2015 Updating and Screening Assessment for the

City & County of Swansea

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

June 2015

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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 areas of exceedences of the nitrogen dioxide annual mean objective outside of the Swansea Air Quality Management Area 2010 within the Mumbles and city centre areas of the authority. It is not proposed at present to declare these areas as Air Quality Management Areas. 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.

Revised guidance issued by DEFRA during June 2014 to predict roadside nitrogen dioxide concentrations in future years now indicates that compliance with the annual mean objective will be seen at all bar one site (site 59 Neath Road) in 2019. Full compliance with the annual mean objective is predicted to be seen at all sites during 2020. Updates on the situation will be provided within future reports

All sites remain compliant for Particulate matter PM_{10}. Similarly, for the other pollutants set in regulation. Ozone is monitored at four sites within Swansea. Compliance with the 8-hour mean UK objective (not set in regulation) has been seen during 2014 at the Morriston Groundhog, St Thomas DOAS and Cwm Level Park monitoring stations. However, 12 exceedences of the 8-hour ozone mean target were seen at the Hafod DOAS site against the permitted 10. Whilst ozone is considered a national rather than local problem it will continue to be measured for the foreseeable future.

The City and County of Swansea participates in the UK Heavy Metals Monitoring Network and had 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 at Glais and YGG Gellionnen were adopted onto the UK Heavy Metals Monitoring network and wholly funded by this council. Monitoring results since 2009-2014 have indicated compliance with the 4th Daughter Directive critical threshold monitoring target value for nickel at all monitoring stations. Improvements continue to be made at the refinery and these improved abatement techniques are becoming increasingly evident within the monitoring results. However, the equipment at Glais has suffered from numerous, expensive breakdowns. These breakdowns coupled with the analytical costs have resulted in monitoring ceasing at this site during early 2013. Similarly, due to budget constraints, monitoring has ceased at YGG Gellionnen during January 2014. Only the two UK Heavy Metal Network funded sites at Gellionnen Cemetery and Morriston Groundhog remain to confirm continued and ongoing compliance with the 4th Daughter Directive critical threshold monitoring target value for nickel.

Whilst the extent of nitrogen dioxide measurements using passive diffusion tubes has been scaled back in some areas of the authority, the number of monitoring points within the city centre has been dramatically increased. Indications from exiting nitrogen dioxide monitoring within the Kingsway, Orchard Street, High Street and Westway areas indicate that whilst the 1-hour objective has not been exceeded that the annual mean objective is being exceeded at several locations. The authority has commissioned a major review into the city centre and detailed talks have now started with the companies shortlisted for Swansea city centre's regeneration. This review will encompass both the economic regeneration of the city centre and the road infrastructure serving the city centre. Footfall within the city centre will aid the economic recovery and plans to increase the number of dwellings within the city are seen as the means to provide this increased footfall. Therefore, from an air quality perspective the number of people living within the city centre will bring air quality challenges should the existing road infrastructure remain. It is envisaged that the additional monitoring undertaken within the city centre will inform the design process as to the suitability of certain locations for the provision of dwellings thus protecting in the long term, the health of city centre residents.

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Introduction

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** groups: 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, when fully 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

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.

The objective of this Updating and Screening Assessment is to identify any matters that have changed which may lead to risk of an air quality objective being exceeded. A checklist approach and screening tools are used to identify significant new sources or changes and whether there is a need for a Detailed Assessment. The USA report should provide an update of any outstanding information requested previously in Review and Assessment reports.

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), The 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 micrograms per cubic metre mg/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	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg/m^3	Running annual mean	31.12.2003
	5.00 µg/m^3	Running annual mean	31.12.2010
1,3-Butadiene	2.25 µg/m^3	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 µg/m^3	Annual mean	31.12.2004
	0.25 µg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 µg/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m^3, 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

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.

Updating and Screening Assessment 2012

The authorities USA 2012 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Hafod, Sketty and Fforestfach areas of the Swansea AQMA 2010. Additionally, other sites outside of the Swansea Air Quality Management Area 2010 in the Mumbles, Uplands, Morriston, and St.Thomas areas were found to be exceeding the nitrogen dioxide annual mean objective. It was stated that the authority would consider the amendment of the Swansea Air Quality Management area 2010 and that further monitoring would be undertaken within the areas to confirm such exceedences before any additional AQMS were declared. Additional real-time chemiluminescent monitoring has not been possible. Similarly, no passive diffusion tube monitoring has been possible at first floor level within the Newton Road area of Mumbles

Progress Report 2013

The authorities Progress Report 2013 identified continuing exceedences of the nitrogen dioxide annual mean objective within the existing Swansea AQMA 2010 and also outside of the existing AQMA, notably within the city centre, Mumbles and Fabian Way areas.

It was stated that the authority intended to locate a real-time chemiluminescent analyser within the High Street area of the city centre prior to year end 2013. This site is not now planned until July 2014.

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.

Progress Report 2014

The authorities Progress Report 2014 identified continuing exceedences of the nitrogen dioxide annual mean objective within the existing Swansea AQMA 2010 and also outside of the existing AQMA, notably within the city centre, Mumbles and Fabian Way areas.

It was stated that the authority intended to locate a real-time chemiluminescent analyser within the High Street area during July 2014. This work was completed on schedule with the site becoming operational on the 7th July 2014. The new site is mentioned within chapter 2.1 below with additional details provided within chapter 2.1.13. The available data is presented within chapter 2.2.2 Automatic Real Time Nitrogen Dioxide data but no conclusions can be reached at present due to the monitoring period achieved so far.

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	http://www.swansea.gov.uk/media/pdf/l/3/Progress_Report_2008.pdf
USA 2009	July 2009	http://www.swansea.gov.uk/media/pdf/e/1/City_and_County_of_Swansea_USA_2009_PDF.pdf
Progress Report 2010	July 2010	http://www.swansea.gov.uk/media/pdf/2/5/Progress_Report_2010.pdf
Progress Report 2011	September 2011	http://www.swansea.gov.uk/media/pdf/d/4/Progress_Report_2011.pdf
USA 2012	September 2012	http://www.swansea.gov.uk/media/pdf/n/1/USA2012.pdf
Progress Report 2013	June 2013	http://www.swansea.gov.uk/media/pdf/i/3/SwanseaProgressReport2013.pdf
Progress Report 2014	July 2014	http://swansea.gov.uk/media/6538/Progress-Report-2014/pdf/Swansea_Progress_Report_2014.pdf

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.

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 has been decommissioned during May 2011.

During late 2012 the authority deployed Met One EBams PM_{10} at five locations in Swansea. These sites are detailed below and tend to be either at busy junctions or other areas of high HGV flow i.e. the EBam at Westway to monitor any impact from the Quadrant Bus Station. It is recognised that the Met One EBam has not participated in the equivalency trials to show compliance with the EU reference gravimetric method but as outlined below the data from the EBams correlate well with the Met One Bam 1020 PM_{10} monitor located at the Swansea AURN. The Met One Bam 1020 has participated in equivalency trails and has been accepted as an equivalent method. The use of the MetOne EBams has therefore been restricted to that of a “screening assessment”. Table 3 below includes details of these PM_{10} monitoring locations. Whilst the Sketty Cross and Fforestfach Cross EBam sites are within the existing Swansea AQMA 2010 boundary, the AQMA was declared as a result of NO_2 annual mean exceedences and not for exceedences of any PM_{10} objectives.

On the 7th July 2014 a new roadside real-time chemiluminescent Teledyne NOx analyser was commissioned. It is located roadside outside a block of flats at Station

Court, High Street, Swansea and fronts onto bus stops and mini-roundabouts and is subject to the effects of considerable congestion at peak times. The site is also within 75m of Swansea Railway Station complex. The site details are given below in table 3 and additional description below as part of chapter 2.1.13.

Site Name	Site Type	OS Grid Ref	LAQM Pollutants Monitored	IN AQMA	Relevant Exposure	Distance to kerb of nearest road	Worst-case Location
Swansea Roadside AURN	Roadside	X 265299 Y 194470	NO_2, PM_{10}, $PM_{2.5}$	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 197674	NO_2, PM_{10}, and Ozone	N	Y (22m)	4m	N
Cwm Level Park	Urban Background	X 265912 Y 195890	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
Fforestfach Cross	Roadside	X 263236 Y 195489	PM_{10}	Y	Y (19m)	3m	N
Uplands Crescent	Roadside	X 264078 Y 192888	PM_{10}	N	Y (12m)	1m	
Sketty Cross	Roadside	X 262681 Y 192871	PM_{10}	Y	Y (14m)	1m	
Westway Quadrant Bus Station	Roadside	X 265256 Y 192731	PM_{10}	N	Y (11m)	2m	
SA1 Junction Port Tennant	Roadside	X 266670 Y 193179	PM_{10}	N	Y (6m)	3m	
Station Court High Street	Roadside	X 265705 Y 193686	NO_2		Y (1m)	2m	N

Table 3 Details of Automatic Monitoring Sites

* Where NO_2 is listed as a pollutant monitored, NO_x and/or NO concentrations are also available.

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 Annual Average Daily Traffic flow (AADT) for 2014 was 21,120 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

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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 Ricardo AEA (formerly AEA Energy and Environment) to perform data management procedures. The data is then further subjected to full network QA/QC procedure's

undertaken by Ricardo AEA 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 Ricardo AEA together with the calibration gases stored on site

Hourly ratified data for 2014 covering the pollutants Nitrogen Dioxide and Particulate Matter PM_{10} and $PM_{2.5}$ (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 (by the then 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 CO and SO_2 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 at the AURN site. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, only NO_2 $PM_{2.5}$ and PM_{10} data are now reported here.

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 were replaced on a regular basis and were 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
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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 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 pre 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 fortnightly 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.

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

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. 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 Ricardo AEA (formally AEA Energy & Environment) to run the Welsh Air Quality Forum in April 2004, all equipment on site will be fully audited yearly by Ricardo AEA together with the calibration gases stored on site. The L40 span gas cylinders are replaced on a regular basis and are to a certified and traceable standard.

Map 3 - Aerial view - Morriston Groundhog
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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 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 2014.

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.

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 fortnightly 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 gas 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. 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 Ricardo AEA (formally AEA Energy & Environment) to run the Welsh Air Quality Forum in April 2004, all equipment on site will be fully audited yearly by Ricardo AEA, together with an audit of the calibration gases stored on site. Data is re-scaled by Ricardo AEA following the authority supplying routine monthly calibration reports. The L10

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

Map 4 Cwm Level Park Monitoring

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span gas cylinders (NO) 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 above 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 closes by as would be expected with the site classification, with the nearest road being nearly 80m away and having an Annual Average Daily Traffic flow (AADT) during 2014 of 14,208 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 metres and less than 0.3m away from the front facade of the terraced dwellings. The DOAS transmitter u 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 v 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 2014 of 16272 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

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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

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

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

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 achieved MCERTS certification and TUV certification.

Monitoring data from the site has been subject to interruption as the property owner at the transmitter site u 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 was 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 v 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 off in 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 2014 of 20,184 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 u 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 v 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

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Quay Parade Bridges are to the south of this location. 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 .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 eventually be resubmitted to include an element of social housing.

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 for Benzene and 30 seconds each for sulphur dioxide, 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 SO_2, 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 off/degradation in lamp intensity during the 5^{th} and 6^{th} 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 achieved MCERTS certification and TUV certification.

2.1.8 Fforestfach Cross - Met One EBam PM_{10}

The Fforestfach Cross EBam PM_{10} station was established during late October 2012 to provide a basic screening opinion on PM_{10} concentrations around the busy Fforestfach Cross junction. The A483 Carmarthen Road has junctions with the A4216 Station Road to the south and Ravenhill Road to the north. Relevant receptors exist at numerous dwellings either side of the junctions. Considerable traffic congestion can be seen on all arms of the junction primarily during working hours. The authority also has numerous NO_2 passive diffusion tube locations within this area. The chosen monitoring location is to the north-west of the junction in front of the war memorial on Carmarthen Road and within 19m of a residential property. Location and ease of connection to an electricity supply dictated the final location.

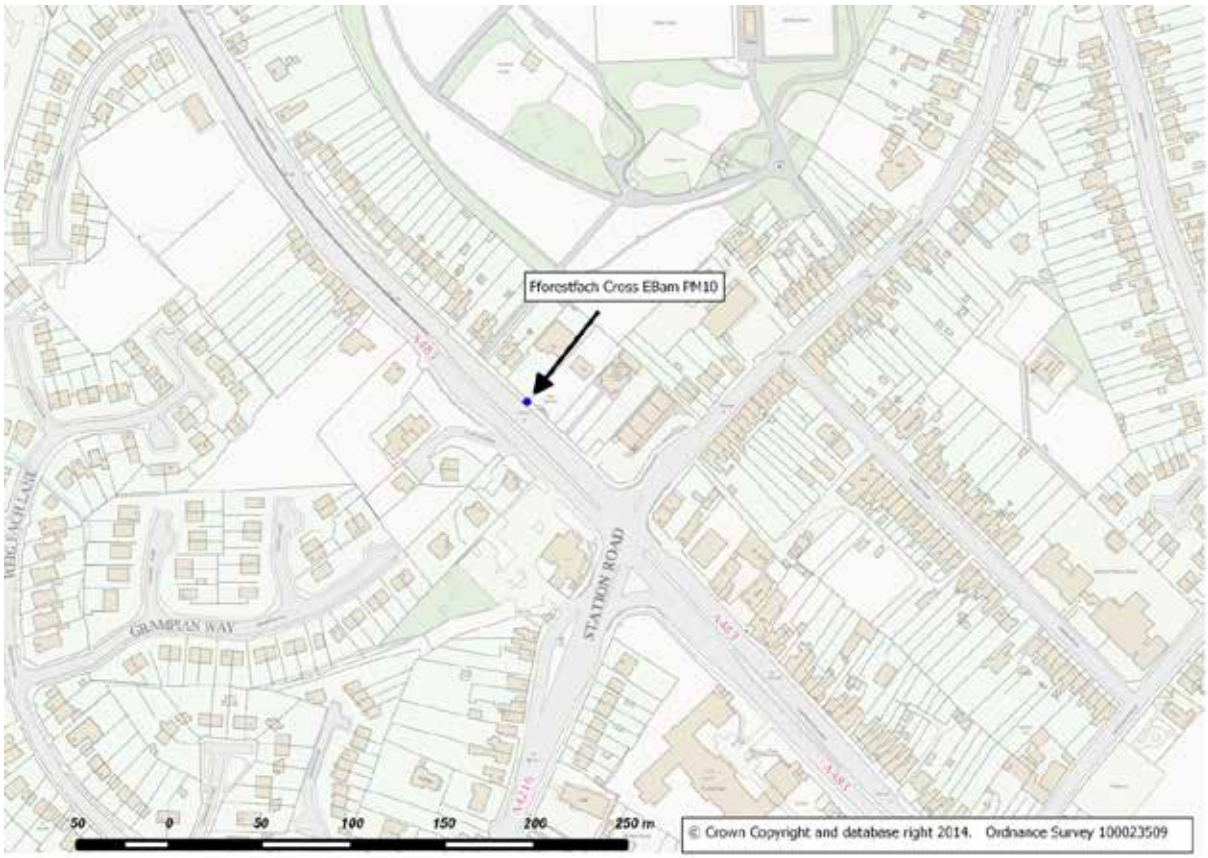
The EBam PM_{10} is similar in operation to the MetOne Bam 1020 deployed at the Swansea AURN approximately 2.3Km away in a south-easterly direction on Carmarthen Road. The EBam has not demonstrated equivalency with the EU reference gravimetric method whilst the MetOne Bam 1020 PM_{10} at the Swansea AURN has demonstrated equivalency during previous trial undertaken during 2006[7]. Installation and operation of the MetOne EBam has been undertaken in accordance with the Operational manual which can be viewed at http://www.metone.com/ebamdocs/E-BAM_Manual(RevL).pdf.

The Met One Instruments, Inc model E-BAM automatically measures and records airborne PM_{10} particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. A small ^{14}C (Carbon 14) element emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air. In this

[7] http://uk-air.defra.gov.uk/assets/documents/reports/cat05/0606130952_UKPMEquivalence.pdf

installation a MetOne approved external pump delivering a flow rate of 16.7 l/min has been included within the site enclosure. The integration of sampling has been set at 1-hour with the tape advancing every 3-hours. Tape life is therefore greater than 3 months with the PM_{10} head being cleaned every month between tape exchanges. 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.

A map of the site and surrounding area is given below as map 7.



Map 7 – Fforestfach Cross EBam PM_{10}

2.1.9 Uplands Crescent - Met One EBam PM_{10}

The Uplands Crescent EBam PM_{10} station was established during late October 2012 to provide a basic screening opinion on PM_{10} concentrations along Uplands Crescent which is heavily congested during working hours. The site is located between the signalled controlled junction of Uplands Crescent and Gwydr Square to the west and between the junction of Uplands Crescent with Walter Road/Brynymor Crescent/Eaton Crescent and Mirador Crescent to the east. The authority also has numerous NO_2 passive diffusion tube locations within this area. The chosen monitoring location is adjacent to the GPRS Automatic Traffic Counter site 33. The Annual Average Daily Traffic (AADT) flow for 2014 was 21,408. A summary of the composition of the flow during 2013 is given below:

Vehicle Class	Flow %	Mean Speed (km/h)
Motorcycles	0.7	31.7
Cars or light Vans	93.4	37.7
Cars or light Vans with Trailer	0.1	28.9
Heavy Van, Mini bus, L/M/HGV	4.6	34.5
Articulated lorry, HGV+Trailer	0.2	27.3
Bus	1.0	27.9

Monitoring is undertaken within 11m of residential properties to the north and 17m of residential properties on the opposite side of the road. Location of, and ease of connection to an electricity supply dictated the final location.

The EBam has not demonstrated equivalency with the EU reference gravimetric method whilst the MetOne Bam 1020 PM_{10} at the Swansea AURN has demonstrated equivalency during previous trial undertaken during 2006[8]. Installation and operation of the MetOne EBam has been undertaken in accordance with the Operational manual which can be viewed at http://www.metone.com/ebamdocs/E-BAM_Manual(RevL).pdf.

The Met One Instruments, Inc model E-BAM automatically measures and records airborne PM_{10} particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. A small ^{14}C (Carbon 14) element

[8] http://uk-air.defra.gov.uk/assets/documents/reports/cat05/0606130952_UKPMEquivalence.pdf

emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air. In this installation a MetOne approved external pump delivering a flow rate of 16.7 l/min has been included within the site enclosure. The integration of sampling has been set at 1-hour with the tape advancing every 3-hours. Tape life is therefore greater than 3 months with the PM_{10} head being cleaned every month between tape exchanges. 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.

A map of the site and surrounding area is given below as map 8.

Map 8 – Uplands Cresent EBam PM_{10}

2.1.10 Sketty Cross - Met One EBam PM_{10}

The Sketty Cross EBam PM_{10} station was established during late October 2012 to provide a basic screening opinion on PM_{10} concentrations along the A4118 Gower Road which is heavily congested during working hours. The site is located between the signalled controlled crossroad junction of Gower Road with Dillwyn Road and Vivian Road to the north-east and the mini roundabout "junction" of De-La-Beche Road with Gower Road and Sketty Road. A major comprehensive school along with a Welsh Primary School are located along De-La-Beche Road. A significant number of pupils attending the comprehensive school arrive, and depart, by contract bus. The area is subject to congestion during the am and pm peak periods as the A4118 Gower Road forms the main artery into and out of Swansea City Centre (and further eastern destinations) from the west of Swansea and Gower. GPRS ATC counters have been installed on each arm of the signalled controlled junction of Gower Road with Dillwyn Road and Vivian Road. No ATC provision has been possible as yet along De-La-Beche Road. The authority also has numerous NO_2 passive diffusion tube locations within this area.

