle data.
The traffic corridor is orientated NNE- SSW, with the predominant wind direction in a similar trajectory (NE-SW). Small-scale industrial sites are located city-wide; however the predominant wind direction (blowing straight from the sea and onto the site) reduces the impact of local industry. Port Talbot to the south east represents the most substantial industrial area in the vicinity, potentially contributing particles dependent upon the wind direction.

Brecon, the rural control site is located approximately 42km north-east of Swansea. Sampling lasted for a period of three weeks; producing only a one week usable sample due to an atypical dust storm (correlated to an event originating from the Sahara), and a neighbour’s bonfire. While achieving the one week usable particulate sample, a local mains power failure resulted in no real-time data collection.

Instrumentation

Particles were collected using a DekatiTM Electrical Low Pressure Impactor (ELPI). The ELPI is an inertial-based cascade impactor, which accumulates both real-time particle data and particle collections onto substrates. It divides particle data into 12 size fractions, from 7nm to 10µm, 3 of which are within the 'nano' size range, and particle collections from 30nm to 10µm. ELPI cut-off diameters (Keskinen et al., 1992) and particle concentration profiles (Zervas and Dorlhène., 2006) have been confirmed in previous studies. A flow rate of 30 l/min was maintained using a Sogevac Leybold vacuum pump. The ELPI stages were loaded with 25mm aluminium foil substrates. Substrates were weighed using a microbalance (Sartorius Micro SC-2) pre- and post-sampling to determine the particulate mass. Substrates were not coated with grease (as recommended by the manufacturers) in order to reduce contamination during subsequent ICP-MS analyses (Fujitani et al., 2006). The equipment set-up on-site included the collection head, teflon tubing, ELPI, pump, and laptop for equipment control and data collection.

Statistical testing

Graphing and statistical testing was completed using Microsoft Excel, with SPSS (version 16) used for non-parametric particle analysis and Spearman's Rank Correlation Coefficient.

Particle characterisation

Analytical electron microscopy

In preparation for Field Emission- Scanning Electron Microscopy (FE-SEM), the aluminium foil substrates were cut into sections. Approximately one-eighth of each collection foil was used for analysis. Epoxy resin (AralditeTM) was used to attach the foil substrate sections to 12.5mm aluminium SEM stubs (Agar Scientific). Samples were then coated with gold using a sputter coater (Bio-Rad SC500). Samples were imaged using a Philips XL30 FE-SEM. A range of working conditions in secondary electron mode were utilised to maximise image quality, including a working distance of 5mm- 10mm, accelerating voltages 5-20kV, spot size 4 and a gold foil aperture.

Particle extraction

Particles were removed from the foil substrates for further physicochemical analysis using a novel freeze-drying technique.

Onto each aluminium foil, 900µl of molecular biology grade water was pipetted. The foil and water were then frozen. Once fully frozen, the ice discs were peeled from the foils using ceramic tweezers. Samples were freeze-dried at -40oC (Model: Edwards Pirani 10) until no ice remained in the samples, a process taking varying lengths of time from overnight, to periods of two or three days depending upon sample size. Samples were combined into three size fractions (30nm- 615nm, 616nm- 2.39µm, 2.4µm- 10µm) in order to provide samples large enough for analysis, representing 'nano-fine', 'fine' and 'fine-coarse' particle size fractions. The accuracy of the particle removal technique has been assessed (Figure 2).

Figure 2 compares the particle recovery efficiencies between the three size fractions. Percentage particle recovery is ascertained by weighing substrates before/ after sampling to find total particle mass, and after extraction to find the particle mass that has been removed from the substrate. Particle percentage recovery therefore represents the mass percentage removed from the substrate using the extraction, in comparison with the original particle mass.

Particle removal using this technique is proven to be efficient (up to 98% particle recovery), removing the majority of the particle mass from the collection substrates. These removal efficiencies are comparable (or more efficient than) than those from other studies. Hartz et al. (2005) obtained a 60- 85% mass recovery using a solvent- based extraction process. Jones et al. (2006) recovered 80% of particles with an initial wash of particles collected onto Polyurethane Foam (PUF) substrate. Further washing provides recoveries of up to 95%, comparable with this study.

Due to the high removal rates, particles removed using this methodology are considered to be representative of the particle sample as a whole. It is shown that particle removal is most effective in the middle size fraction, a factor likely to be closely related to a larger initial mass and volume in this size fraction, combined with similar substrate adherence areas to the smallest and largest size fractions, reducing the relative percentage of particles in contact with the substrate.

ICP-MS analysis

Samples were digested for ICP-MS analysis using a CEM MDS-200 microwave system. Particle samples (n=2) were washed into teflon-coated composite vessels using 5ml 70% nitric acid. The samples were digested using an existing programme developed for refractory carbon-based particulate matter (Jones et al., 2006). The microwave programme consists of a stepped increase in pressure to 80psi for a period of 20minutes, with a corresponding temperature rise to 180oC. The programme lasts for approximately 2.5 hours, including warm up and cool down periods. Samples were then diluted to a level of 10µg/ml (dependent upon their original weight) using deionised (>18ΩM) H2O. Raw data was corrected for blanks and controls accordingly.

Results

Real-time particle data

After processing the raw data using ELPIvi software, it is seen that throughout the daily cycle, on both weekdays (Figure 3 [a- c]) and Sundays (Figure 3 [d- f]), particle number concentrations are consistently highest in the smallest size fraction (D50% 7nm). In this size fraction, particle number concentration peaks at 140,000 particles cm-3.

During the weekday averages, there is a consistent daily concentration profile which is replicated in all three analysed size fractions. The profile is characterised by a steep rise in particle numbers during the morning rush hour. Interestingly, whilst all three size fractions show this trend, particle numbers in the coarse size fraction (2.4µm- 10µm; Figure 3c) do not begin to increase until 08:30am, compared to a 06:00am increase identified in the two smaller size fractions. Similarly, the evening rush hour signal identified in the two smaller size fractions (7nm- 2.39μm) which begins at 15:00pm, does not begin in the coarse size fraction until 17:00pm.

During weekdays, the “night-time” particle concentrations (18:30- 06:30) are significantly lower (95% conf.) than “daytime” particle concentrations (06:30- 18:30) in the two smaller particle size fractions (7nm- 2.39μm). When considering the coarse size fraction (2.4μm- 10μm), this statistical difference (95% conf.) is not identifiable.

In contrast to the weekday data, Sunday particle number concentrations peak at 38,000 particles cm-3 at 20:30pm. The smallest (7nm- 615nm) and largest (2.4μm- 10μm) measured size fractions do not show a significant difference in particle number concentrations between “daytime” and “night-time” hours (95% conf.). In contrast, the middle size fraction does indicate number concentration variation between day and night-time hours (95% conf.).

Averaged data across the week (Monday- Sunday; Figure 4) illustrates the daily particle concentration profile differences at Neath Road, Swansea. Outputs for Monday- Thursday are consistent in terms of profile shape and magnitude in the smallest size fraction (7nm- 615nm). This profile pattern begins to break down on Friday and Saturday, and by Sunday, the original number concentration profile has broken down completely, with smaller magnitudes and a different profile shape, with a particle concentration low during the morning replacing the number concentration high identified in the weekday data.

Fine (616nm- 2.39μm) and Coarse (2.4μm- 10μm) particles do not have a similar weekly concentration distribution to the smallest size fraction. The consistency of the number concentration profile (Monday-Thursday) identified in the smallest size fraction is not repeated in these size fractions. Instead, concentration profiles are generally more poorly defined, with occasional time periods appearing to be synchronised with the finest size fraction. In both larger size fractions, particle concentrations are higher from 12:00pm Saturday to 00:00am Sunday than on the Wednesday and Thursday, which contain some extreme particle concentration lows, for example Thursday (14:30pm), potentially a product of meteorological conditions.Physicochemistry of collected particles

FE-SEM

As shown in Figure 5, particle morphology, and consequently type, increased in variability as particle size increased. Particles in the smallest size fraction (30- 615nm) have a consistent morphology of spherical to sub-spherical particles. In the middle size fraction, a combination of agglomerated spherical/ sub-spherical particles and more sheet-like platy grains dominate. The largest size fraction (2.4μm - 10μm) exhibits much greater particle variability, with a range of particle morphologies visible (Figure 5e, f), agglomerated spherical/ sub-spherical particles, platy grains, cubic morphologies, larger spherical particles and large near-spherical particles with nodules.

ICP-MS

The ICP-MS elemental analysis confirmed that iron, zinc and magnesium were the most abundant elements in the particles (Figure 6). Element concentrations were found to vary with respect to particle size, but differently between elements, for example, iron and magnesium were found to increase in concentration with increasing particle size, compared to nickel and lead, which had the highest elemental concentrations in the smallest size fraction.

In terms of average PM10 concentration, elements were identified in the descending concentration order Fe> Zn> Mg> Ni> Cu> Cr> Ba> Mo> Pb> Mn> Ti> V> Zr> Co> Cd.

Associations were identified between a number of elements using Spearman's rank correlation coefficient including Fe and Cu, Fe and Ba, Fe and Mn, Mg and Co, Ni and Ba, Cu and Ba, Cu and Mn, Ba and Mn to a 0.01 confidence level.

Discussion

Particle data analysis

Throughout the 24-hour sampling period shown in Figure 3, the highest particle concentrations are found in the smallest particle size fraction, particles 7nm- 615nm. These findings reinforce work completed by others, for example in Brisbane (Mejìa et al., 2007) where peak particle concentrations were below 30nm (82- 90% of particles). A study in two German cities, Erfurt and Leipzig (Tuch et al., 2003), found the highest particle concentrations in the 10nm- 20nm size range; whilst an urban air study focussed upon Copenhagen (Ketzel et al., 2004) and lasting several years placed the particle concentration maximum between 20nm- 30nm. This particle concentration maximum is attributed to the traffic contribution at these urban sites (Mejìa et al., 2007; Ketzel et al., 2004; Shi et al., 1999). The findings within the Swansea traffic corridor are therefore comparable with those found in other locations, and the concentration maximum, combined with what is known about the street canyon can confirm that whilst the input of particles from other sources (for example industrial and marine) will contribute to the particle totals, vehicles are the dominant sources of particles at Neath Road in Swansea.

Particle concentrations throughout the day in the traffic corridor are high (mean: 52,000 particles cm-3) when compared against some urban areas sampled in similar studies. The German two city study (Tuch et al., 2003) found a particle concentration maximum of 40,000 particles cm-3, whilst the Copenhagen study (Ketzel et al., 2004) found an average of only 7,700 particles cm-3 during a three month investigation period. A study completed in Rouen, France (Gouriou et al., 2004) using an ELPI found average particle concentrations below 50,000 particles cm-3; if particular external factors were combined, concentrations in the range of 106 particles cm-3 were sometimes obtained. This distribution is similar to the situation in the Swansea traffic corridor. Whilst the mean averages at 52,000 particles cm-3, specific events happening over timescales as short as seconds are influencing and dramatically increasing the particle concentrations observed in the traffic corridor at particular times, leading to concentration peaks of up to 140,000 particles cm-3 in the nano-fine size fraction. A Three European City study (Ruuskanen et al., 2001) obtained similar results, with an Erfurt peak at 188,000 particles cm-3 during the morning rush hour.

On weekdays, days dominated by traffic, all size fractions are identified as having a traffic-responsive profile. That is, it is possible to identify a morning and afternoon rush hour signal. The coarse size fraction was found to have a later rush hour peak (both morning and afternoon). This finding could be explained by the rapid sensitivity of nanoparticles to vehicle exhaust particles, as previously identified by Rodriguez et al. (2007), in a study carried out in Milan, Barcelona and London. Nanoparticles were found to vary extremely quickly and significantly in response to traffic, a finding reinforced in a study of urban air particle concentrations in Helsinki (Buzorius et al., 1998), where individual vehicles were found to affect the observed particle concentrations.

A number of studies have found that particle concentrations are higher during the day, and are linked to the vehicular particle source and its predominance during daytime hours (Buzorius et al., 1998; Laasko et al., 2003); as seen in the Swansea traffic corridor. Some studies (for example Rodríguez et al., 2007) have investigated further to find that the difference between daytime and night-time concentrations is much more pronounced in the nano-fine range; a result also found in this study on weekdays. On days not dominated by traffic sources (Sunday), this nanoparticle day-night variation was not significant, reinforcing traffic as a source of the smallest particles. This continuity between day and night-time particle number concentrations on Sundays could also be contributed to by the lack of industry and other related sources of particles on the weekend.