Monitoring is undertaken within 13m of residential properties on the opposite side of the road. It proved necessary to locate the EBam outside of a petrol station as to site the EBam within pavements fronting any residential properties proved to problematic. Location of, and ease of connection to an electricity supply therefore dictated the final location.

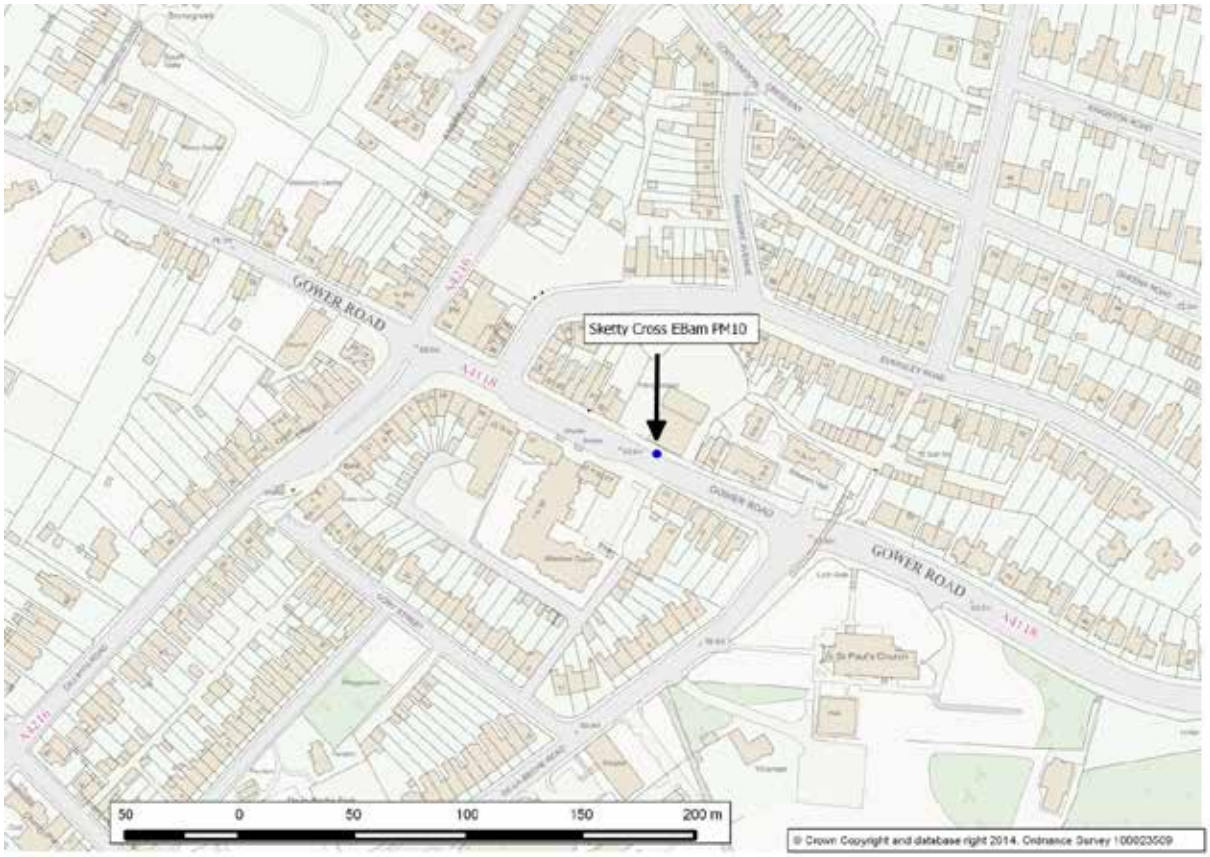
The EBam has not demonstrated equivalency with the EU reference gravimetric method whilst the MetOne Bam 1020 PM_{10} at the Swansea AURN has demonstrated equivalency during previous trial undertaken during 2006[9]. Installation and operation of the MetOne EBam has been undertaken in accordance with the Operational manual which can be viewed at http://www.metone.com/ebamdocs/E-BAM_Manual(RevL).pdf.

The Met One Instruments, Inc model E-BAM automatically measures and records airborne PM_{10} particulate concentration levels using the principle of beta ray

[9] http://uk-air.defra.gov.uk/assets/documents/reports/cat05/0606130952_UKPMEquivalence.pdf

attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. A small $_{14}C$ (Carbon 14) element emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air. In this installation a MetOne approved external pump delivering a flow rate of 16.7 l/min has been included within the site enclosure. The integration of sampling has been set at 1-hour with the tape advancing every 3-hours. Tape life is therefore greater than 3 months with the PM_{10} head being cleaned every month between tape exchanges. 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.

A map of the site and surrounding area is given below as map 9.



Map 9 – Uplands Cresent EBam PM_{10}

2.1.11 Westway Quadrant Bus Station - MetOne EBam PM_{10}

The Westway EBam PM_{10} station was established during late August 2012 to provide a basic screening opinion on PM_{10} concentrations along Westway opposite the Quadrant Bus Station. This is the major public transport hub within Swansea with both local and “long-haul” services using the facilities provided. Significant volumes of traffic use Westway but it has not been possible due to budget restraints to install the required number of GPRS ATC’s to cover all of the arms and turning movements. The road infrastructure is complex with additional volumes of traffic being attracted not only by the city centre destinations but also by a major superstore located to the south of the site. It is desirable to also record the movements into and out of the superstore as well as the significant number of bus movements/traffic movements along Westway in order to obtain an accurate picture of the total number of movements. As some sections of highway along Westway are 9 lanes in width a total of 3 GPRS ATCs fitted with dual loop cards has been determined as the minimum

number necessary to capture all of the movements along Westway. At the present moment in time this financial commitment is not possible.

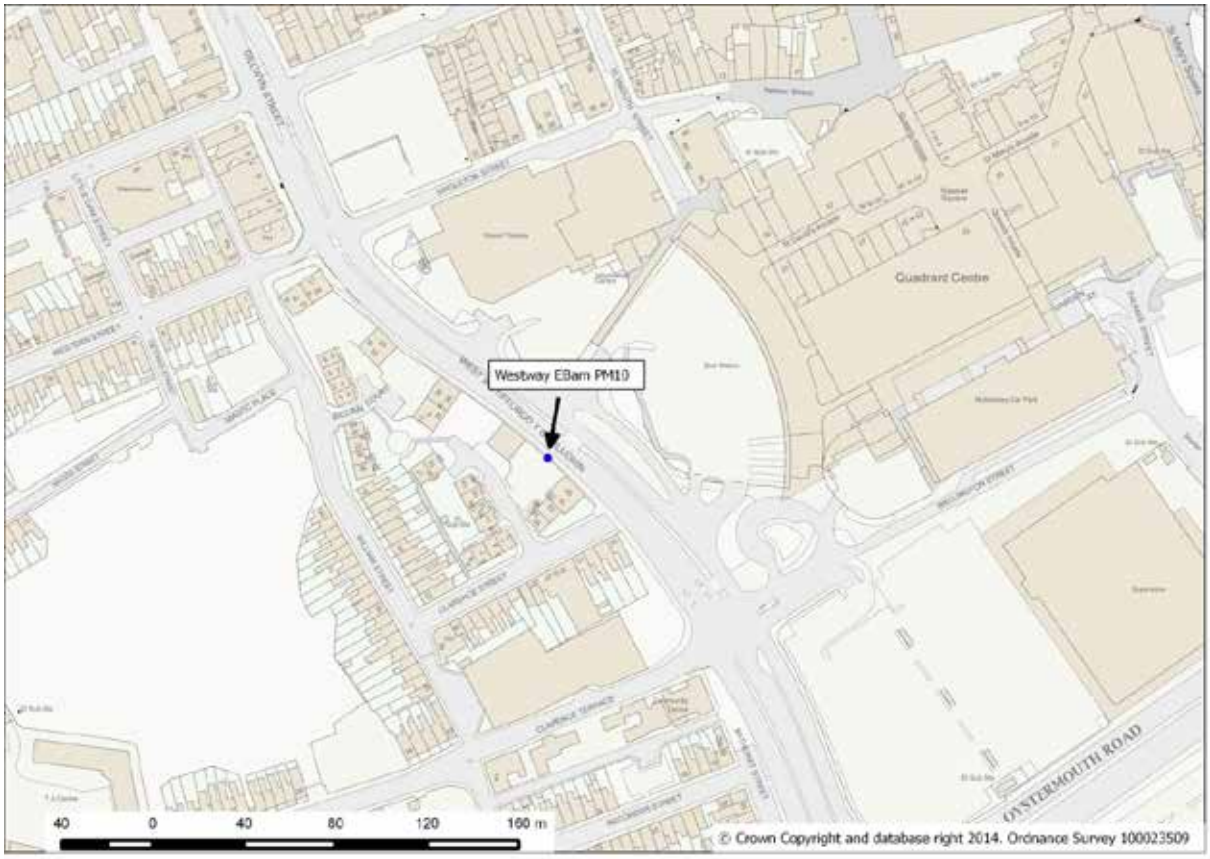
There are receptor locations within approximately 30m of the boundary of the Quadrant Bus Station and within 3m of Westway itself as there are blocks of warden sheltered flat accommodation over 5 or more stories setback off Westway.

The EBam has not demonstrated equivalency with the EU reference gravimetric method whilst the MetOne Bam 1020 PM_{10} at the Swansea AURN has demonstrated equivalency during previous trial undertaken during 2006[10]. Installation and operation of the MetOne EBam has been undertaken in accordance with the Operational manual which can be viewed at http://www.metone.com/ebamdocs/E-BAM_Manual(RevL).pdf.

The Met One Instruments, Inc model E-BAM automatically measures and records airborne PM_{10} particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. A small ^{14}C (Carbon 14) element emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air. In this installation a MetOne approved external pump delivering a flow rate of 16.7 l/min has been included within the site enclosure. The integration of sampling has been set at 1-hour with the tape advancing every 3-hours. Tape life is therefore greater than 3 months with the PM_{10} head being cleaned every month between tape exchanges. 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.

A map of the site and surrounding area is given below as map 10.

[10] http://uk-air.defra.gov.uk/assets/documents/reports/cat05/0606130952_UKPMEquivalence.pdf



Map 10 – Westway EBam PM_{10}

2.1.12 SA1 Junction Port Tennant Road - MetOne EBam PM_{10}

The SA1 Port Tennant EBam PM_{10} station was established during late November 2012 to provide a basic screening opinion on PM_{10} concentrations along the A483 Fabian Way at the recently constructed signal controlled SA1 junction with Port Tennant Road. The A483 Fabian Way is a major artery into/from Swansea centre from/to junction 42 of the M4. The authority operate a GPRS ATC (site 20) approximately 200m west of the EBam monitoring location between Quay Parade bridges and the signalled controlled SA1 junction with Fabian Way/Port Tenant Road. The Annual Average Daily Traffic (AADT) flow for 2014 was 31,824. A summary of the composition of the flow during 2014 is given below:

Vehicle Class	Flow %	Mean Speed (km/h)
Motorcycles	1.1	47.8
Cars or light Vans	93.1	47.0
Cars or light Vans with Trailer	0.2	39.1
Heavy Van, Mini bus, L/M/HGV	4.3	44.8
Articulated lorry, HGV+Trailer	0.4	42.3
Bus	1.0	41.9

Whilst relatively “free flow” is achieved at the ATC site, traffic queues back from the signal controlled junction in both directions. Therefore, significant stationary traffic queues west past the block of terraced housing on Port Tennant Road (their facades are within 6m of the EBam itself) and also eastwards in front of the newly constructed Mariners Court block of flats that front onto Fabian Way. The authority also has a passive NO_2 monitoring location front façade of the terraced properties on Port tenant Road and also several within the general vicinity.

The EBam has not demonstrated equivalency with the EU reference gravimetric method whilst the MetOne Bam 1020 PM_{10} at the Swansea AURN has demonstrated equivalency during previous trial undertaken during 2006[11]. Installation and operation of the MetOne EBam has been undertaken in accordance with the Operational manual which can be viewed at http://www.metone.com/ebamdocs/E-BAM_Manual(RevL).pdf.

The Met One Instruments, Inc model E-BAM automatically measures and records airborne PM_{10} particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams of particulate per cubic meter of air. A small $_{14}C$ (Carbon 14) element emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. A vacuum pump pulls a measured amount of dust-laden air through the filter tape, which is positioned between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and the volumetric concentration of particulate matter in ambient air. In this installation a MetOne approved external pump delivering a flow rate of 16.7 l/min has been included within the site enclosure. The integration of sampling has been set at 1-hour with the tape advancing every 3-hours. Tape life is therefore greater than 3 months with the PM_{10} head being cleaned every month between tape exchanges. 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.

[11] http://uk-air.defra.gov.uk/assets/documents/reports/cat05/0606130952_UKPMEquivalence.pdf

A map of the site and surrounding area is given below as map 11

Map 11 - SA1 Port Tennant EBam PM_{10}

2.1.13 Station Court High Street – Teledyne Chemiluminescent NOx box

The authority has located a real-time chemiluminescent NOx analyser outside a block of flats at Station Court, High Street, Swansea. This provision had been mentioned in previous LAQM reports but had been delayed due to budget restrictions. Data capture commenced on the 7th July 2014. Details and the limited data set are provided within this report for information only at present as no conclusions can be made from the limited dataset.

The station has been given a site classification of Roadside[12]. Photo 3 below shows its location in relation to a series of bus stops and the block of flats immediately behind the site. The site is opposite Swansea railway station and is heavily

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

influenced by not only the bus stops but congestion caused by its proximity to signal controlled junctions and mini roundabouts. The site lies within the boundary of the existing Swansea 2010 AQMA. Congestion is noticeable most days during peak periods. The sample inlet can be seen in the photograph to the left top of the site enclosure and is at a height of 1.5m.

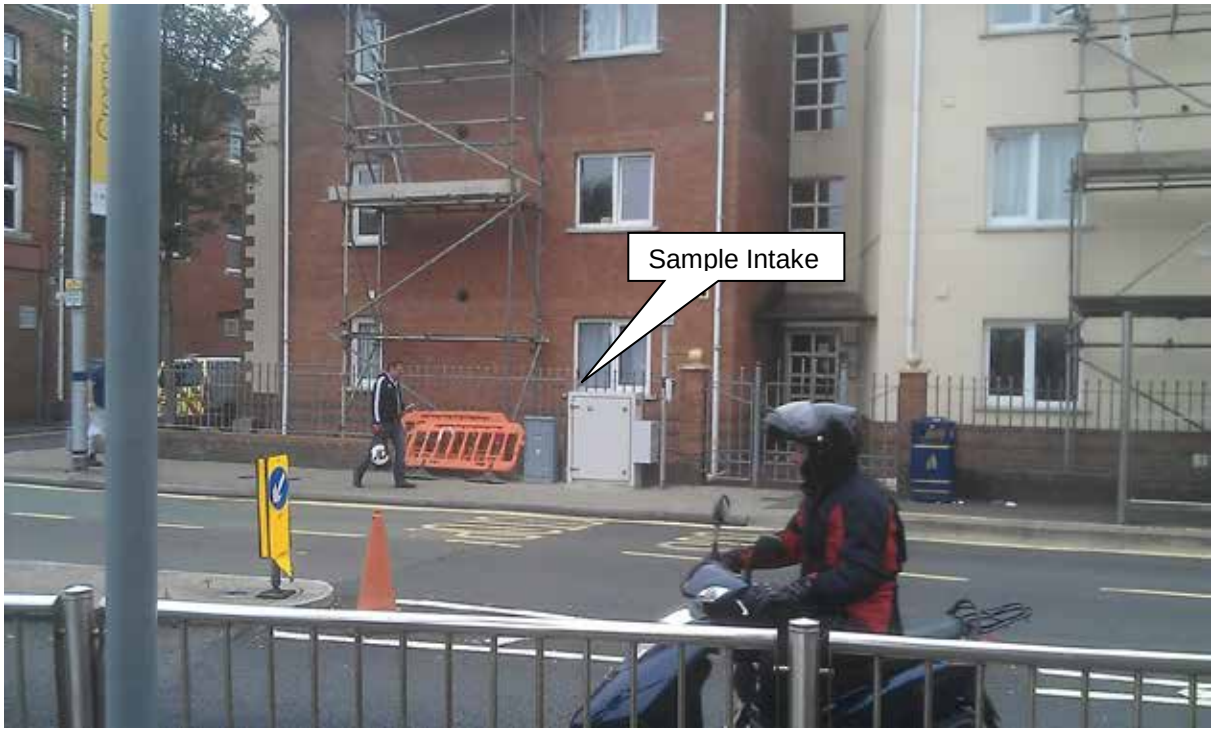
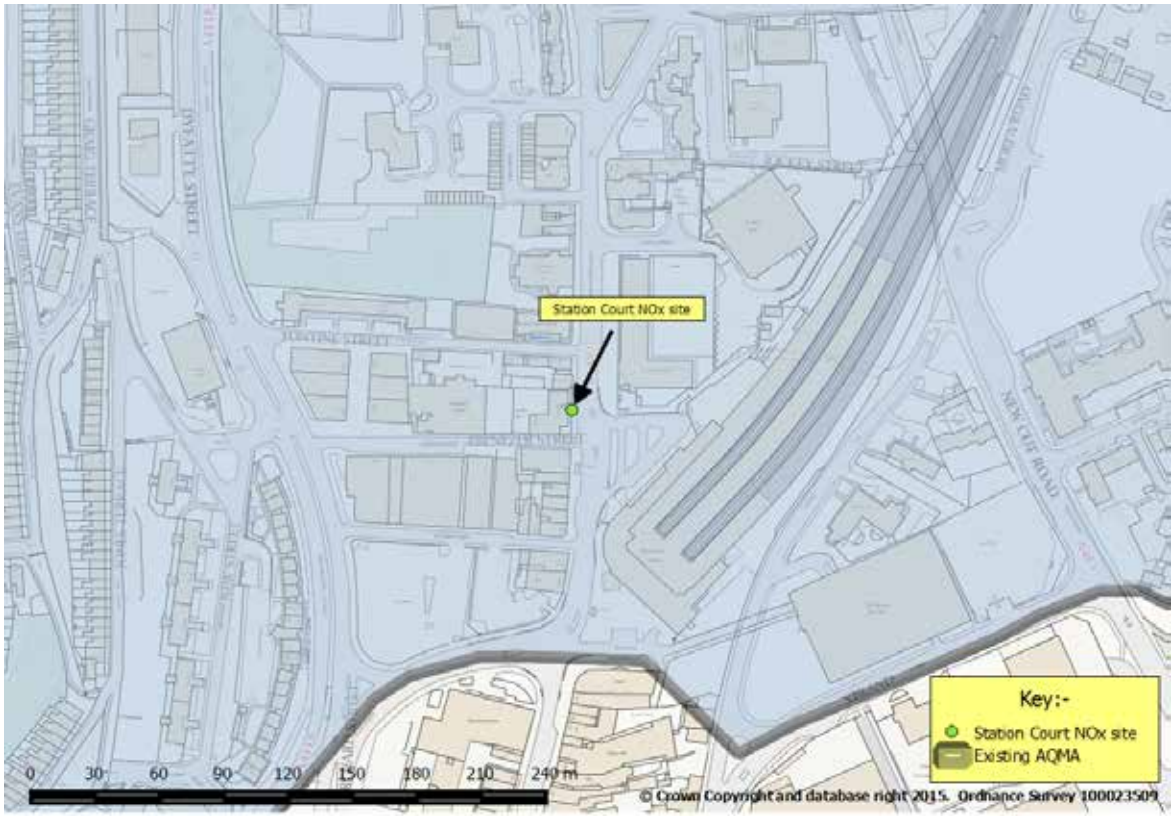


Photo 8 – Station Court, High Street NO_x monitoring site.

All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of a Teledyne real-time analyser measuring NO_x . The Teledyne 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 data-logger. In addition officers from this authority perform routine fortnightly manual calibrations. The analyser is 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 gas 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. 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. At present, the data is collected by the Welsh Air Quality Forum but it does not form part of the QA/QC contract with Ricardo AEA. The L10 span gas cylinder (NO) will be replaced on a regular basis and is to a certified and traceable standard.



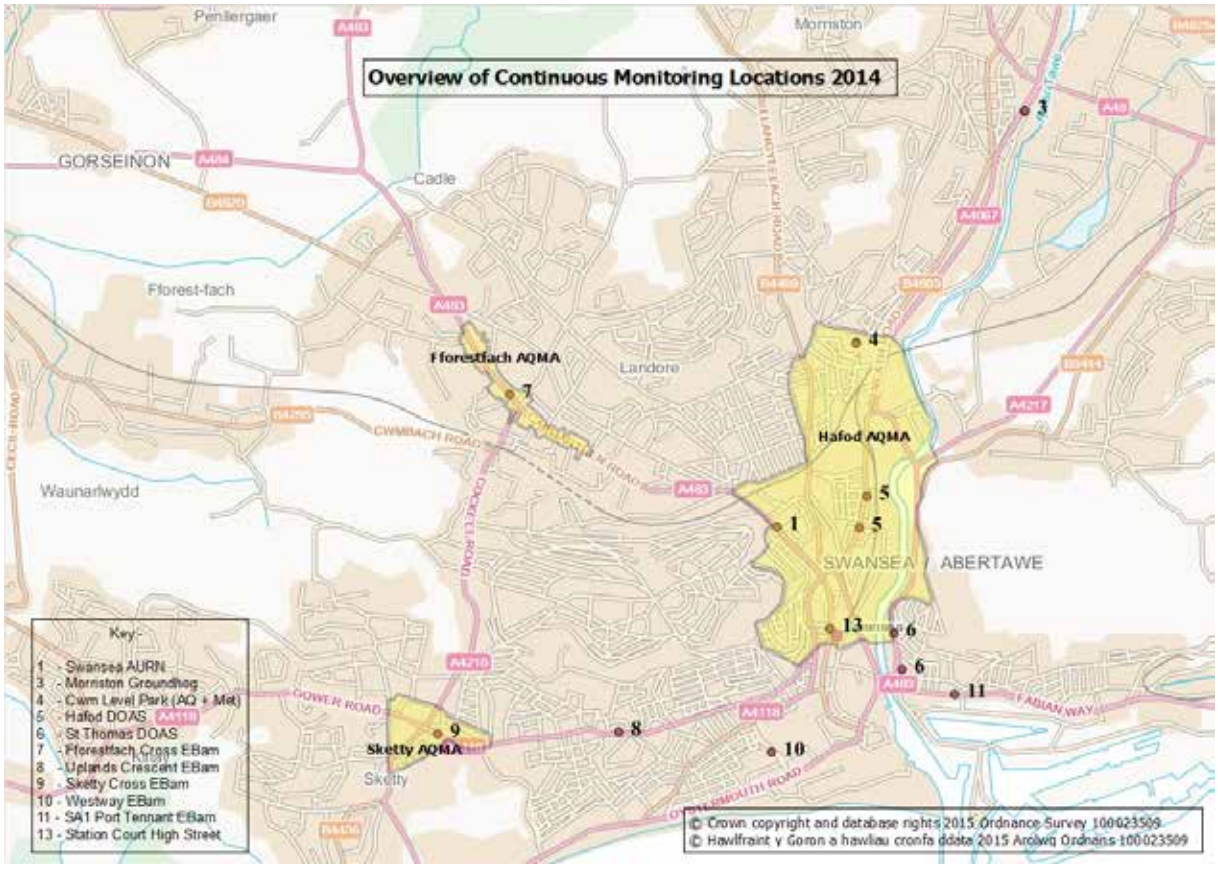
Map 12 – Station Court High Street, Swansea NOx box

2.1.14 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 13. Also included within map 13 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 only includes a dedicated 30m mast at Cwm Level Park. The AQ500 SODAR remote sensing instrument previously reported as being located in Vale Nickel Refinery Clydach, has been removed from site during 2014 and put into temporary storage due to noise complaints from local residents surrounding the facility. It is envisaged that the meteorological monitoring from Cwm Level Park 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 13, the reader will no doubt realise that no continuous and automatic chemiluminescent NO_x 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 of NO_2 within these areas has been, and will continue to be undertaken, via passive nitrogen dioxide diffusion tubes.



Map 13 – Overview of continuous monitoring locations 2014

Table 4 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	Commencement Date of Measurements	Pollutants Monitored	IN AQMA	Inlet height	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	2.5m	Y (12m)	4m	N
Morfa Groundhog	**2**	Roadside	**24th July 2000**	NO_2, PM_{10},	Y	2.5m	Y (34m)	5m	Y
Morriston Groundhog	**3**	Roadside	**11th October 2000**	NO_2, PM_{10}, and Ozone	N	2.5m	Y (22m)	4m	N
Cwm Level Park	**4**	Urban Back ground	**(O_3) 28th November 2008** **(NOx) 21st January 2009**	NO_2 and Ozone	Y	1.5m	N (100m)	78m	N/A
Hafod DOAS	**5**	Roadside	**8th January 2004**	NO, NO_2 Ozone and Benzene	Y	N/A	Y (0.2m)	1.7m	Y
St Thomas DOAS	**6**	Roadside	**4th May 2005**	SO_2, NO_2 Ozone and Benzene	N	N/A	Y(2m) Varies along path	1.7m	N
Fforestfach Cross	**7**	Roadside	**October 2012**	PM_{10}	Y	5m			
Uplands Crescent	**8**	Roadside	**October 2012**	PM_{10}		5m			
Sketty Cross	**9**	Roadside	**October 2012**	PM_{10}	Y	5m			
Westway Quadrant Bus Station	**10**	Roadside	**August 2012**	PM_{10}		5m			
SA1 Junction Port Tennant	**11**	Roadside	**November 2012**	PM_{10}		5m			
Station Court High Street	**13**	N/A	**7th July 2014**	NO_2	Y	1.5m	Y (1m)	2m	N

Table 4 - Automatic Continuous Measurements Commencement Dates

2.1.15 Additional Continuous Monitoring

2.1.16 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[13]. 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 5.

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

Table 5 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Glais Primary School, School Road, v was chosen as the initial monitoring location due to its proximity to the refinery u and for additional security issues with the equipment at the time. A Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling

[13] *COM 2003 (423)*

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 w upwind of the high level stack release and one at the Morriston Groundhog y 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 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 is no longer able to continue to fund heavy metals monitoring at this site. **Monitoring ceased at Glais Primary School due to continued breakdown repair costs and analytical costs in April 2013**

A further site has been established to the north of the high level stack release point during November 2007 at YGG Gellionnen x (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 continued to fund heavy metals monitoring at YGG Gellionnen until January 2014 when due to the analytical costs involved, monitoring ceased.**

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 formed part of the UK network within Swansea – these are the site upwind of the high level stack release at Coed-Gwilym Cemetery w and the site located downwind of the release point at the Morriston Groundhog y .

Both the sample units deployed at these sites are Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling units.

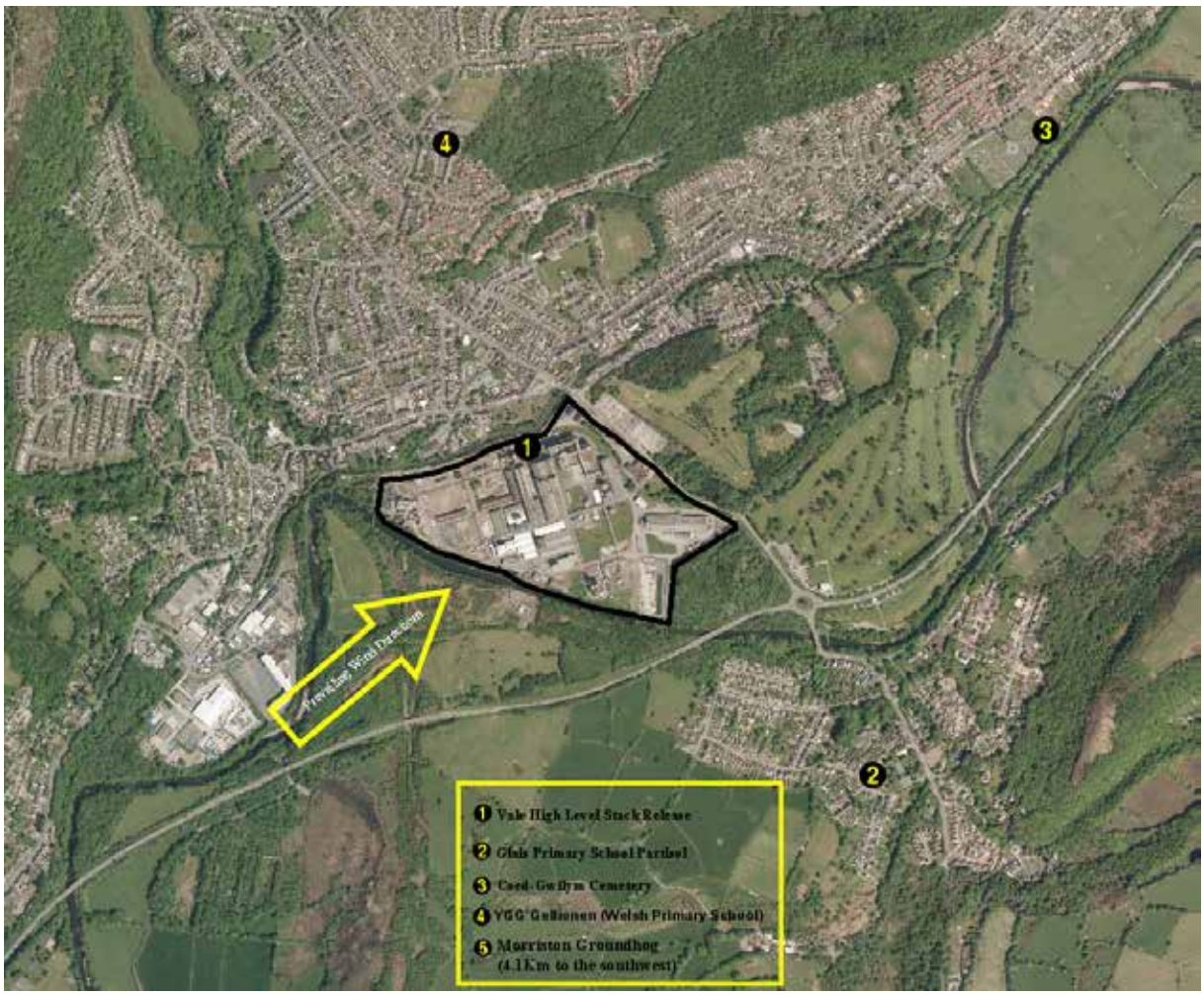
The authority as stated above, can no longer fund heavy metals monitoring at the Glais Primary School v and at the YGG Gellionnen x (Welsh Primary School) sites.

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/had an Industrial classification[14]. **Data from 2014 will continue to only be captured from points directly to the north (Coed-Gwilym Cemetery** w) **and from south (Morriston Groundhog** y) **of the high level stack release point.**

The location of Vale and the sampling locations (including those now decommissioned) can be seen below within map 14.

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



Map 14 Heavy Metals Monitoring, Vale, Glais

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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[15].

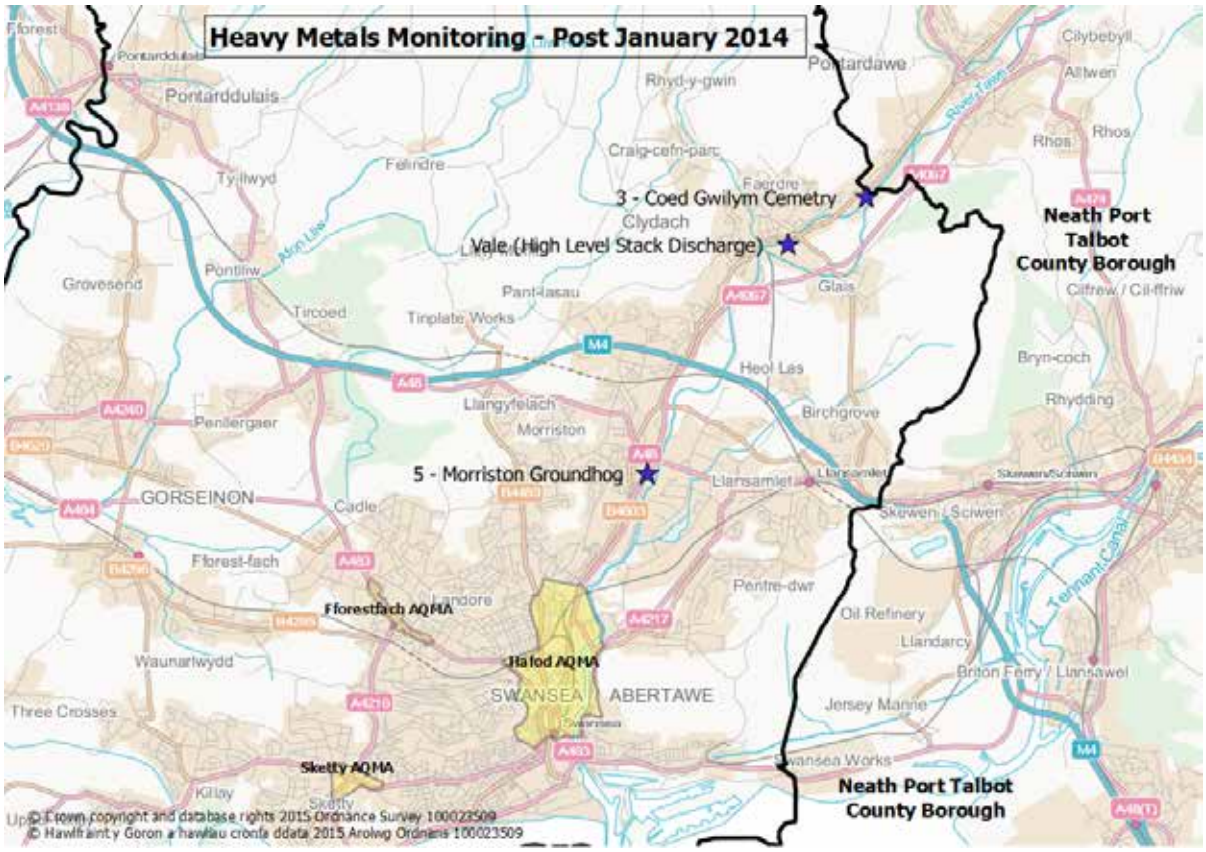
The uncertainty weighted mean for a series of N measurements, where the i^{th} measurement produces a value, x_i, with a measurement uncertainty, u_i, the uncertainty-weighted mean of the measurement, $\bar{x}_u$, would be given by:

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

Again, in order for the reader to be aware spatially of the UK Heavy Metal Monitoring sites within Swansea post January 2014, the monitoring locations are presented within map 15 below. The Swansea Air Quality Management Area 2010 (former Hafod AQMA) is indicated for reference purposes.

Neath Port Talbot Borough Council also undertake Heavy Metals Monitoring within their boundary at a number of sites in Pontardawe. Monitoring within Pontardawe is undertaken north of both the high level discharge point at Vale and Coed Gwilym Cemetry. Additional nickel sources have been identified within Pontardawe that were at one time masked by the release from Vale.

[15] 2008 NPL Report-AS 34 (March 2009) Annual Report for 2008 on the UK Heavy Metals Monitoring Network



Map 15 Swansea *UK Heavy Metal Monitoring Sites Post January 2014*

2.1.17 Continuous PAH Monitoring

The authority operate a continuous PAH monitoring site at the Cwm Level Park station (see 2.1.5 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,[16] 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.

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

2.1.18 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 starting to be 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 these sites are no longer included within table 6 below. Additionally, in January 2014 a further decision was made to cease monitoring at all sites that, for the last 3-4 years had again consistently returned a bias corrected annual mean below 30ug/m^3 unless these sites would provide useful information due the proximity to failing areas etc.

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 6 and a map showing the monitoring locations is included below as map 16. Due to the number of passive diffusion tube locations, it is not possible to label the site numbers within map16. 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 16.

Due to the proposals to regenerate the city centre, additional passive diffusion tube sites have been established during January/February 2015. These sites are not reported here but the aim is to supplement the decision making process regarding the aspiration to increase the number of people living within the city centre. It is thought that this proposal will increase the footfall within the city centre, significantly benefiting the city centre traders. However, as has been previously reported, nitrogen dioxide concentrations have exceeded the annual mean objective at several locations along key routes in the city centre. Previously, assessment has been made primarily to establish if any exceedences of the 1-hour nitrogen dioxide objective may have been breached around the café type restaurants which exist roadside to the café environment. However, with the aspiration to increase the number of dwellings along these roads as part of the redevelopment proposals, additional monitoring is required. The locations and results of this additional city centre monitoring will be reported in due course. A City Centre Infrastructure Study is underway with a focus on these key areas of proposed redevelopment.

Site Name	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	
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	
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	
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	
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	
38	266662	193181	Roadside	NO_2		Y (0.1m)	6m	
40	266951	198278	Roadside	NO_2		Y (0.1m)	8m	
41	266953	198085	Roadside	NO_2		Y (0.1m)	2m	
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)	
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	
51	268593	197434	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
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	
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

Site Name	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?
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	
78	263819	192948	Roadside	NO_2		Y (0.1m)	7m	
79	263842	192896	Roadside	NO_2		Y (0.1m)	10m	
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	
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	

Site Name	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?
Ä118	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	
Ä124	265651	193253	Roadside	NO_2		Y (2M)	4m	
Ä125	265641	193162	Roadside	NO_2		Y (3m)	1m	Y
Ä126	265475	193144	Roadside	NO_2		Y (10m)	5m	
Ä127	265348	193110	Roadside	NO_2		Y(10m)	1m	
Ä128	265297	193085	Roadside	NO_2		N (>50m)	4.5m	
Ä129	265153	193098	Roadside	NO_2		Y (5m)	7m	
Ä130	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	
Ä134	265113	192903	Roadside	NO_2		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	
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	
155	269009	201280	Roadside	NO_2		Y(0.1m)	2.5m	
156	269059	201296	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	
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	

Site Name	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?
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	
180	259064	197781	Roadside	NO_2		Y(0.1m)	1.5m	
182	259050	197790	Roadside	NO_2		Y(0.1m)	2m	
183	259036	197795	Roadside	NO_2		Y(0.1m)	2.5m	
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	
201	254522	195859	Roadside	NO_2		Y(0.1m)	2m	
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	
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	
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	
258	254906	189110	Roadside	NO_2		Y(0.1m)	1.5m	
265	266375	198023	Roadside	NO_2		Y(0.1m)	2m	265
267	266382	198028	Roadside	NO_2		Y(0.1m)	2m	
268	266419	198053	Roadside	NO_2		Y(0.1m)	3m	

Site Name	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?
271	266879	198078	Roadside	NO_2		Y(0.1m)	1.5m	
272	266888	198074	Roadside	NO_2		Y(0.1m)	1.5m	
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	
293	262302	196688	Roadside	NO_2		Y(0.1m)	7m	
294	262342	196742	Roadside	NO_2		Y(0.1m)	10m	
295	258998	198698	Roadside	NO_2		Y(5m)	0.5m	Y
296	259054	198679	Roadside	NO_2		Y(0.1m)	3m	
323	266765	193224	Roadside	NO_2		Y(0.1m)	3m	
324	269815	197657	Roadside	NO_2		Y(0.1m)	10m	

Table 6 – Nitrogen Dioxide Passive Diffusion Tubes 2014

*** 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.

***** Site 125** Army Careers Centre, City Centre – Relevant exposure is given to a block of flats over commercial premises

Ä 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

**** **Site 295** High Street, Gorseinon is located on a lamppost outside a primary school playground. The intention here is worse case scenario to establish concentrations against the 1-hour objective fronting onto the school playground area

The contract for the supply and analysis of all passive diffusion tubes has been awarded to Environmental Scientifics Group (ESG) Moorbrook Southmead Industrial Estate Didcot, Oxon. Previously this group was known as Harwell Scientifics.