The morning rush hour peak has been identified in this study, a finding also seen in a study at Marylebone Road (Harrison and Jones, 2005). A daily pattern, with nanoparticle peaks between 8am and 9am, and 4pm and 5pm identified in the German Two City study (Tuch et al., 2003) correlates with the nanoparticle morning and afternoon rush hour peaks identified in Swansea on weekdays. A link between nanoparticle concentrations and solar radiation has previously been identified (Shi et al., 2001); perhaps explaining the sustained nanoparticle numbers observed at Neath Road between morning and afternoon rush hour peaks.

The difference in particle concentrations and distributions identified at the Neath Road collection site between weekdays and weekends has also been identified in other studies (Buzorius et al., 1998), and is attributable to a reduction in commuter traffic and to an extent, industrial processes during the weekends. This result has not been consistent for all studies (Mejìa et al., 2007), perhaps due to a reduced importance of commuter traffic-sourced particles in the study, and the dominance of other sources.

Identifiable in the Neath Road data is reduced particle number concentrations in the fine and coarse size fractions during Wednesday and Thursday, and increased particle number concentrations on Saturday and Sunday. If the smallest size fraction (7nm- 615nm) is taken to be representative of the particle number profile predominantly as a result of traffic, this finding reinforces that particles in the middle and largest size fractions are contributed to by a variety of sources other than traffic exhaust, perhaps road dust, marine particles and industrial particles (Moreno et al., 2004).

The week-long study at Neath Road traffic corridor identified variability in particle concentration signals for different days of the week, especially emphasised in the smallest size fraction, particles between 7 and 615nm. Different particle signals were also identified in a study carried out in Milan, Barcelona and London (Rodríguez et al., 2007), a finding explained by the importance of semi-volatile compound condensation in urban areas. In contrast, a study at three sites within Birmingham, England (Shi et al., 1999) found that despite variable weather conditions, particle concentrations and distributions measured varied only negligibly. Day to day particle concentration and distribution variances at Neath Road can be assumed to be dependent upon traffic compositional, volume changes or meteorological differences. Further work is required to elucidate the relative contribution of each component.

Physicochemistry of collected particles

Carbonaceous material was found to be dominant in all size fractions; as identified from the FESEM imaging (nano-sized spherical to sub-spherical particles found singularly or in aggregates; Figure 5). Results from a characterisation analysis of particulate matter collected on the coast of Sicily (Rinaldi et al., 2007) agree with this finding, especially in the size range 50- 140nm. In this study, the smallest measured size fraction (30nm- 615nm) was also found to have the highest carbonaceous material of all the measured size fractions. These study findings are in agreement with others including those completed in Pasadena, California (Hughes et al., 1998), Milwaukee, Wisconsin (Lough et al., 2005), Belfast (urban), London (urban) and Harwell (rural) in the UK (Jones and Harrison, 2005). The large contribution of carbonaceous soot nanoparticles to the samples, whether as individual particles (or small groupings of particles) in the smallest size fraction, or larger agglomerates in the middle and largest size fraction reaffirms traffic exhaust particles as the main particle source in the street canyon. The large contribution of traffic exhaust particles to total particle concentrations in urban settings is well documented (e.g. BéruBé et al., 2008).

Particles of cubic morphology, as recognised using FESEM imaging (Figure 5), can be identified as marine-derived halite crystals (Jones and BéruBé, 2007), due to the proximity of the sampling site to the sea and the predominant wind direction (Figure 1). Those particles with perfect cubic morphology are likely to have grown in situ on the collection substrate, whilst more damaged particles are likely to have origins of either marine processes or road salting (Moreno et al., 2004). The combined factors of proximity to the sea and comparatively stable weather conditions suggests a predominance of marine-derived halite crystals.
Large (coarse size fraction) spherical particles with nodules covering the surface are attributed to biogenic processes, confirmed by their behaviour beneath the FESEM beam (BéruBé et al., 2008).

FESEM imaging identified sheet-like particles in the largest size fraction. These particles (2.4- 10μm) are identified as mineralogical particles, perhaps derived from local or more distant areas of exposed crust and soil (BéruBé et al., 2008).

Due to the naturally variable wind directions encountered during a sampling period, the origin of industrial- generated perfect spherical particles may be local (within Swansea) or wind-blown from a distance (for example Port Talbot to the south- east). Spherical particles are common in both urban and industrial air (Moreno et al., 2004).

The metals identified in the particle samples (ICP-MS analysis) were found to increase in variety with increasing particle size, as found also in the Milwaukee study (Lough et al., 2005). PM10 was found to contain more metals than PM2.5, perhaps due to the greater variety of contributing sources to the larger size fractions; including crustal, traffic, biological and technogenic-type sources. In another study, investigation of analytical SEM images identified that particles under 1μm predominantly consist of traffic-derived soot (Baulig et al., 2004). Other studies have found a more bimodal distribution of elements within particulate samples, for example a peak in the nano-size fraction, and a peak in the particle size range 3.2- 5.6μm as found in a study conducted in southern Taiwan (Lin et al., 2005).

Iron was found to be the most abundant metal in the particles in agreement with results from other physicochemical analysis studies (Hughes et al., 1998; Lough et al., 2005; Baulig et al., 2004).

Some elements identified by ICP-MS analysis can be identified as partly arising from diesel emissions, for example Fe, Ca, Si, Mg and Mn (Wang et al., 2003) a number of these elements are also associated with crustal components, for example Fe, Ca, Si, Mg (Lough et al., 2005). This highlights the fact that source apportionment is extremely complicated, with different studies identifying different tracers for the same source, and different sources for the same tracer or combination of tracers.

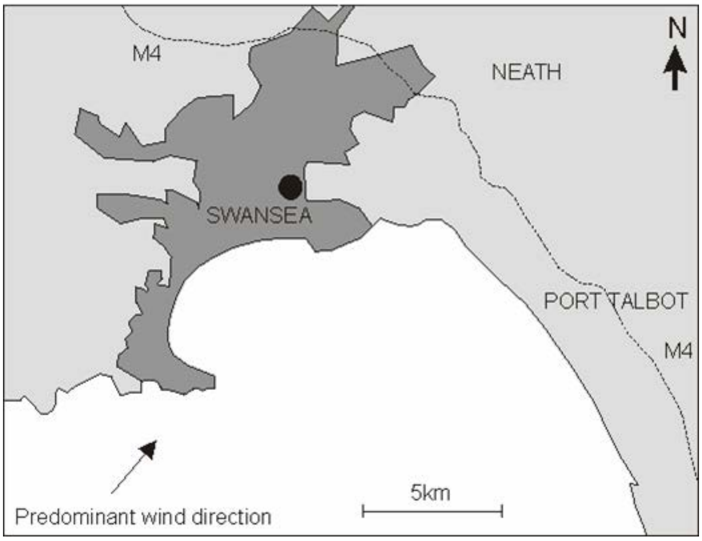
The elemental concentrations identified in this study (ICP-MS analysis; Figure 6) are much lower than in London 1950s particulate samples (Whittaker et al., 2004). Comparisons include 157ppm Fe concentration at Neath road and 19,294μg g-1 London 1955 sample, and 1.3ppm Mn concentration at Neath Road and 508 μg g-1 from the London 1955 samples. Additionally, in a paper by Shao et al. (2007), outdoor Beijing particulate matter was collected and analysed by ICP-MS. Levels of 17ppm Mn in the Beijing air can be compared with 39ppb (Neath Road). Therefore total metal concentrations of particulate matter from urban Swansea air are lower than concentrations identified in historic studies (Whittaker at al., 2004) and in rapidly developing countries (Shao et al., 2007). This finding is to be expected (Donaldson, 2003) due to improved legislation and current British technological requirements, and more local factors including meteorological conditions, road usages and the prevalence of local polluting industries.

Metal concentration ordering at the Neath Road collection site (Fe> Zn> Mg> Ni> Cu> Cr> Ba> Mo> Pb> Mn> Ti> V> Zr> Co> Cd) can be compared to those in the literature for urban locations (Whittaker et al., 2004 (Fe> Pb> Cu> Mn> V> As> Co); Chandra Mouli et al., 2006 (Fe> Mn> Ni> Cu> Pb> Co); da Silva et al., 2008 (Cu> Pb> Ni. Sb> Ce)). The difference between the concentration orders of metals at different sites highlights the importance of local factors; including geography, meteorology and variability of sources and source compositions. Correlations were identified between some of the metals analysed by ICP-MS (p>0.01). These correlations may indicate the same or similar elemental sources, for example correlation between Ba and Ni may be associated with road exhaust emissions (Dongarrà et al., 2007).

Summary and Conclusions

Particulate matter within the Neath Road street canyon, Swansea, Wales was studied for particle concentration variations and particle physicochemical properties. The particle concentrations within the traffic corridor were found to be consistently highest in the smallest size fraction, with particle concentrations and daily patterns comparable to previous studies in this field. Evening and weekend concentrations of particles were significantly lower than daytime particles, highlighting the role of traffic exhausts as a primary and influential provider of the smallest (and most abundant) particles.

Generally, with increasing particle size, particle morphology and type increased in variability, with particles in the nanoparticle-range being dominated by traffic exhaust particles. The associated metal content increased in both amount and variety of types with increasing particle size. The ICP-MS analyses generally added to and reinforced results from the FESEM and were useful in providing bulk elemental analysis.



Figures

Figure 1. Location map showing the Neath Road, Swansea sampling site (black circle) in relation to surrounding feature

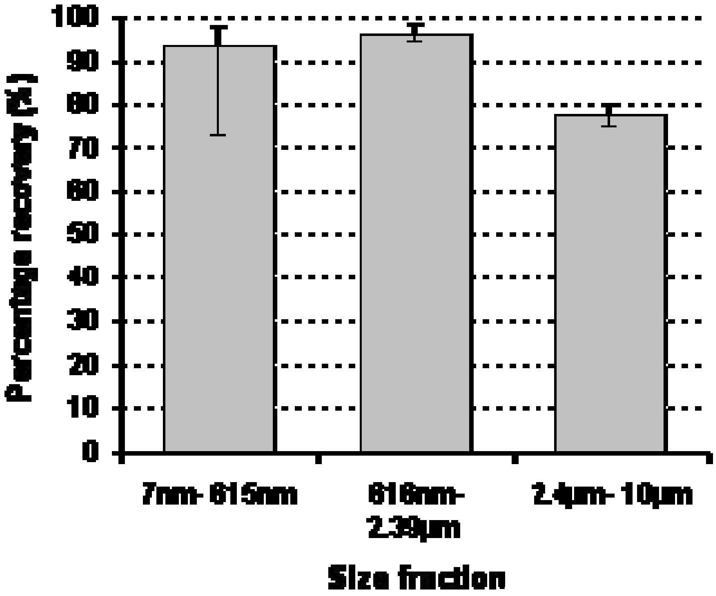


Figure 2. Particle mass extraction efficiency for the three analysed size fractions (30nm- 615nm, 616nm-2.39µm, 2.4µm- 10µm). Error bars indicate the range of recovery efficiencies measure