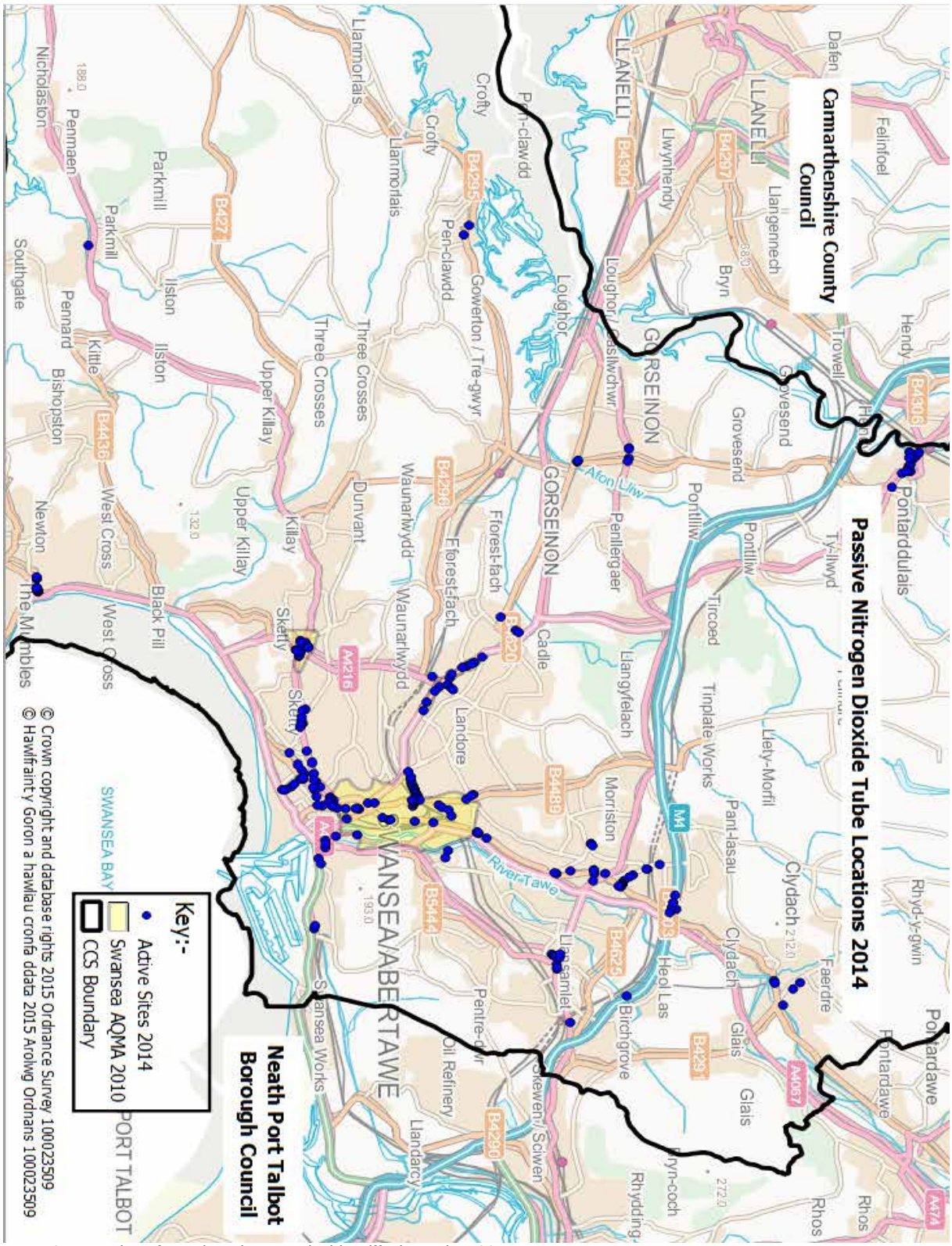
This contract laboratory has been operating for over 20 years and has extensive UKAS accreditation. In addition, all work is accredited to BS EN ISO 9001. Its predecessor the EMS Division, Harwell, carried out Swansea's original NO_2 mapping in 1985/86.

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 auto-analyser with ultraviolet detection. The analytical methods employed by Environmental Scientifics Group follow the procedures set out in the Harmonisation Practical Guidance.

ESG 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, Ricardo AEA 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 16 – Location of Passive Nitrogen Dioxide Diffusion Tubes 2014

2.1.19 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, Cwm Level Park and Morriston Groundhog sites. 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 the then AEA Energy and Environment (now Ricardo AEA) on behalf of DEFRA and the Devolved Administrations: NO_2 Diffusion Tubes for LAQM: Guidance note for Local Authorities[17].

Following on from previous auditors comments dated 9th September 2010 where it was highlighted that the bias adjustment factors from the three 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 2014.

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. Ricardo AEA 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 2014 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

[17] 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 / Teledyne) 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[18]. 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.

In the case of the Swansea AURN, the QA/QC procedures undertaken by Ricardo AEA 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. In the case of data from the Morriston Groundhog and Cwm Level Park sites, Ricardo AEA also undertakes QA/QC procedures on behalf of the Welsh Air Quality Forum and Welsh Assembly. Hourly ratified data expressed in $\mu g/m^3$ has been downloaded for the sites from http://www.welshairquality.co.uk/data_and_statistics.php . These data have then all 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 and St.Thomas DOAS systems. Annual means derived for 2014 are given below within table 7 along with those for previous years 2010-2014.

[18] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47

Site ID (see table4 above)	Location	Within AQMA	Data Capture 2014 %	Annual mean (ug/m^3)				
				2010	2011	2012	2013	2014
1	Swansea AURN ** (12m)	Y	99.1%	27.8 (36.1)	25.6 (32.38)	26.0 (30.66)	26.8 (31.15)	25.0 (30.76)
3	Morriston Groundhog ** (22m)	N	90.9%	22.6 (30.5)	21.1 (27.25)	23.4 (28.10)	23.2 (28.58)	21.1 (25.89)
4	Cwm Level Park ** (100m)	Y	95.7%	23.38	20.87	19.61	18.54	17.08
5	Hafod DOAS	Y	90.9%	58.60	57.61	52.60	50.68	48.99
6	St.Thomas DOAS	N	98.5%	45.88	40.89	38.62	39.45	35.83
13 *	Station Court, High Street	Y	48.4%	N/A	N/A	N/A	N/A	56.85

Table 7 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

***** *For information purposes only. Data capture commence July 2014. Data remains provisional*

** 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 page 2-6. The supporting simple calculator Excel spreadsheet (Issue 4: 25/01/11) 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 (for 2014 based on Background maps base year of 2011) were downloaded from http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011 and overlain on a GIS background map within Quantum GIS v2.4.0 (Chugiak). 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 8 below were used:

Site ID (see table 4 above)	Location	Background NO_2 Concentrations (ug/m^3)				
		2010	2011	2012	2013	2014
1	Swansea AURN)	16.3	16.3	19.57	19.01	17.06
3	Morriston Groundhog	17.8	17.8	19.71	19.03	17.34

Table 8 – Background NO_2 concentrations 2010-2014

As the site at Cwm Level Park has an Urban Background classification, with the nearest receptor being 100m away, the annual mean presented above 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 7 it can be seen that the Hafod DOAS continues to experience annual mean NO_2 concentrations above the objective level but it should be noted that the annual mean concentrations continue to show a decline from previous years. The St Thomas DOAS, marginally exceeded the annual mean objective during 2011 and then has marginally complied with the annual mean objective during 2012 and 2013 with 2014 now showing full compliance. Improvements with the more recent annual means to that of 2010 at St Thomas are possibly due to the improvements made around Quay Parade bridges during November/December 2011. The two other roadside sites at the Swansea AURN and Morriston Groundhog both continue to see an overall decrease in measured concentrations and exhibit full compliance with the annual mean objective.

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 11 of NO_2 tube results within section 2.3 below). The bias corrected annual mean of 50.28ug/m^3 for 2014 (100% data capture) from this site also indicates exceedence of the annual mean objective within this street canyon. Passive NO_2 diffusion sites 26 and 27 are located south of the Hafod DOAS along Neath Road, approximately 50m and 140m from the DOAS Transmitter and importantly, outside of the tighter confines of the Neath Road “canyon”. These sites indicate marginal compliance but remain at risk of exceedence of the annual mean objective with bias corrected annual means of 38.59ug/m^3 and 39.25ug/m^3 respectively. They should

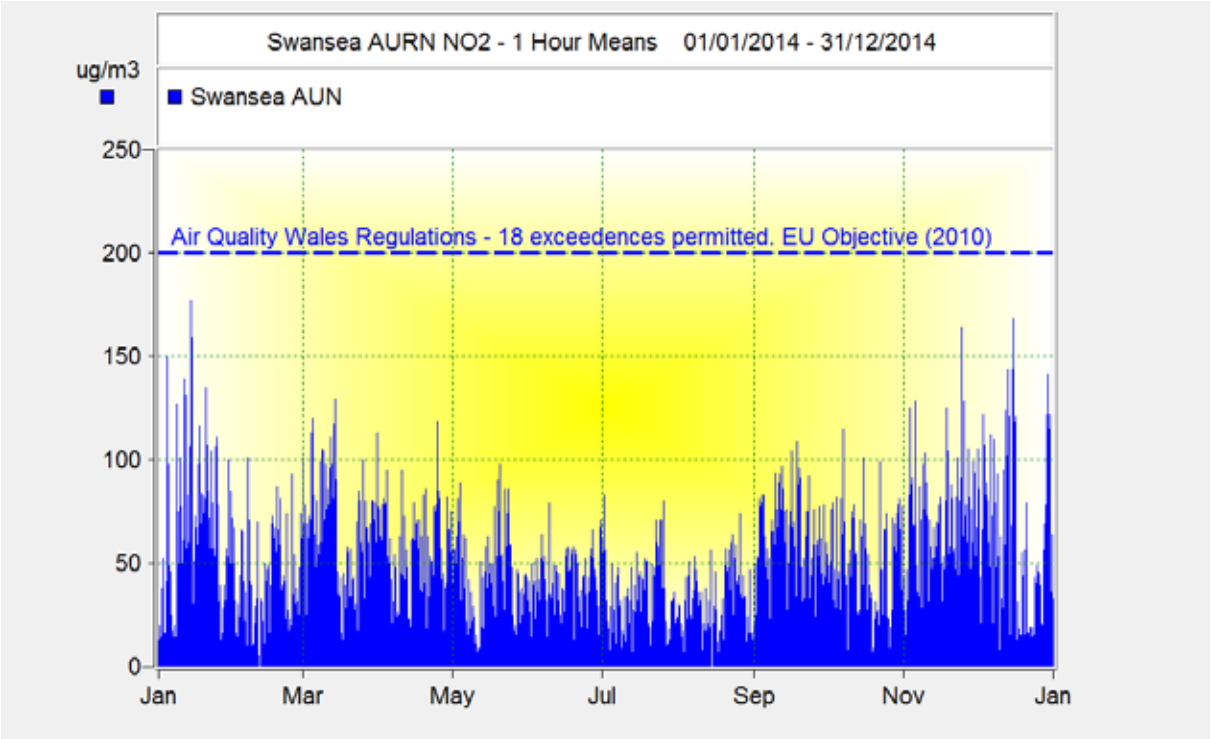
therefore also be considered to be breaching the NO_2 annual mean objective and is further evidence of the justification for the AQMA.

Table 9 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.

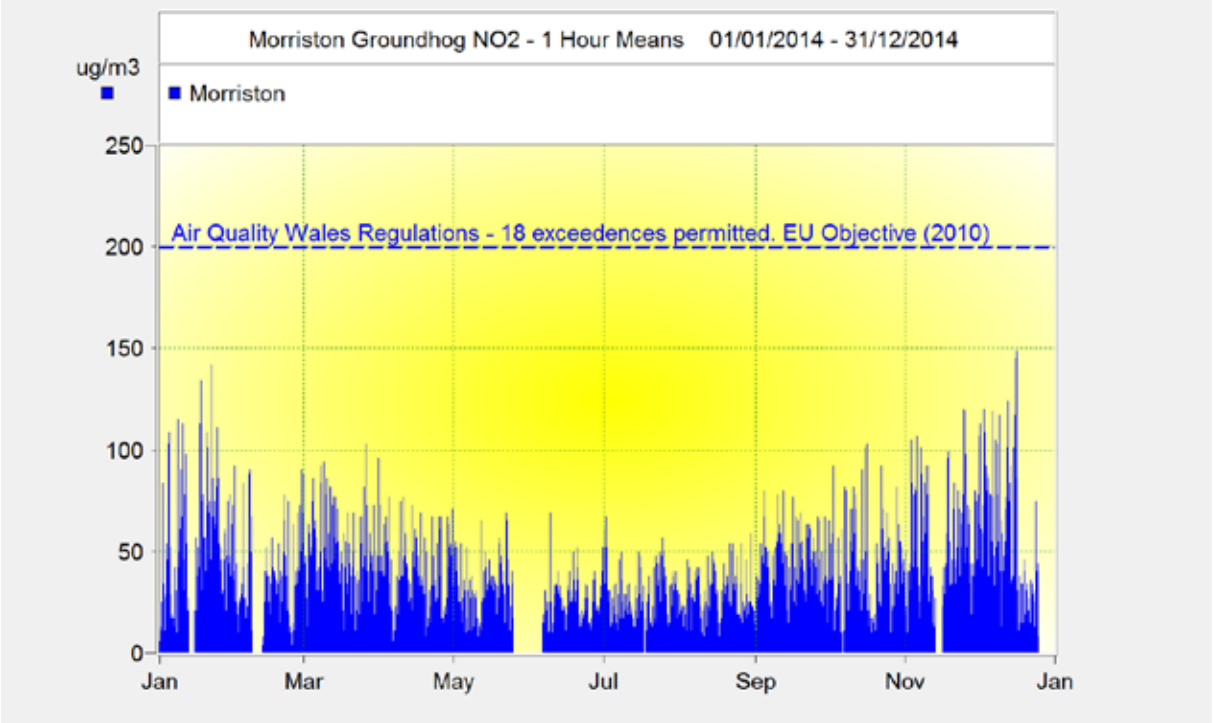
Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2014 %	Number of Exceedences of hourly mean (200 µg/m^3)					
				2009	2010	2011	2012	2013	2014
1	Swansea AURN	**Y**	**99.1%**	0	0	1	0	0	0
3	Morriston Groundhog	**N**	**90.9%**	0	0	0	0	0	0
4	Cwm Level Park	**Y**	**95.7%**	0 ****(92.0)**	0	0	0	0	0
5	Hafod DOAS	**Y**	**90.9%**	11	**20** ****(203.13)**	16	5	6	1
6	St.Thomas DOAS	**N**	**98.5%**	0	0	0	0	0	0
13 *	Station Court, High Street	**Y**	**48.4%**	-	-	-	-	-	5 **(194.7)**

Table 9- Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective
*** Data capture rate below 90% 99.8th percentile presented in brackets*
** For information only at present*

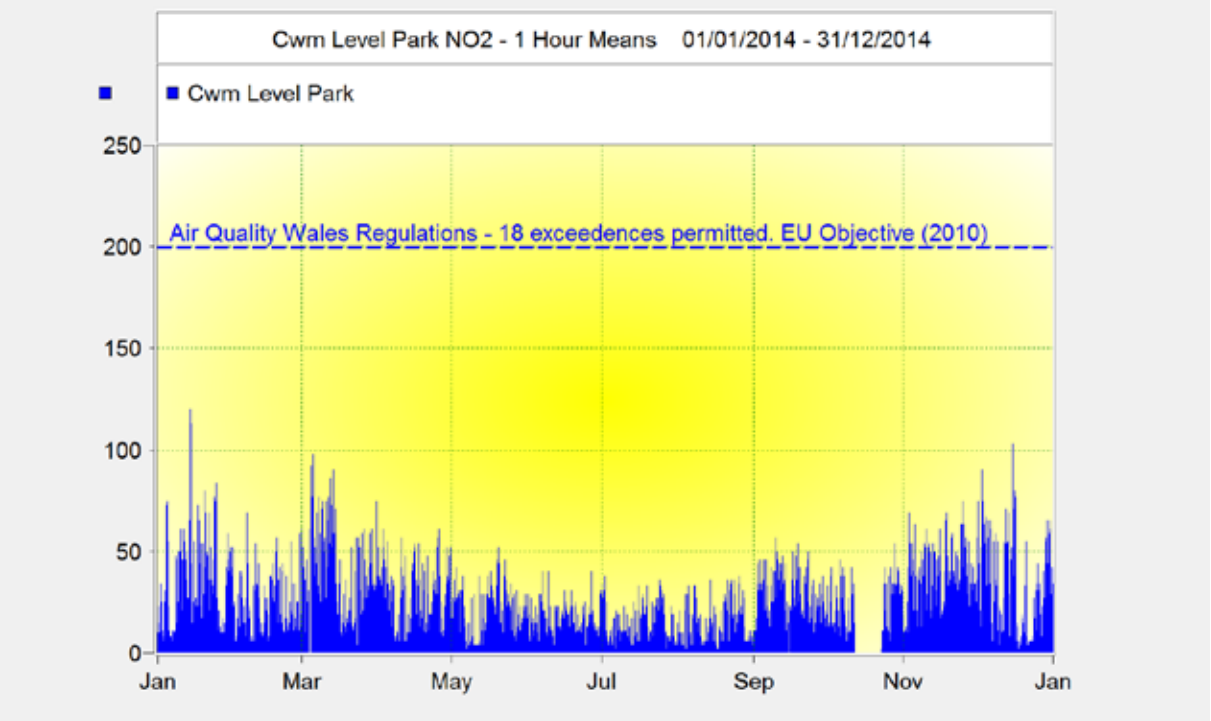
Graphs 1- 6 below show the $NO_2$1-hour means for 2014 from the 6 automatic and continuous sites now within Swansea



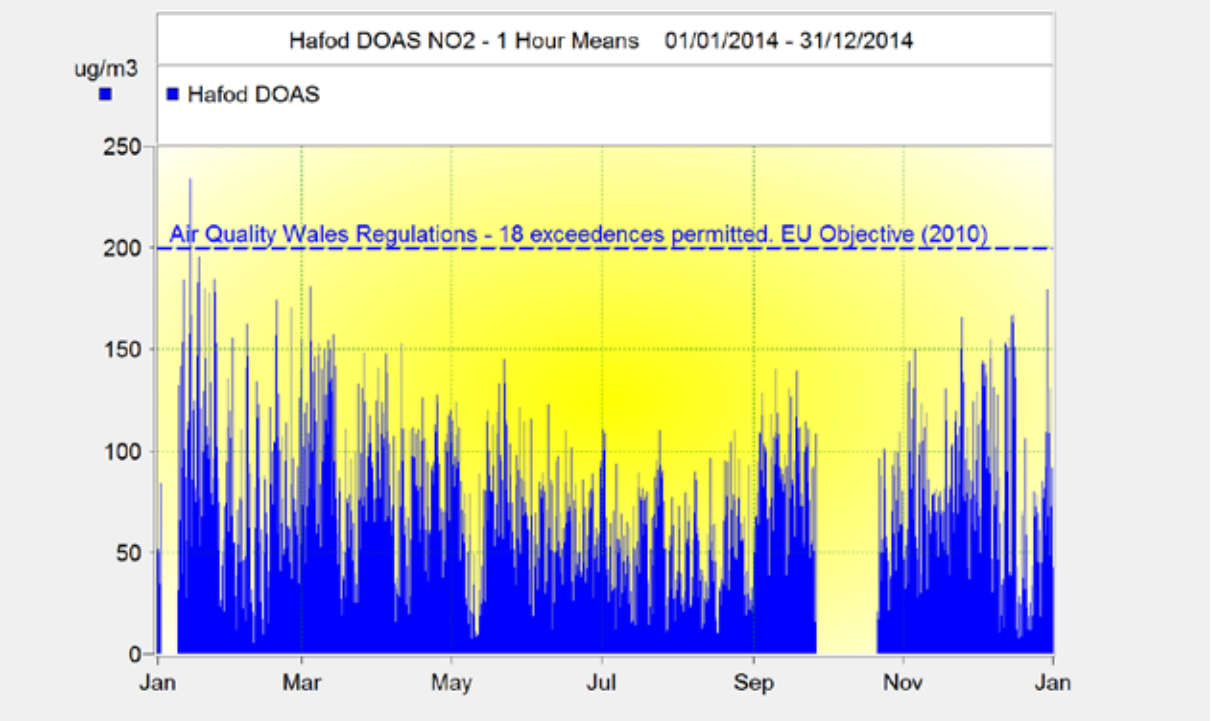
Graph 1 – NO_2 1- hour means Swansea AURN 2014



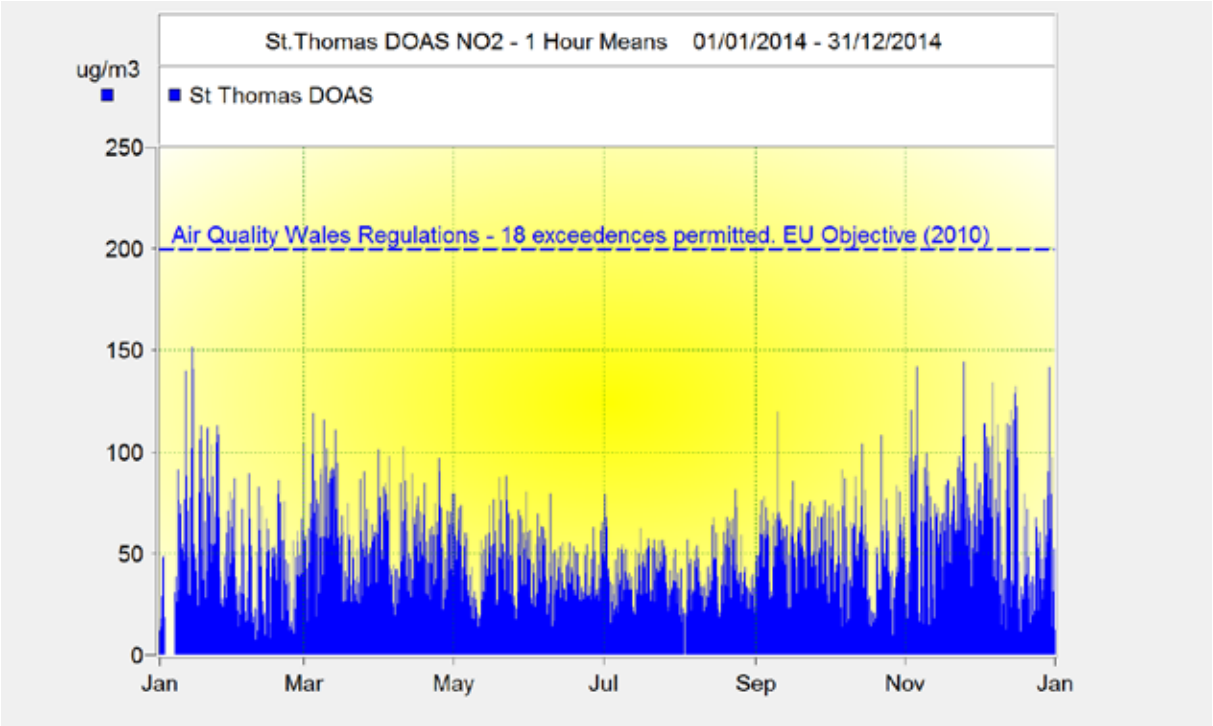
Graph 2 – NO_2 1- hour means Morriston Groundhog 2014



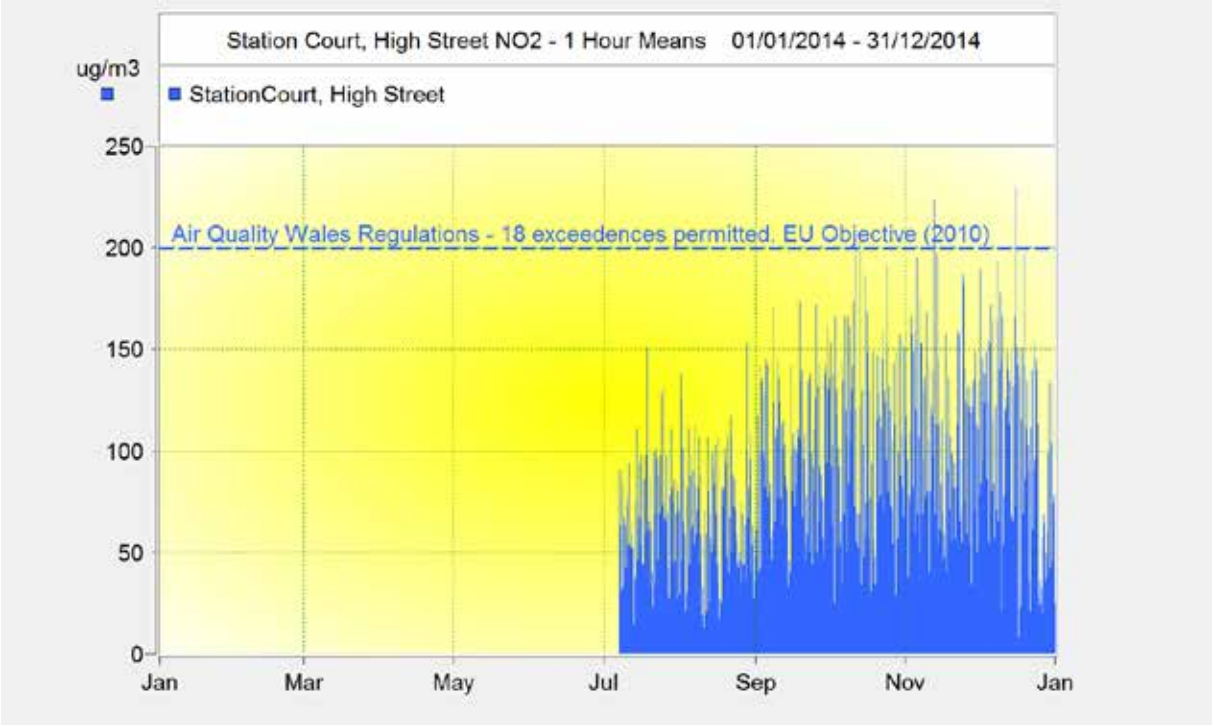
Graph 3 – NO_2 1- hour means Cwm Level Park 2014



Graph 4 – NO_2 1- hour means Hafod DOAS 2014



Graph 5 – NO_2 1- hour means St.Thomas DOAS 2014

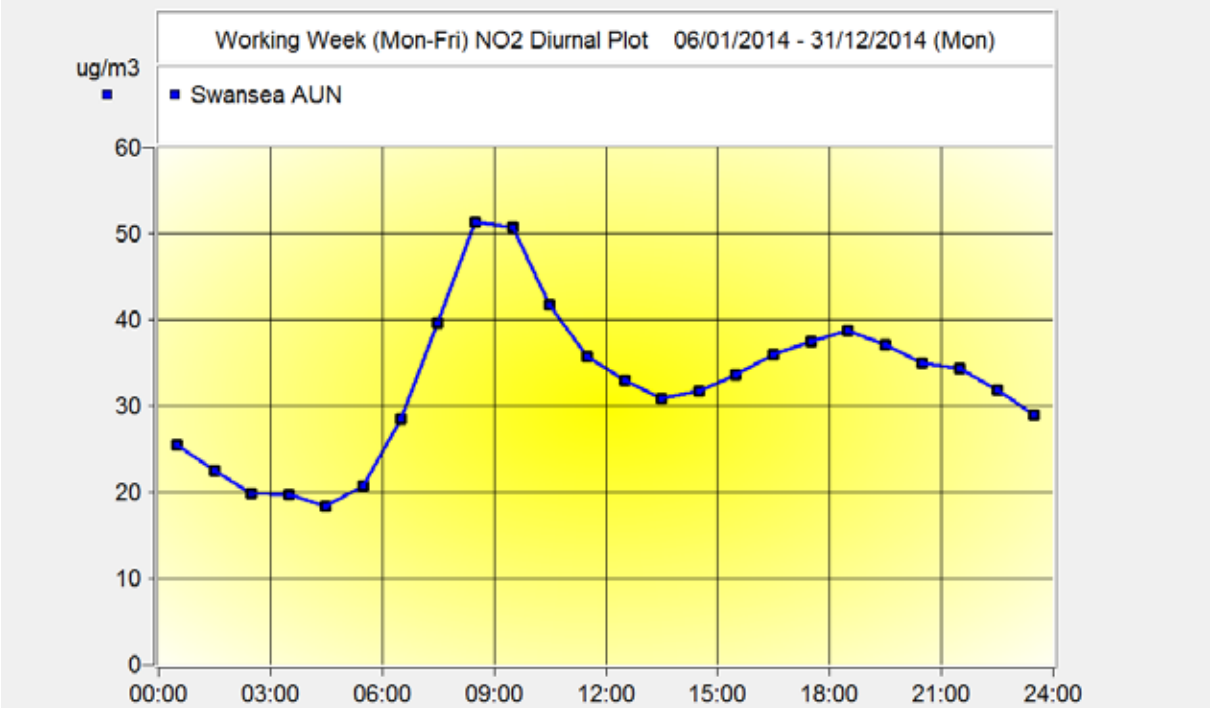


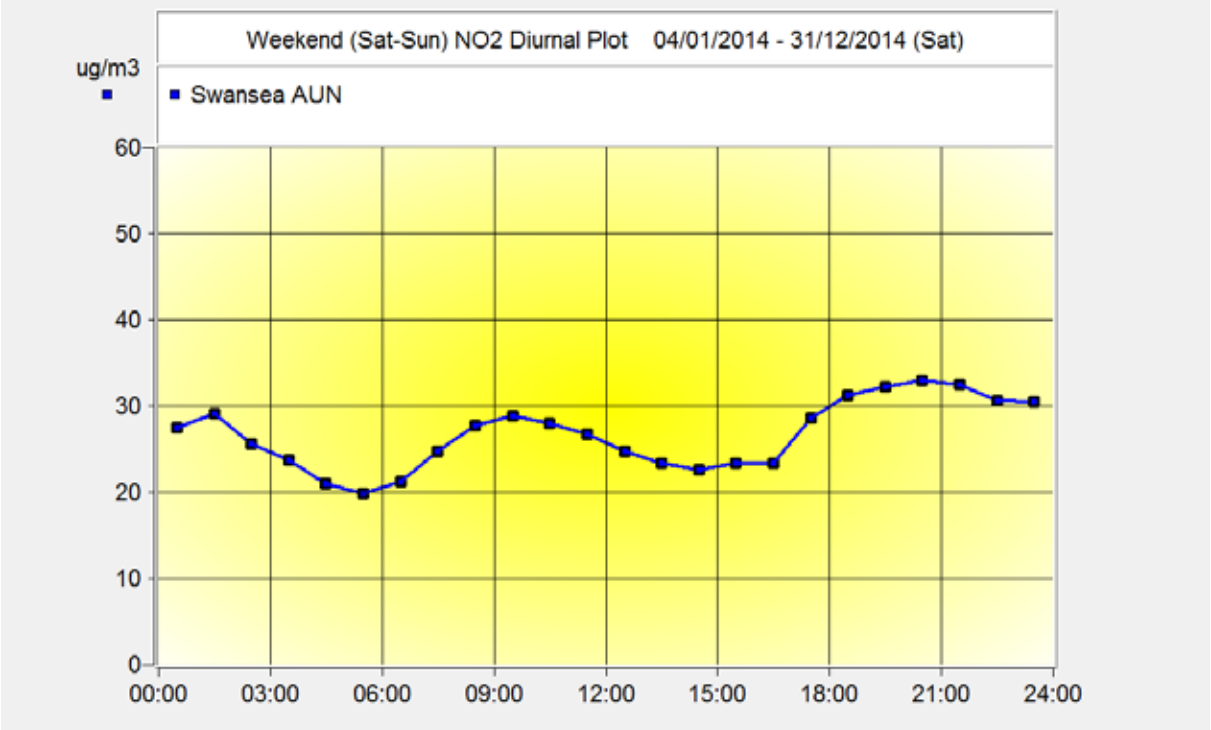
Graph 6 – NO_2 1- hour means Station Court, High Street 2014

Diurnal NO_2 profiles of the working week (Mon – Fri) and the weekend (Sat – Sun) for each site are provided below within diurnal plots 1-6. Again, as would be expected, the weekday peak concentrations are seen at each site during the am period with the

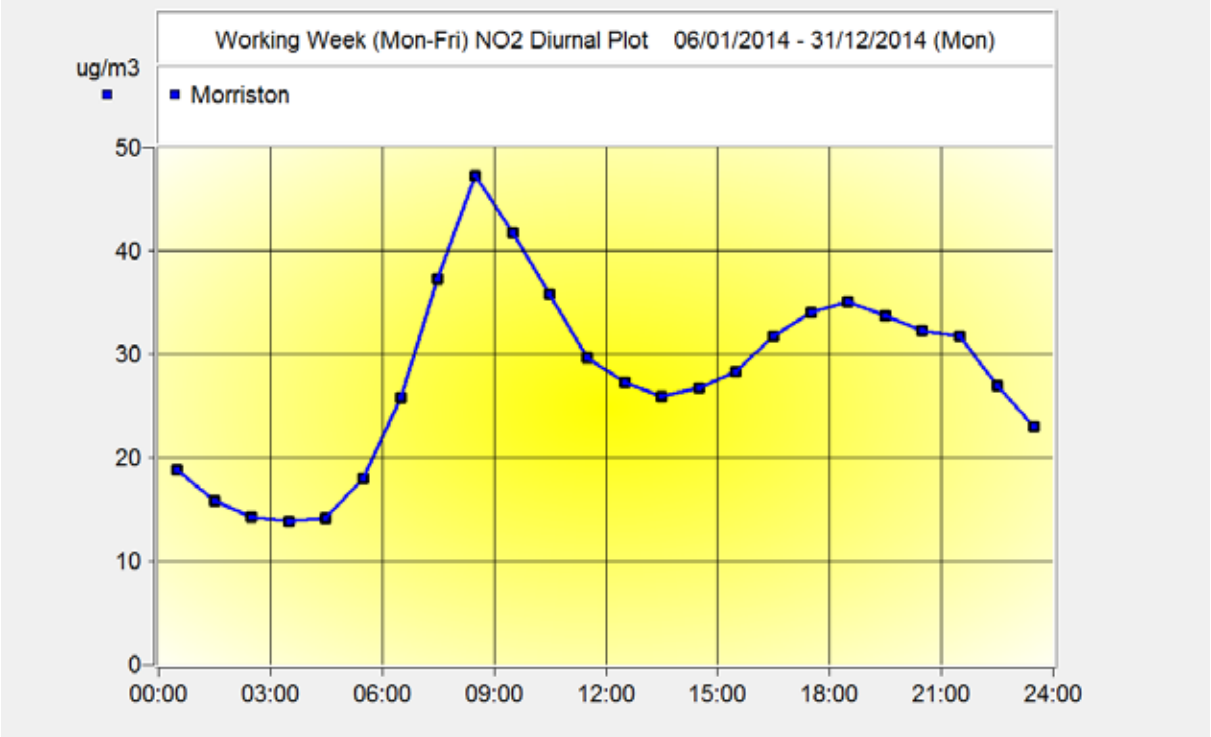
pm period being much smoother. The am peak is thought likely to be influenced more by the prevailing meteorological conditions during the morning period which are then dispersed before the pm period i.e. wintertime inversions. A completely different profile is obtained for the weekend period.

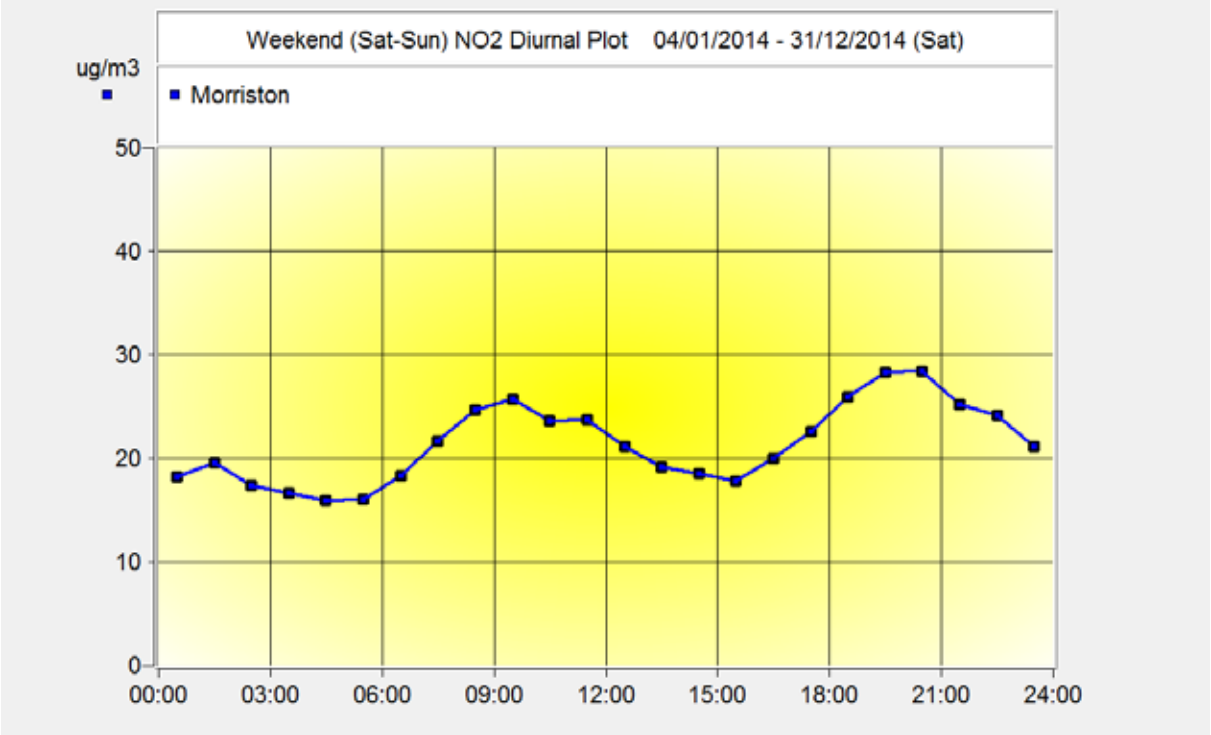
The weekday profiles raise the question whether the authority should, as part of its Air Quality Action Plan, concentrate efforts on reducing the NO_2 impact solely around the am peak traffic period of 7-10am. Thought is still being given as to what effect this may have on the overall NO_2 annual mean and 1 hour objectives and is expanded on below. The newly established site at Station Court does seem to paint a different picture with concentrations remaining high throughout the whole working day. Whatever traffic management measures are introduced into the Nowcaster forecast system being developed for such situations, to achieve widespread compliance with the objectives, will obviously require detailed and thorough planning.