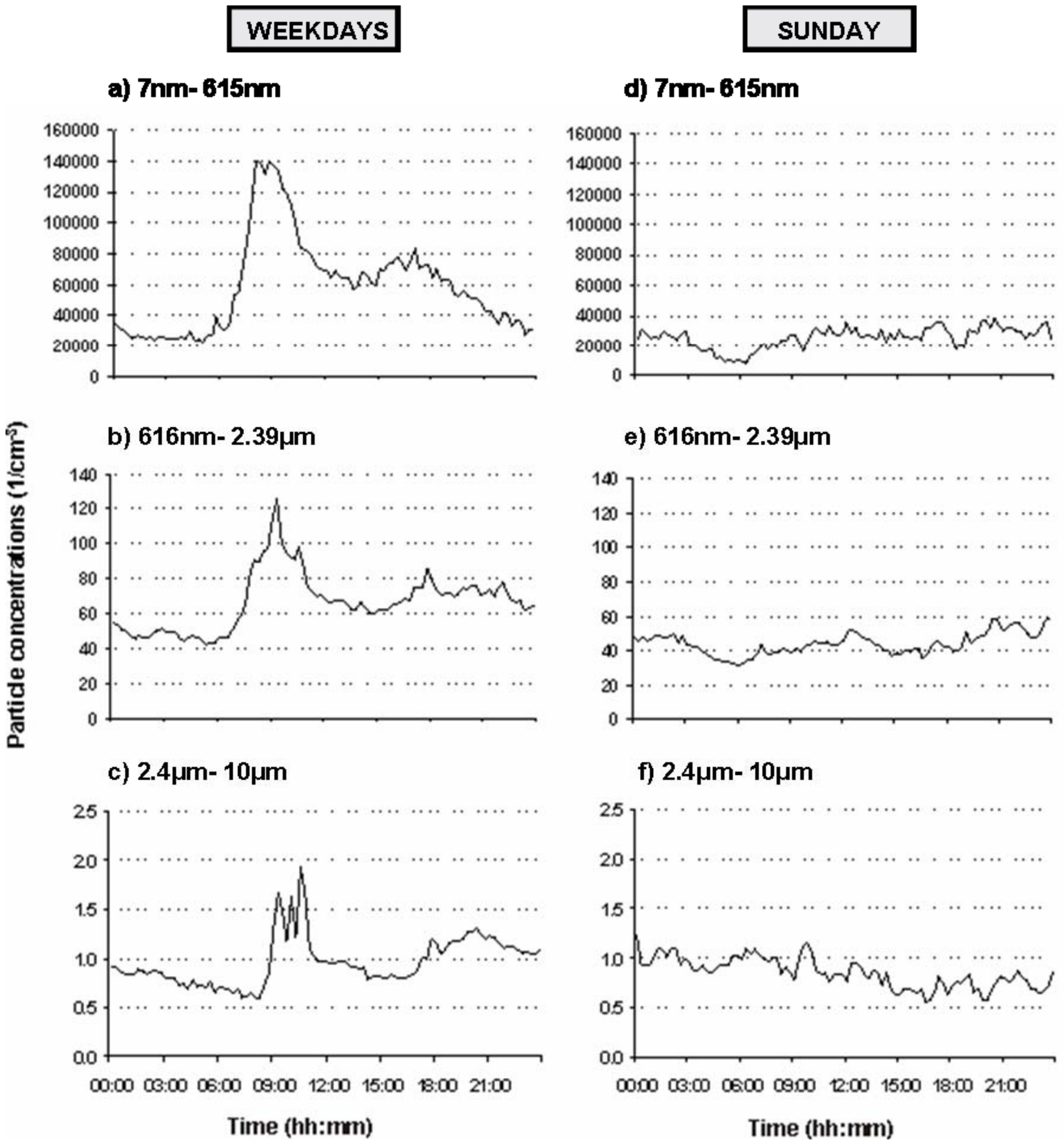


Figure 3. Average daily particle concentration profile in Neath Road traffic corridor for (1) weekdays and (2) Sundays in three size fractions (a) 7nm- 615nm, (b) 616nm- 2.39µm, (c) 2.4µm- 10µm