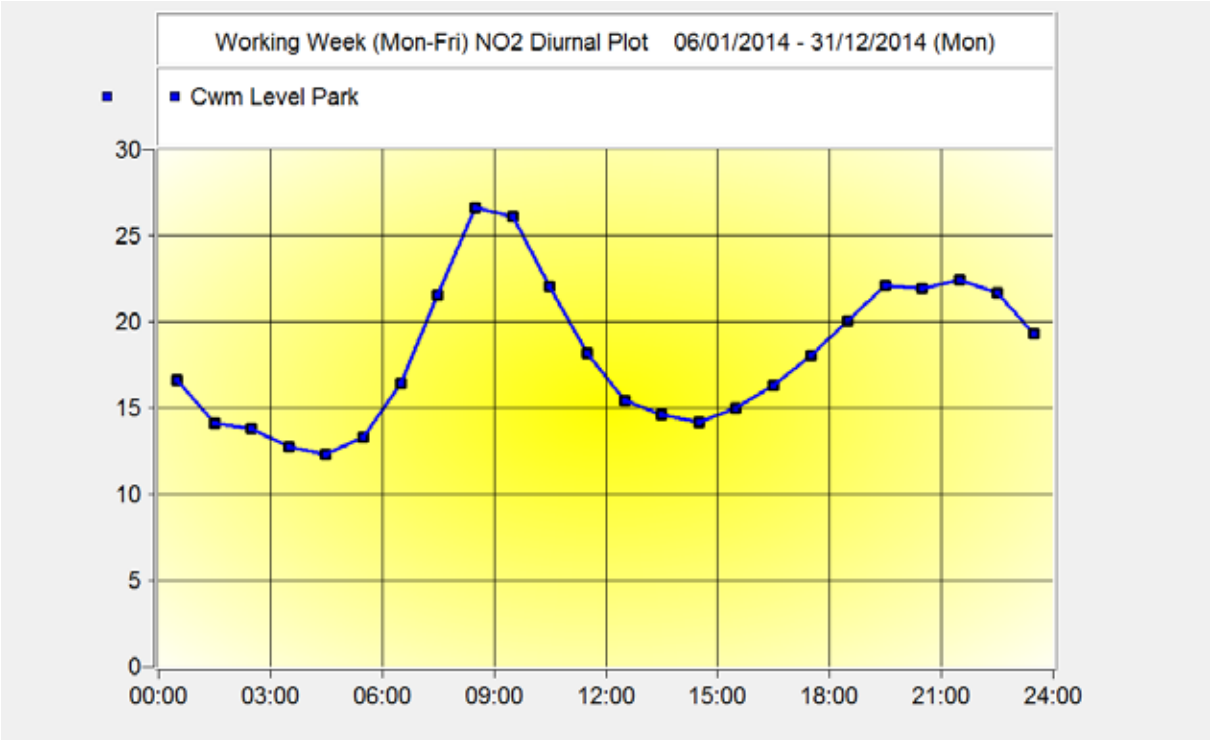


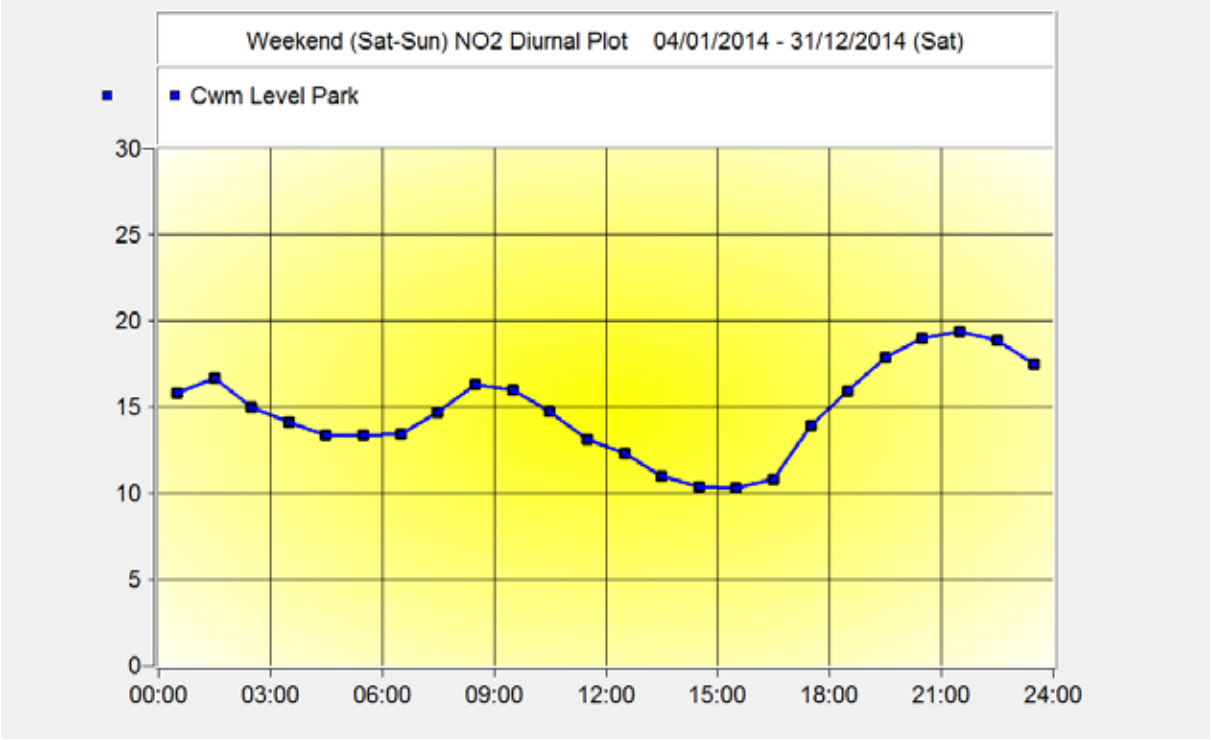
NO_2 Diurnal Profile 1 – Swansea AURN 2014 (top weekday profile, bottom weekend profile)



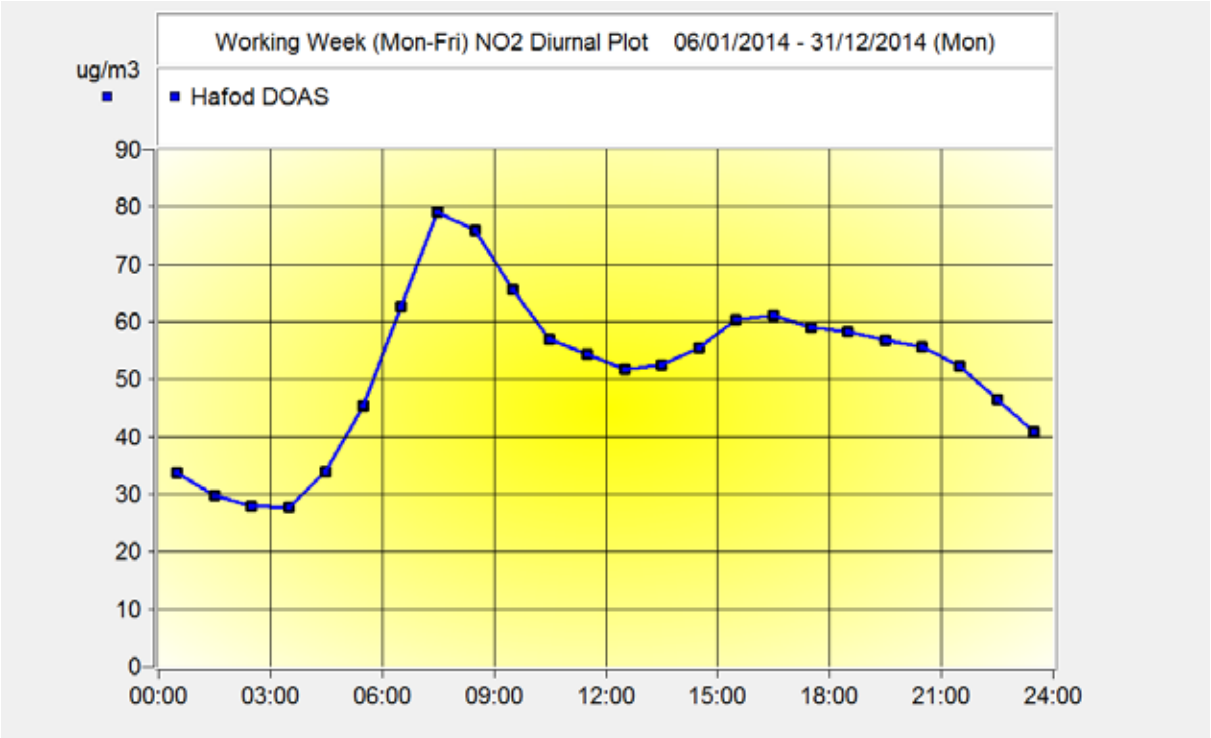


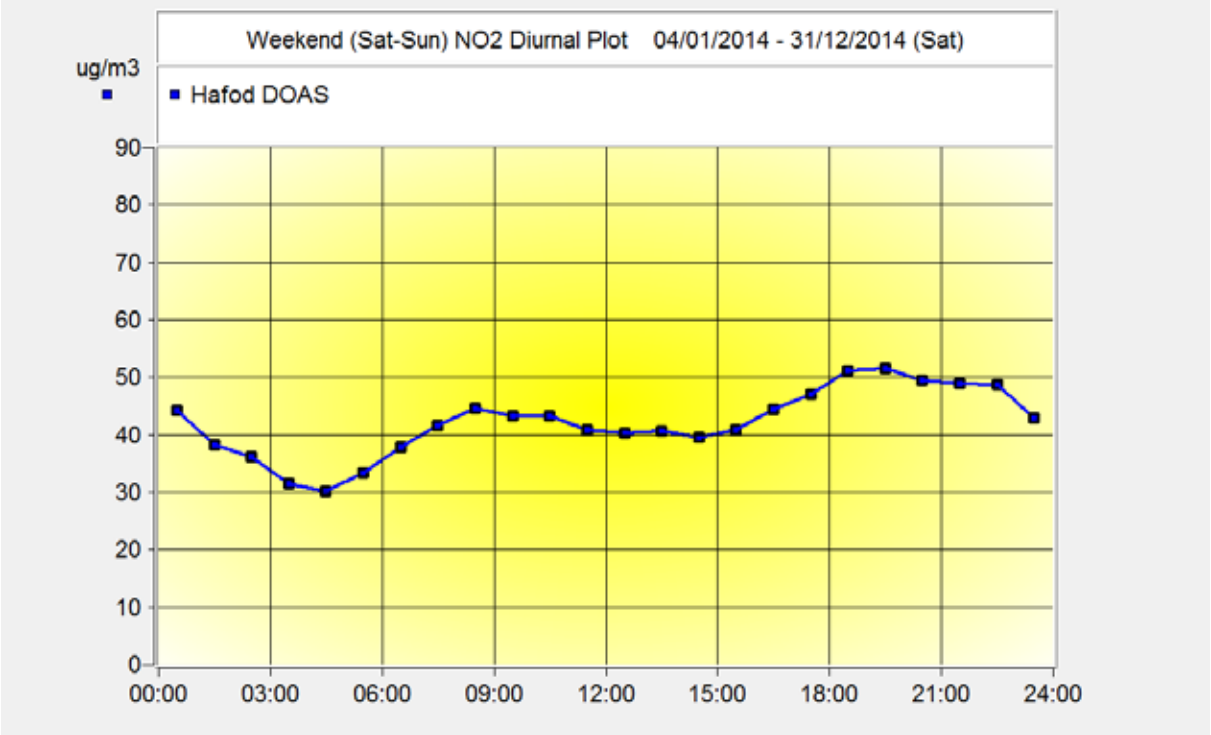
NO_2 Diurnal Profile 2 – Morriston Groundhog 2014 (top weekday profile, bottom weekend profile)



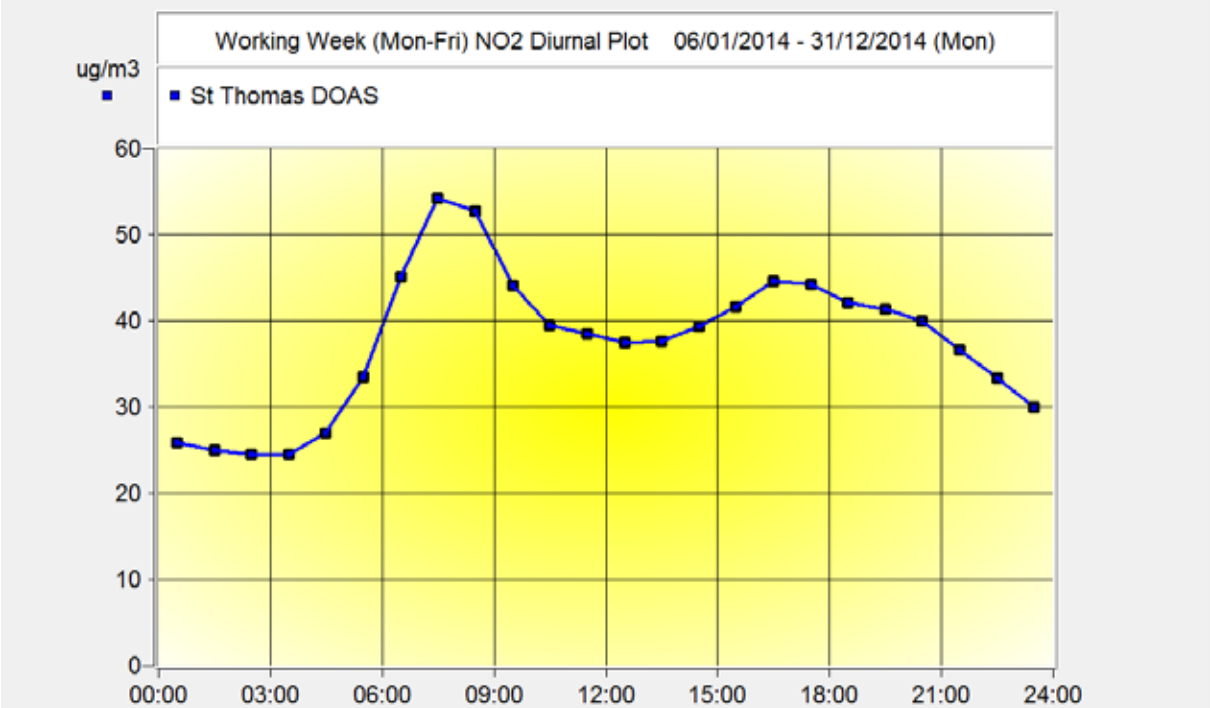


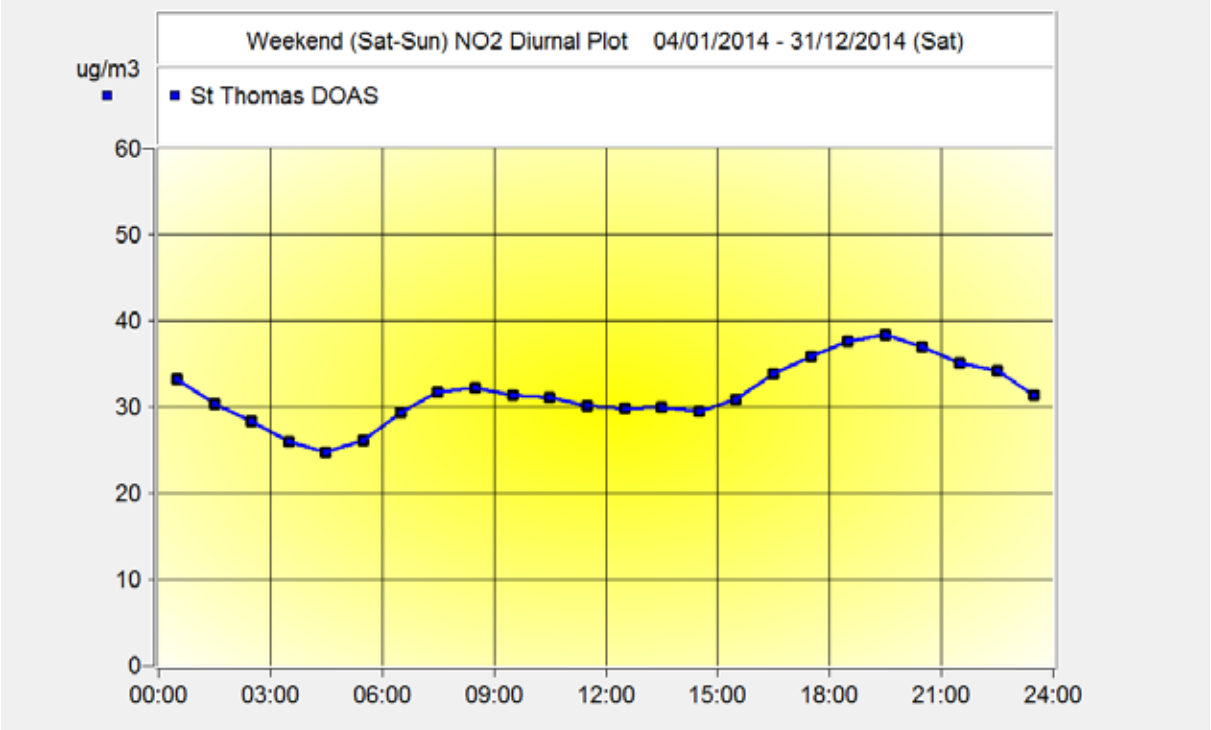
NO_2 Diurnal Profile 3 – Cwm Level Park 2014 (Urban background site) (top weekday profile, bottom weekend profile)



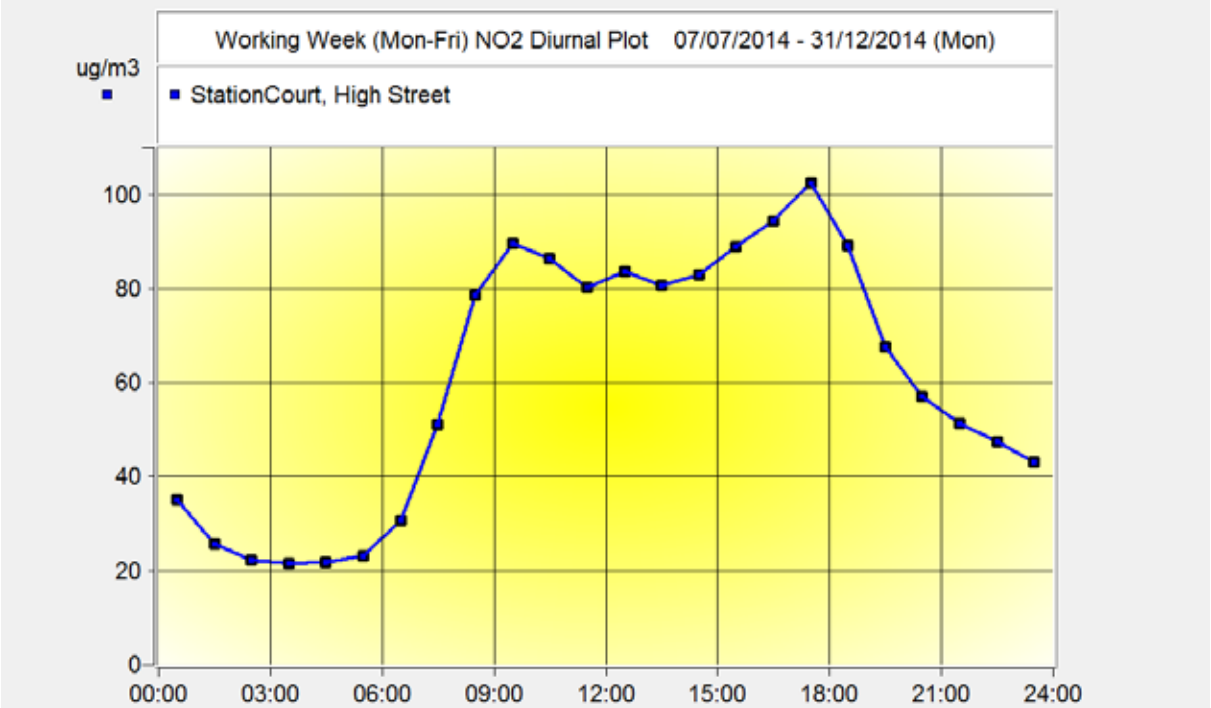


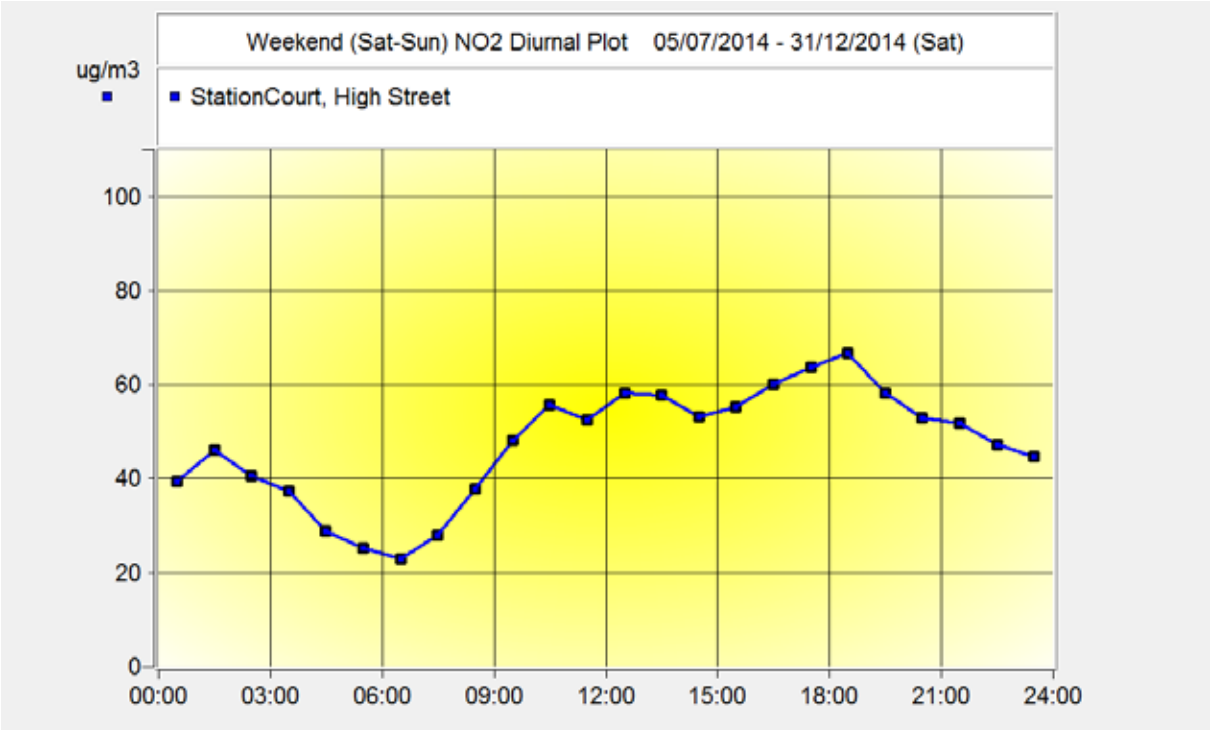
NO_2 Diurnal Profile 4 –Hafod DOAS 2014 (top weekday profile, bottom weekend profile)





NO_2 Diurnal Profile 5 – St Thomas DOAS 2014 (top weekday profile, bottom weekend profile)



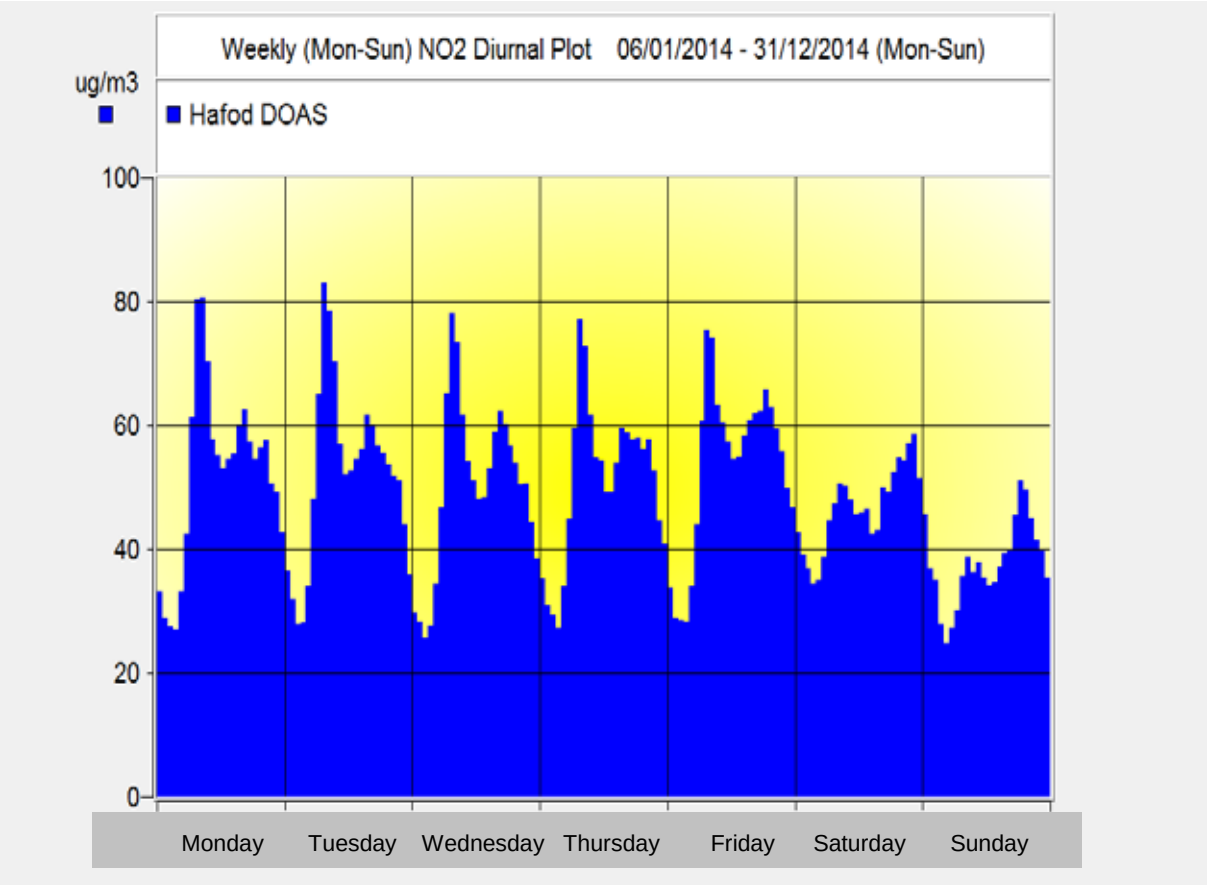


NO_2 Diurnal Profile 6 – Station Court High Street 2014 (top weekday profile, bottom weekend profile)

Of particular interest even though the time period of analysis only runs from July 2014 to December 2014 are the diurnal profiles obtained at the Station Court High Street site. These are presented here for information purposes at present but are though to provide a valuable insight into conditions at this site. Concentrations remain elevated during the whole of the working period throughout the day with concentrations showing a rapid rise from around 06:00hrs, not decreasing greatly after the am rush-hour period and in fact continuing to increase following mid day with peak concentrations not being reached until the pm rush-hour starting around 18:00hrs. This is a completely different profile to that obtained from every other site in that at all other sites, a drop in concentrations is seen after the am peak before they rise again during the pm peak – at the Station Road site, concentrations continue to increase during mid-morning and over the lunch period into early afternoon and only peak during the pm rush-hour period.

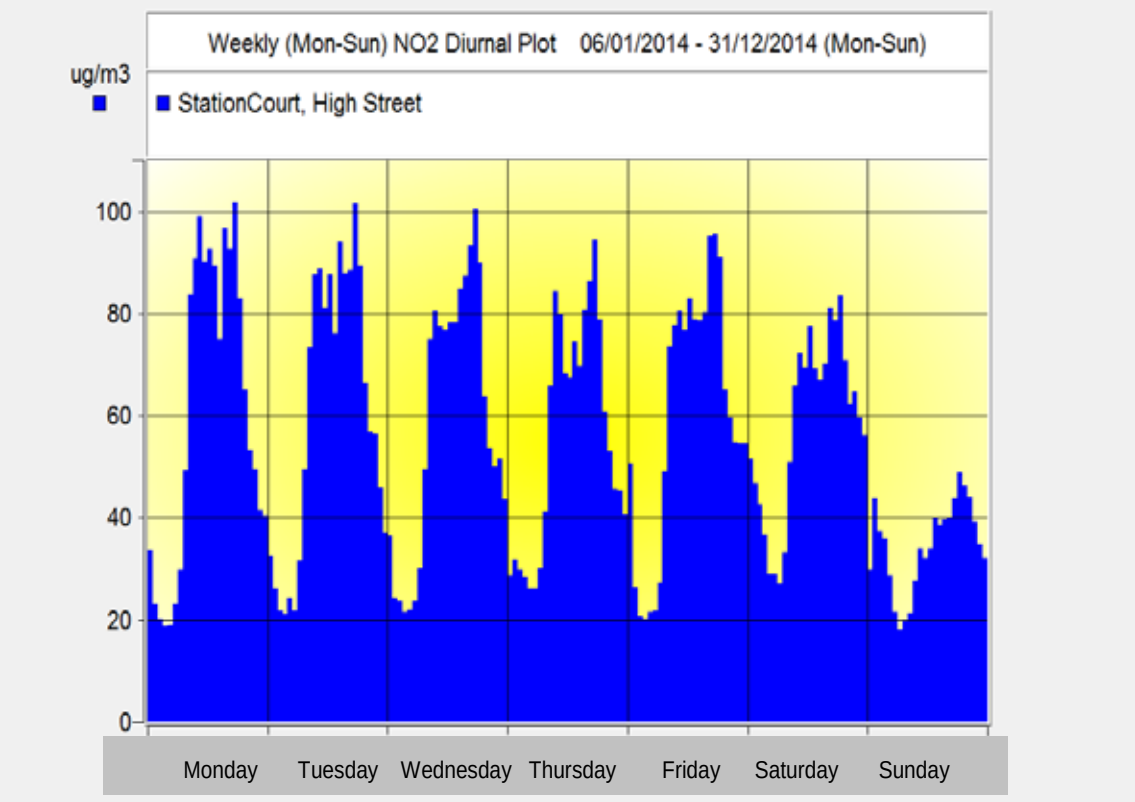
The diurnal weekday profiles obtained for the both the Hafod DOAS and Station Court sites are both interesting and concerning in that can these profiles be better explained and more importantly what practicable measures in the case of the Hafod DOAS site would reduce the impact of the morning rush hour along this street canyon. Early thoughts with the data from the Hafod DOAS were that it was envisaged that additional “source apportionment” would be required with specific emphasis on identifying the fuel being combusted and also the EURO classification and the adopted abatement technology employed within each vehicle. Obviously, the only way to accurately obtain this information would be via a static ANPR camera linked to the DVLA databases. When sufficient information had been gathered, thought would then have to be given as to how interventions could practicably be made with specific vehicle types within the fleet. However, budgetary restraints no longer permit this action to be considered further.

If diurnal profiles are created for each individual working day at the Hafod DOAS, the same am peak trend is apparent, therefore, it could be argued that whatever interventions are decided upon would need to be applied for every morning of every working day of the week in order to make any difference to the concentrations being recorded. A weekly summary of the individual daily diurnal plots from the Hafod DOAS is given below as diurnal profile 7.



Diurnal Profile 7 – Hafod DOAS – Weekly 2014

The weekly profile obtained at the Station Court site is shown below as Diurnal Profile 8 and presents a different challenge and scenario to that painted above for the Hafod DOAS. Visual observations confirm that congestion and a high flow of buses, together with the location of bus stops/mini roundabouts may well be contributory factors to the concentrations being seen. These high concentrations exist from early morning to early/late evening Monday to Saturday with the peak concentrations not being seen until the pm period. The only day that does not experience these conditions are Sundays. It will be interesting to see if the same profile is evident once a full calendar years worth of data is available.



Diurnal Profile 8 – Station Court High Street – Weekly 2014

**Data capture commenced 7th July 2914*

Detailed traffic flow data for the authorities GPRS network of ATC's is presented in subsequent chapters. The nearest GPRS traffic counters to the Hafod DOAS are GRPS site 6 (located approximately 50m south of the Hafod DOAS transmitter and GPRS site 18 (located approx 25m north of the Hafod DOAS receiver. The nearest traffic counters to the Station Court site are GPRS site 22 (located 330m to the North) and GPRS site 57 (located 350m to the South)

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 produced a further update to the previously revised future year projection

guidance by way of a further note entitled "Note on Projecting NO_2 concentrations" [19] dated 30th April 2012. Box 2.1 page 2-4 of LAQM.TG(09) had also been updated "live" at http://laqm.defra.gov.uk/documents/LAQM-TG-(09)-Dec-12.pdf with the latest future year adjustment factors.

However, a further update to the adjustment factors within Box 2.1 - Projecting annual mean roadside nitrogen dioxide concentrations to future years LAQM.TG(09) was published on 19th June 2014. This revision of the adjustment factors now includes adjustment factors where HDV content is <=10% and where HDV >=10% elsewhere in the UK meaning outside of London. It is the latest revision of the adjustment factors dated 19th June 2014 that have been used in the future projections. In the case of the GPRS ATC data collected in Swansea HDV is defined Heavy Van, Mini bus. LGV,MGV,HGV, Articulated lorry, HGV+Trailer and Bus.

Using the above rational, table 10 below indicates the range of predicted NO_2 concentrations in 2015 - 2025 at the automatic roadside sites and the urban background site in Swansea. An indication is given for the Station Court, High Street site but this is for information purposes only at this stage due to the commencement of monitoring date in 2014. Where applicable, the correction derived for distance from the roadside measurement location to the nearest receptor location is given in bold within table 10. 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. For completeness, the same method is used for the background site at Cwm Level Park despite the method relating to roadside sites. As such the projections for Cwm Level Park should be viewed as for information purposes only.

[19] 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) (19th June 2014 Updated Adjustment Factors) Predicted exceedence of annual mean objective highlighted in **bold red** Prediction within 3ug/m^3 of annual mean objective highlighted in **bold blue**						
			2014	2015	2016	2017	2018	2019	2020	2025
1	Swansea AURN	Y	**25.0** (30.76)	24.7	23.5	22.2	21.0	19.7	18.5	15.7
3	Morriston Groundhog	N	**21.1** (25.89)	20.9	19.8	18.7	17.7	16.6	15.6	13.2
4	** Cwm Level Park (Urban Background)	Y	**17.08**	16.9	16.0	15.2	14.3	13.5	12.6	10.7
5	Hafod DOAS	Y	**48.99**	**48.4**	**46.0**	**43.5**	**41.1**	**38.6**	36.2	30.7
6	St.Thomas DOAS	N	**35.83**	35.4	33.6	31.8	30.0	28.3	26.5	22.5
13	Station Court High Street	Y	**56.85**	**54.9**	**51.8**	**48.7**	**45.5**	**42.4**	**39.2**	32.9

Table 10 – Predicted Future Years Roadside NO_2 2015-2025

*** Urban background site included for sake of completeness. Revised.*

Site ID's 1, 3, 4, 5, 6 use HDV =<10% Elsewhere UK adjustment factors

Site ID 13 use HDV >= 10% Elsewhere UK adjustment factors

From table 10, the view can be taken that the Hafod DOAS will continue to experience exceedences of the annual mean until at least 2019 given current thinking (using the Revised June 2014 method), with the St Thomas DOAS now showing full compliance with the annual mean objective. If the limited data available from 2014 from the Station Court, High Street site is used for the projections then compliance with the annual mean objective is not seen until 2020 (using the HDV >=10% adjustment factors). All other stations exhibit existing full compliance with the annual mean objective.

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2.2.3 Nitrogen Dioxide Diffusion Tube Monitoring

All data presented within table 11 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[20]. 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 total number of sites operational during 2013 was 246 and during 2014 this was reduced to 220 due to budgetary restraints. The number of sites has fluctuated up and down between 2011 and 2014 due to competing demands but, in general, a decision has made to cease monitoring at all sites that have consistently returned a bias corrected annual mean below 30ug/m^3. This decision will now apply to sites 162-178 during 2015. However, during 2015 there is no alternative but to increase the monitoring undertaken within the city centre due to the requirement to inform the redevelopment proposals.

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 11 indicates the bias corrected annual means including any correction necessary for distance to nearest receptor from the sampling location - see table 6 for distance to nearest receptor. The relevant distance correction/background concentration (where applicable) is given within table 12 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.