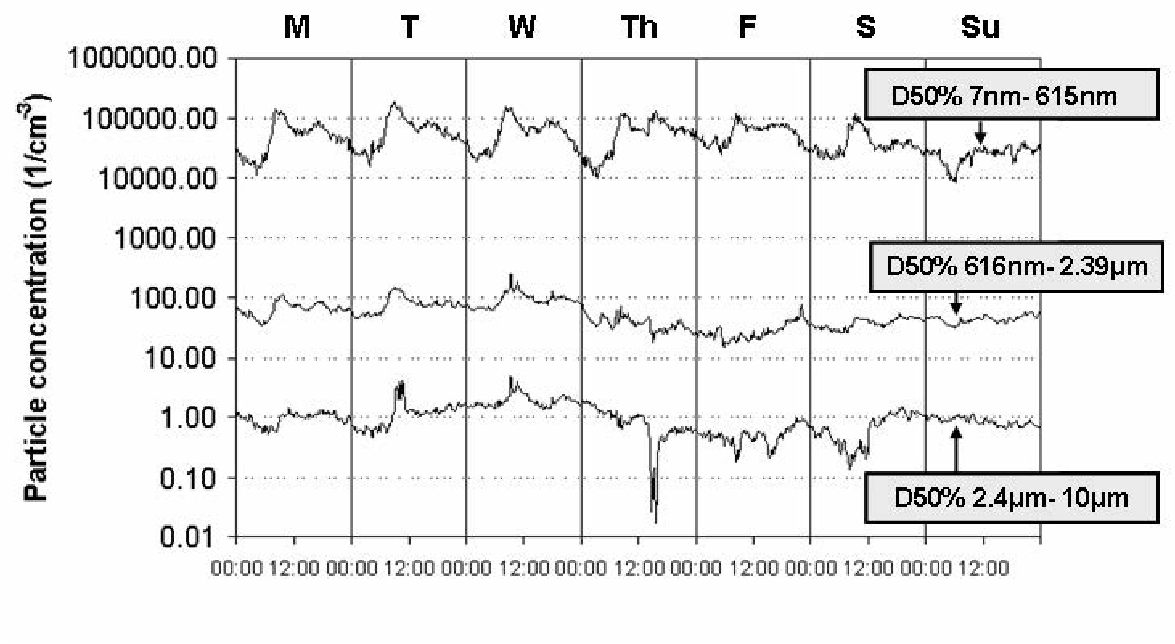


Figure 4. Average weekly particle concentration profile for Neath Road, Swansea

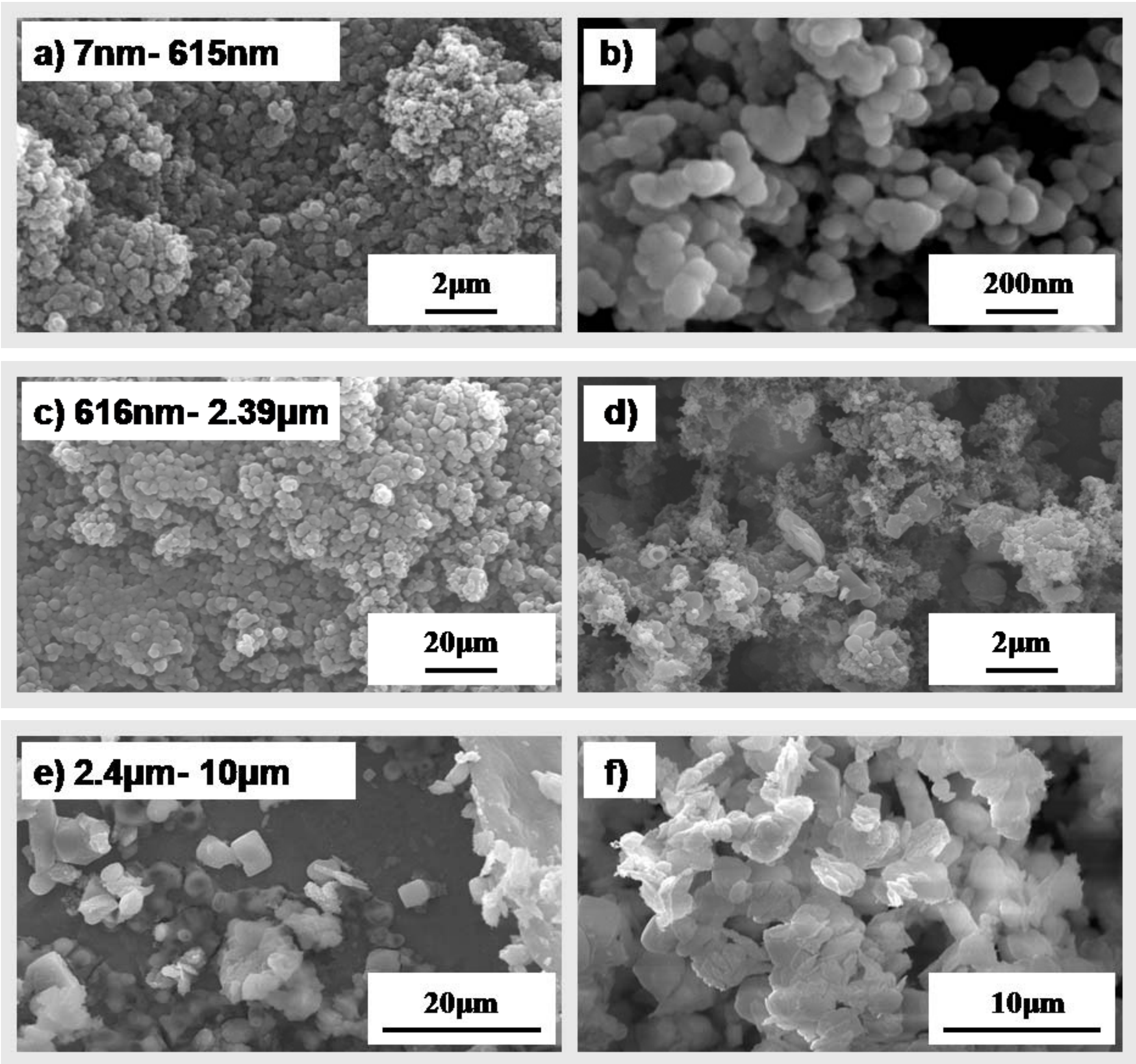


Figure 5. FE-SEM images of particles in the three measured size fractions collected in Neath Road, Swansea

(a) Particles in the 30- 615nm size range. (b) Close-up view of the 30- 615nm particle size range. (c) Particles in the middle size fraction (616nm- 2.39µm), at a large-scale view. (d) Closer view of particles in the middle size fraction. (e) Particles in the largest size fraction (2.4µm- 10µm). (f) Closer view largest size fraction

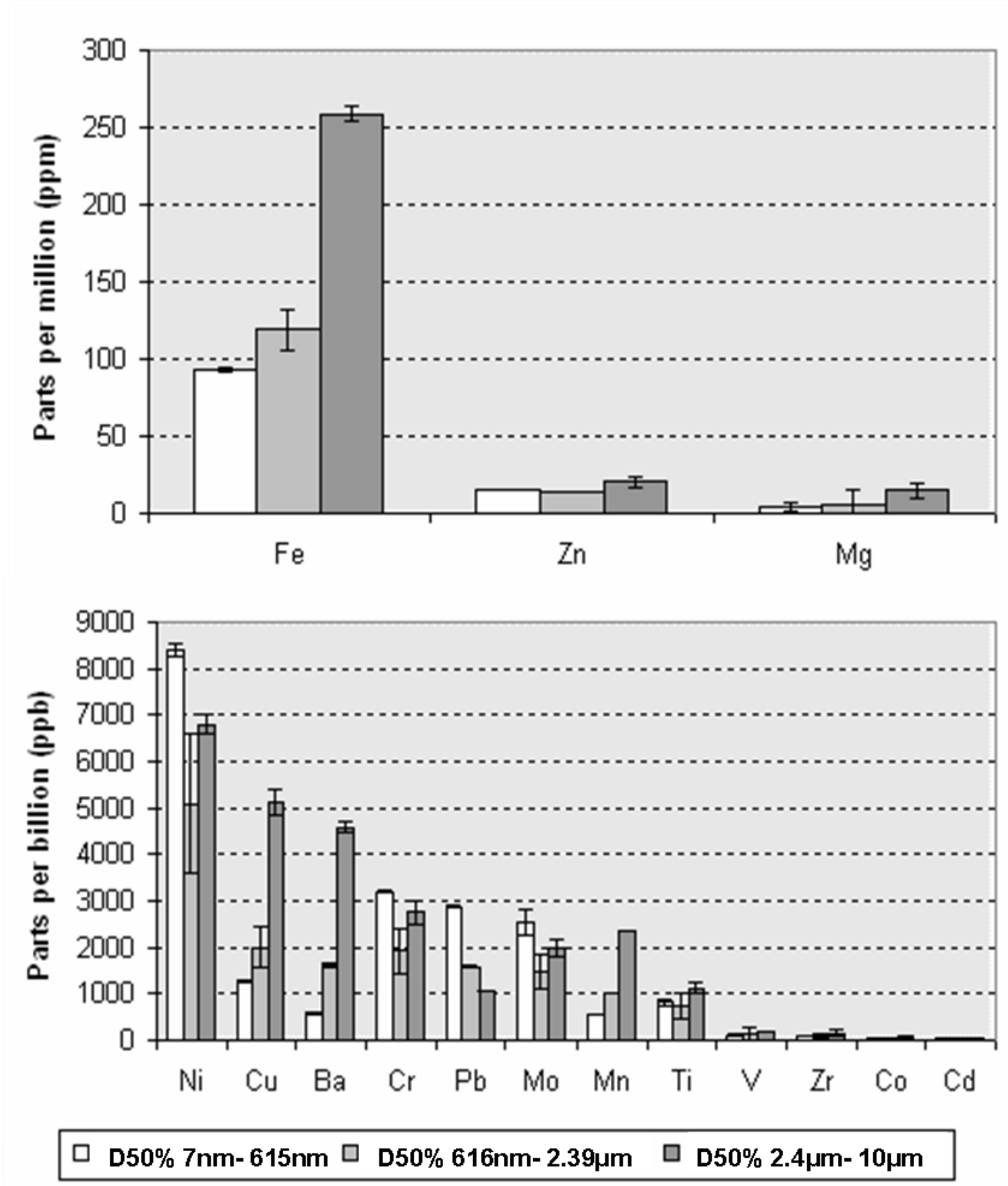


Figure 6. ICP-MS elemental analysis of the three analysed size fractions
Bars represent the three different analysed size fractions (white= D50% 30nm- 615nm; light grey= D50% 616nm- 2.39µm; dark grey= D50% 2.4µm- 10µm), top graph showing elements in parts per million (ppm) concentrations and bottom graph showing elements in parts per billion (ppb) concentrations. Error bars represent one standard deviation either side of the mean.

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References

Baulig, A., Poirault, J-J., Ausset, P., Schins, R., Shi, T., Baralle, D., Dorlhene, P., Meyer, M., Lefevre, R., Baeza-Squiban, A., Marano, F. 2004. Physicochemical characteristics and biological activities of seasonal atmospheric particulate matter sampling in two locations of Paris. Environ. Sci. Technol. 38: 5985- 5992.

BéruBé, K., Jones, T., Jones, C. 2008. Environmental Particles: a breath of fresh air? In focus.9: 6- 17.

Brown, D.M., Wilson, M.R., MacNee, W., Stone, V., Donaldson, K. 2001. Size- Dependent Proinflammatory Effects of Ultrafine Polystyrene Particles: A Role for Surface Area and Oxidative Stress in the Enhanced Activity of Ultrafines. Toxicol. Appl. Pharmacol. 175: 191- 199.

Buzorius, G., Hämeri, K., Pekkanen, J., Kumala, M. 1998. Correlation studies of urban aerosol number concentration. J. Aerosol. Sci. 29: S595- S596.

Chandra Mouli, P., Venkata Mohan, S., Balaram, V., Praveen Kumar, M., Jayarama Reddy, S. 2006. A study on the trace elemental composition of atmospheric aerosols at a semi-arid urban site using ICP-MS technique. Atmos. Environ. 40: 136- 146.

Davis, D.L., Bell, M.L., Fletcher, T. 2002. A look back at the London smog of 1952 and the half century since. Environ. Health Perspect. 110: 734- 735.

Donaldson, K., Stone, V., Clouter, A., Renwick, L., MacNee, W. 2001. Ultrafine particles. Occup. Environ. Med. 58: 211- 216.

Donaldson, K. 2003. The biological effects of coarse and fine particulate matter. Occup. Environ. Med. 60: 313- 314.

Donaldson, K., Tran, L., Jimenez, L., Duffin, R., Newby, D., Mills, N., MacNee, W., Stone, V. 2005. Combustion-derived nanoparticles: A review of their toxicology following inhalation exposure. Part. Fibre Toxicol. 2.

Dongarrà, G., Manno, E., Varrica, D., Vultaggio, M. 2007. Mass levels, crustal component and trace elements in PM10 in Palermo, Italy. Atmos. Environ. 41:7977- 7986.

Elsom, D. 1987. Atmospheric Pollution. 1st ed. Basil Blackwell Ltd publishers. 197- 202.

Fujitani, Y., Hasegawa, S., Fushimi, A., Kondo, Y., Tanabe, K., Kobayashi, S., Kobayashi, T. 2006. Collection characteristics of low-pressure impactors with various impaction collection substrate materials. Atmos. Environ. 40: 3221- 3229.

Gouriou, F., Morin, J. –P., Weill, M.-E. 2004. On-road measurements of particle number concentrations and size distributions in urban and tunnel environments. Atmos. Environ. 38: 2831- 2840.

Harrison, R.M., Yin, J. 2000. Particulate Matter in the atmosphere: which particle properties are important for its effects on health? Sci. Total Environ. 249: 85-101.

Harrison, R.M., Jones, A.M. 2005. Multisite study of particle number concentrations in urban air. Environ. Sci. Technol. 39: 6063- 6070.

Huff Hartz, K.E., Weitkamp, E., Sage, A.M., Allen, R.R., Donahue, N.M. 2005. A relative rates method for evaluation of organic aerosol aging kinetics. AAAR Annual conference.

Hughes, L.S., Cass, G.R., Gone, J., Ames, M., Olmez, I. 1998. Physical and chemical characterization of atmospheric ultrafine particles in the Los Angeles area. Environ. Sci. Tech. 32: 1153- 1161.

Jones, A.M., Harrison, R.M. 2005. Interpretation of particulate elemental and organic carbon concentrations at rural, urban and kerbside sites. Atmos. Environ. 39: 7114- 7126.

Jones, T., Moreno, T., BéruBé, K., Richards, R. 2006. The physicochemical characterisation of microscopic airborne particles in southWales: A review of the locations and methodologies. Sci. Total Environ. 360: 43-59.

Jones, T., BéruBé, K. 2007. Mineralogy and Structure of Pathogenic Particles. In: Particle Toxicology, eds. K. Donaldson and P. Borm, pp. 13- 46. Taylor and Francis.

Keskinen, J., Pietarinen, K., Lehtimäki, M. Electrical Low Pressure Impactor. J. Aerosol Sci. 23: 353- 360.

Ketzel, M., Wåhlin, P., Kristensson, A., Swietlicki, E., Berkowicz, R., Nielsen, O.J., Palmgren, F. 2004. Particle size distribution and particle mass measurements at urban, near-city and rural level in the Copenhagen area and Southern Sweden. Atmos. Chem. Phys. 4: 281- 292.

Kittelson, D.B., Watts, W.F., Johnson, J.P., Remerowki, M.L., Ische, E.E., Oberdörster, G., Gelein, R.M., Elder, A., Hopke, P.K., Kim, E., Zhao, W., Zhou, L., Jeong, C. –H. 2004. On-Road Exposure to Highway Aerosols. 1. Aerosol and Gas Measurements. Inhal. Toxicol. 16: 31-39.

Kretzschmar, J.G. 2007. Fifty years air pollution research and policy in the EU. Air pollution XV. 101: 3- 13.

Laasko, L., Hussein, T., Aarnio, P., Komppula, M., Hiltunen, V., Viisanen, Y., Kulmala, M. 2003. Diurnal and annual characteristics of particle mass and number concentrations in urban, rural and Arctic environments in Finland. Atmos. Environ. 37: 2629- 2641.

Lin, C-C., Chen, S-J., Huang, K-L., Hwang, W-I., Chang-Chien, G-P., Lin, W-Y. 2005. Characteristics of metals in nano/ ultrafine/ fine/ coarse particles collected beside a heavily trafficked road. Environ. Sci. Technol. 39: 8113- 8122.

Lough, G.C., Schauer, J.J., Park, J., Shafer, M.M., Deminter, J.T., Weinstein, J.P. 2005. Emissions of metals associated with motor vehicle roadways. Environ. Sci. Technol. 39: 826- 836.

Mejìa, J.F., Morawaska, L., Mengersen, K. Spatial variation in particle number size distributions in a large metropolitan area. 2007. Atmos. Chem. Phys. Discuss. 7: 17147- 17177.

Moreno, T., Jones, T.P., Richards, R.J. 2004. Characterisation of aerosol particulate matter from urban and industrial environments: examples from Cardiff and Port Talbot, South Wales, UK. Sci. Tot. Environ. 334- 335: 337- 346.

Nemery, B., Hoet, P.H.M., Nemmar, A. 2001. The Meuse Valley Fog of 1930: An air pollution disaster. Lancet 357 (9257): 704- 708.

Oberdörster, G. 1995. The NTP Talc Inhalation study: a critical appraisal focused on lung particle overload. Regulat. Toxicol. Pharmacol. 21: 233- 241.

Oberdörster, G., Oberdörster, E., Oberdörster, J. 2005. Nanotoxicology: An Emerging Discipline Evolving from Studies of Ultrafine Particles. Environ. Health. Perspect. 113: 823- 839.

Rinaldi, M., Emblico, L., Decesari, S., Fuzzi, S., Facchini, M.C., Librando, V. 2007. Chemical characterization and source apportionment of size- segregated aerosol collected at an urban site in Sicily. Water Air Soil Pollut. 185: 311- 321.

Rodríguez, S., Van Dingenen, R., Putaud, J.-P., Dell'Acqua, A., Pey, J., Querol, X., Alastuey,A., Chenery, S., Ho, K.-F., Harrison, R., Tardivo, R., Scarnato, B., Gemelli, V. 2007. A study on the relationship between mass concentrations, chemistry and number size distribution of urban fine aerosols in Milan, Barcelona and London. Atmos. Phys. Chem. 7: 2217- 2232.

Ruuskanen, J., Tuch, Th., Ten Brink, H., Peters, A., Khlystov, A., Mirme, A., Kos, G.P.A., Brunekreef, B., Wichmann, H.E., Buzorius, G., Vallius, M., Kreyling, W.G., Pekkanen, J. 2001. Concentrations of ultrafine, fine and PM2.5 particles in three European cities. Atmos. Environ. 35: 3729-3738.

Shao, L., Li, J., Zhao, H., Yang, S., Li, H., Li, W., Jones, T., Sexton, K., BeruBé, K. 2007. Associations between particle physicochemical characteristics and oxidative capacity: an indoor PM10 study in Beijing, China. Atmos. Environ. 41: 5316- 5326.

Shi, J.P., Khan, A.A., Harrison, R.M. 1999. Measurements of ultrafine particle concentration and size distribution in the urban atmosphere. Sci. Total. Environ. 235: 51- 64.

Shi, J.P., Evans, D.E., Khan, A.A., Harrison, R.M. 2001. Sources and concentrations of nanoparticles (<10nm diameter) in the urban atmosphere. Atmos. Environ. 35: 1193- 1202.

da Silva, L., Sarkis, J.E., Zanon Zotin, F.M., Carneiro, M.C., Neto, A.A., da Silva, A., Cardoso, M.J.B., Monteiro, M.I.C. 2008. Traffic and catalytic converter- Related atmospheric contamination in the metropolitan region of the city of Rio de Janeiro, Brazil. Chemosphere 71: 677- 684.

Tuch, T. M., Wehner, B., Pitz, M., Cyrys, J., Heinrich, J., Kreyling, W.G., Wichmann, H.E., Wiedensohler, A. 2003. Long-term measurements of size-segregated ambient aerosol in two German cities located 100km apart. Atmos. Environ. 37: 4687- 4700.

Wang, Y-F., Huang, K-L., Li, C-H., Mi, H-H., Luo, J-H., Tsai, P-J. 2003. Emissions of fuel metals content from a diesel vehicle engine. Atmos. Environ. 37: 4637- 4643.

Whittaker, A., BéruBé, K., Jones, T., Maynard, R., Richards, R. 2004. Killer smog of London, 50 years on: particle properties and oxidative capacity. Sci. Total Environ. 334-335: 435- 445.

Zervas, E., Dorlhène, P. 2006. Comparison of Exhaust Particle Number Measured by EEPS, CPC and ELPI. Aerosol Sci. Technol. 40: 977- 984.