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

Site Name	OS Grid Ref Easting	OS Grid Ref Northing	Site Type	In AQMA?	Data Capture 2014 %	Annual Mean concentrations 2014 (ug/m3) Adjusted for tube bias and distance to receptor (Bias Adjustment factor 2014 = 0.89)
1	262046	196420	Roadside		100.00	22.14
4	262497	192857	Roadside	Y	100.00	29.78
5	262548	192943	Roadside	Y	100.00	32.46
6	262612	192995	Roadside	Y	100.00	28.52
7	262691	192852	Roadside	Y	100.00	48.66
8	262990	195820	Roadside	Y	100.00	41.76
9	263190	195205	Roadside		100.00	27.89
10	263219	195513	Roadside	Y	83.33	24.97
11	263344	195474	Roadside	Y	100.00	37.58
12	263680	195103	Roadside	Y	100.00	42.78
13	264830	193066	Roadside		100.00	27.78
14	265285	192696	Roadside		100.00	24.30
15	265334	192608	Roadside		91.67	24.45
16	265339	192534	Roadside		100.00	28.61
18	265526	195807	Roadside	Y	100.00	45.85
19	265597	194061	Roadside	Y	100.00	42.61
20	265594	194175	Roadside	Y	100.00	37.74
21	265634	195316	Roadside	Y	100.00	27.96
22	265682	195374	Roadside	Y	100.00	31.43
23	265728	195494	Roadside	Y	100.00	28.49
25	265845	195547	Roadside	Y	100.00	27.06
26	265876	194318	Roadside	Y	100.00	38.59
27	265922	194428	Roadside	Y	91.67	39.25
28	265949	194891	Roadside	Y	91.67	28.21
29	265973	195222	Roadside	Y	91.67	47.36
31	266153	196003	Roadside		100.00	31.70
32	266209	193867	Roadside		100.00	33.38
33	266236	193488	Roadside		91.67	31.33
34	266272	196168	Roadside		91.67	29.80
35	266314	193298	Roadside		83.33	32.21
36	266455	193300	Roadside		91.67	27.49
38	266662	193181	Roadside		100.00	31.05
40	266951	198278	Roadside		91.67	27.42
41	266953	198085	Roadside		100.00	35.33
43	267093	198063	Roadside		100.00	36.22
44	267639	199543	Roadside		100.00	27.35
45	267661	199451	Roadside		91.67	30.78
48	268011	193101	Roadside		100.00	21.72
49	268501	197329	Roadside		100.00	26.77
50	268530	197419	Roadside		91.67	36.43
51	268593	197434	Roadside		100.00	28.81
54	268693	197416	Roadside		91.67	33.93
55	268789	197420	Roadside		100.00	32.31
56 *	269306	198661	Roadside		100.00	22.00
58	264052	192884	Roadside		100.00	29.70
59	265918	194463	Roadside	Y	100.00	50.28
60	265036	192931	Roadside		100.00	34.21
61	264959	192878	Roadside		100.00	38.16
63	262675	192775	Roadside	Y	100.00	21.00
64	262719	192840	Roadside	Y	100.00	38.30

Site Name	OS Grid Ref Easting	OS Grid Ref Northing	Site Type	In AQMA?	Data Capture 2014 %	Annual Mean concentrations 2014 (ug/m3) Adjusted for tube bias and distance to receptor (Bias Adjustment factor 2014 = 0.89)
65	262735	192855	Roadside	Y	100.00	24.77
66	262802	192829	Roadside	Y	100.00	26.45
67	265903	193683	Roadside	Y	91.67	35.60
68	265573	193432	Roadside		100.00	36.13
69	265543	193450	Roadside		100.00	40.30
70	266649	195435	Roadside		100.00	24.80
71 **	266514	195485	Roadside		83.33	25.00
72	264091	192900	Roadside		100.00	23.58
73	264138	192868	Roadside		91.67	29.60
74	264163	192853	Roadside		100.00	28.41
75	264072	192869	Roadside		100.00	39.99
76	263968	192880	Roadside		100.00	27.61
78	263819	192948	Roadside		100.00	25.69
79	263842	192896	Roadside		100.00	30.07
83	262785	192838	Roadside	Y	91.67	27.41
84	262714	192839	Roadside	Y	100.00	35.13
85	262702	192847	Roadside	Y	100.00	35.62
86	262704	192865	Roadside	Y	100.00	25.51
87	262697	192798	Roadside	Y	100.00	20.80
88	262605	192916	Roadside	Y	100.00	28.21
89	262587	192956	Roadside	Y	75.00	20.12
90	262631	192996	Roadside	Y	91.67	32.61
91	262534	192950	Roadside	Y	100.00	29.28
92	262545	192869	Roadside	Y	108.33	23.70
93	263406	195534	Roadside		83.33	29.21
94	263444	195572	Roadside		100.00	28.09
95	262815	196090	Roadside		83.33	25.23
96	262922	195950	Roadside		100.00	26.20
97	262946	195902	Roadside	Y	75.00	31.62
98	263142	195548	Roadside	Y	100.00	36.21
99	263387	195332	Roadside	Y	75.00	32.73
100	263470	195250	Roadside	Y	100.00	24.02
101	263843	195047	Roadside	Y	83.33	23.31
102	266379	193307	Roadside		100.00	27.96
103	268526	197359	Roadside		100.00	33.45
104	268538	197389	Roadside		100.00	27.70
105	268562	197472	Roadside		100.00	29.81
106	268496	197476	Roadside		100.00	28.90
107	268765	197420	Roadside		91.67	32.23
108	267608	199461	Roadside		100.00	28.72
109	267510	199487	Roadside		100.00	26.43
110	267369	199521	Roadside		100.00	25.75
111	267705	199426	Roadside		100.00	27.15
112	264868	192814	Roadside		75.00	32.58
113	264654	192662	Roadside		100.00	26.60
114	264622	192971	Roadside		91.67	30.07
115	265031	193097	Roadside		100.00	40.40
116	265192	193138	Roadside		91.67	38.73
117	265288	193211	Roadside		100.00	35.30

Site Name	OS Grid Ref Easting	OS Grid Ref Northing	Site Type	In AQMA?	Data Capture 2014 %	Annual Mean concentrations 2014 (ug/m3) Adjusted for tube bias and distance to receptor (Bias Adjustment factor 2014 = 0.89)
Ä118	265483	193385	Roadside		75.00	29.33
119	265522	193390	Roadside		100.00	34.78
120	265570	193366	Roadside		100.00	47.24
121	265706	193662	Roadside	Y	100.00	52.71
122	265694	193505	Roadside		100.00	34.83
123	265655	193423	Roadside		83.33	47.00
Ä124	265651	193253	Roadside		91.67	38.43
Ä125	265641	193162	Roadside		100.00	37.90
Ä126	265475	193144	Roadside		100.00	40.64
Ä127	265348	193110	Roadside		100.00	44.26
Ä128	265297	193085	Roadside		100.00	38.82
Ä129	265153	193098	Roadside		83.33	32.56
Ä130	265139	192912	Roadside		100.00	39.17
131	265137	192846	Roadside		100.00	44.79
132	265229	192753	Roadside		75.00	27.11
133	265350	192566	Roadside		91.67	25.28
Ä134	265113	192903	Roadside		100.00	42.65
^136	262612	192995	Roadside	Y	75.00	25.53
^137	262631	192996	Roadside	Y	100.00	32.63
138	266779	199246	Roadside		91.67	22.01
139	266867	199030	Roadside		91.67	27.04
140	266863	199009	Roadside		100.00	29.12
141	266979	198772	Roadside		100.00	25.84
142	267017	198710	Roadside		100.00	24.85
143	267089	198608	Roadside		100.00	30.29
144	267141	198591	Roadside		100.00	27.05
145	267139	198578	Roadside		100.00	28.27
146	267156	198571	Roadside		100.00	32.28
147	267165	198580	Roadside		91.67	33.79
148	267170	198564	Roadside		100.00	32.05
149	267204	198561	Roadside		100.00	26.66
150	267205	198545	Roadside		91.67	27.63
151	267192	198518	Roadside		91.67	25.59
155	269009	201280	Roadside		100.00	26.20
156	269059	201296	Roadside		100.00	27.61
158	269480	201441	Roadside		100.00	24.62
159	269171	201620	Roadside		91.67	26.98
160	269049	201744	Roadside		100.00	31.97
162	259553	203379	Roadside		75.00	24.40
163	259287	203556	Roadside		83.33	21.18
164	259195	203667	Roadside		100.00	25.02
165	259149	203675	Roadside		91.67	19.94
166	259148	203690	Roadside		91.67	22.10
167	259126	203700	Roadside		83.33	19.93
168	259115	203705	Roadside		100.00	19.82
169	259013	203747	Roadside		100.00	19.17
170	258971	203797	Roadside		100.00	16.28
171	258917	203826	Roadside		83.33	23.18
172	258887	203859	Roadside		91.67	23.98

Site Name	OS Grid Ref Easting	OS Grid Ref Northing	Site Type	In AQMA?	Data Capture 2014 %	Annual Mean concentrations 2014 (ug/m3) Adjusted for tube bias and distance to receptor (Bias Adjustment factor 2014 = 0.89)
173	259250	203708	Roadside		100.00	17.16
174	259253	203660	Roadside		91.67	14.47
175	259251	203638	Roadside		100.00	13.31
176	258872	203691	Roadside		100.00	11.89
177	258896	203697	Roadside		91.67	10.93
178	258986	203684	Roadside		100.00	11.64
180	259064	197781	Roadside		100.00	29.67
182	259050	197790	Roadside		100.00	28.71
183	259036	197795	Roadside		100.00	30.07
197	258797	198701	Roadside		91.67	34.22
198	258811	198701	Roadside		91.67	35.56
199	254703	195764	Roadside		100.00	28.81
201	254522	195859	Roadside		100.00	27.62
206	261565	188211	Roadside		100.00	42.50
207	261561	188222	Roadside		91.67	32.85
208	261541	188215	Roadside		100.00	35.06
209	261534	188198	Roadside		100.00	40.72
210	261516	188207	Roadside		100.00	32.69
211	261501	188188	Roadside		100.00	33.04
212	261486	188200	Roadside		75.00	23.93
213	261490	188186	Roadside		100.00	34.86
214	261315	188193	Roadside		100.00	25.35
215	261299	188191	Roadside		100.00	22.77
216	261276	188190	Roadside		91.67	23.80
238	266902	197660	Roadside		100.00	28.09
239	266181	196022	Roadside		91.67	30.20
240	266169	195995	Roadside		100.00	31.37
241	266159	196013	Roadside		100.00	30.31
242	265655	193423	Roadside		83.33	40.94
243	265474	194949	Roadside		91.67	35.75
244	265466	194930	Roadside	Y	91.67	44.02
245	265448	194922	Roadside	Y	91.67	42.03
246	265425	194927	Roadside		91.67	27.42
247	265394	194899	Roadside	Y	91.67	35.00
248	265342	194894	Roadside		91.67	29.13
249	265326	194871	Roadside	Y	91.67	34.95
250	265274	194867	Roadside		91.67	25.03
251	265263	194845	Roadside	Y	91.67	31.52
252	265226	194830	Roadside	Y	91.67	29.69
253	265194	194833	Roadside		91.67	24.77
254	265142	194816	Roadside		83.33	23.76
255	265098	194825	Roadside		83.33	23.17
256	264995	194777	Roadside		91.67	38.21
258	254906	189110	Roadside		100.00	25.87
265	266375	198023	Roadside		100.00	28.90
267	266382	198028	Roadside		100.00	29.15
268	266419	198053	Roadside		91.67	26.25
271	266879	198078	Roadside		91.67	31.59
272	266888	198074	Roadside		100.00	31.05
275	265658	194856	Roadside	Y	83.33	22.60

Site Name	OS Grid Ref Easting	OS Grid Ref Northing	Site Type	In AQMA?	Data Capture 2014 %	Annual Mean concentrations 2014 (ug/m3) Adjusted for tube bias and distance to receptor (Bias Adjustment factor 2014 = 0.89)
276	265610	194871	Roadside	Y	91.67	34.17
277	265596	194875	Roadside	Y	91.67	36.72
278	265573	194882	Roadside	Y	91.67	36.15
279	265555	194926	Roadside	Y	100.00	49.83
280	265542	194980	Roadside	Y	100.00	41.10
281	265542	194872	Roadside	Y	100.00	33.40
282	265540	194840	Roadside	Y	100.00	32.10
283	265436	195937	Roadside		100.00	29.47
284	265452	195899	Roadside		100.00	32.14
285	266955	197415	Roadside		91.67	32.57
286	266938	197377	Roadside		91.67	34.35
287	265715	193902	Roadside	Y	100.00	29.53
288	265698	193878	Roadside	Y	100.00	31.48
289	265702	193842	Roadside	Y	100.00	32.95
290	263014	195737	Roadside	Y	100.00	26.97
291	267952	193121	Roadside		100.00	39.73
293	262302	196688	Roadside		100.00	19.80
294	262342	196742	Roadside		100.00	23.29
295	258998	198698	Roadside		100.00	30.70
296	259054	198679	Roadside		91.67	35.59
323	266765	193224	Roadside		100.00	33.62
324	269815	197657	Roadside		100.00	28.20

Table 11- Nitrogen Dioxide Passive Diffusion Tube Results 2014

*** 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. These flats are due for completion during 2014/2015, thus site 71 has been corrected back by 10m (see table 8 below)
^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

Ä 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.
*** **Site 295** High Street, Gorseinon is located on a lamppost outside a primary school playground. The intention here is worse case scenario to establish concentrations against the 1-hour objective fronting onto the school playground area
^ See table 12 below for Correction of NO_2 for distance from road

The distance to the nearest receptor location is given in brackets after the site name in table 6. The NO_2 annual mean at the nearest receptor location has been derived following guidance within LAQM.TG.09 box 2.3 page 2-6 and use of the spreadsheet at http://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html (Issue 4 dated 25/01/2011).

The spreadsheet calculator has been setup to work from 0.1 to 50m only. As can be seen from table 11, 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 6 and table 11 indicate two monitoring sites (site 56 and 71) that are utilised to provide an indicative annual mean to the **nearest existing/proposed dwelling** within the development sites. 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. Developments around site 71 continued apace during 2014 and receptor locations were present come the end of 2014 (some not yet occupied). Site 71 is therefore presented as corrected to the proposed nearest dwelling (10m) with site 56 being presented with a corrected annual mean as if it 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 12. Background 1k by 1k NO_2 concentrations (for 2014 based on Background maps base year of 2011) were downloaded from http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011 and overlain on a GIS background map within Quantum GIS v2.4.0 (Chugiak). 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 11 above.

Site ID	Distance of Measurement Site from Kerb	Distance of Receptor from Kerb	NO_2 Background Map Concentration (2014 dataset) ug/m^3	Measured 2014 Annual Mean ug/m^3 Corrected for bias	Predicted Annual Mean at Receptor ug/m^3
*56	2	*166	17.8	35.05	22.0
58	4	8	14.3	33.38	29.7
63	2	6	11.7	24.27	21.0
64	1	3	11.7	45.83	38.3
67	2	5	16.7	40.78	35.6
69	2	4	16.7	44.83	40.3
70	2	7	16.4	28.27	24.8
**71	2	**10	16.4	30.23	25.0
92	1	3	11.7	27.14	23.7
112	1	6	14.3	32.58	26.0
125	1	3	16.7	43.98	37.9
275	1	3	17.0	24.14	22.6
280	1	2	17.0	44.97	41.1
281	1	3	17.0	38.02	33.4
282	1	3	17.0	36.45	32.1
295	1	1.5	11.2	32.49	30.7

Table 12 – Correction of NO_2 for distance from road 2014

* Calculated as if 50m

** Calculated as10m as development due for completion during late 2014/early 2015

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. Due to the aspirations to rejuvenate the city centre it is highly likely that the road infrastructure within the city centre will be significantly altered during the coming years. With the intention of the authority to increase the number of dwellings within the city centre to aid the regeneration of the shopping centre, additional monitoring locations continue to be established to provide the evidence required to feed into the planning process for this initiative.

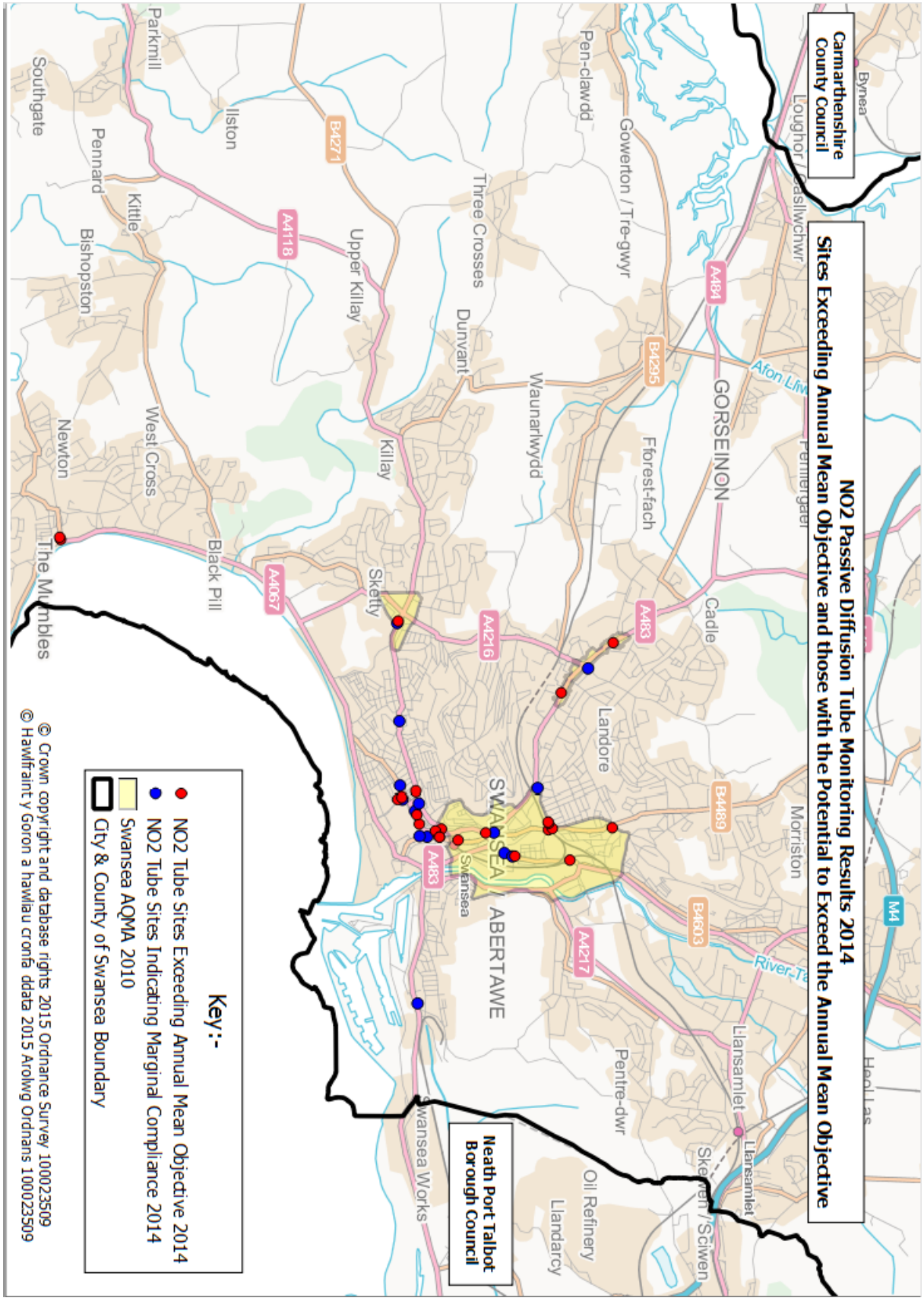
It is thought reasonable to access existing exposure to the 1 hour objective to the general population within the city centre area especially where this exposure can be related to existing external café area type environments. This process will provide valuable information for the limited number of dwellings that already exist within the city centre. 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[21] to assess compliance with the 1 hour objective for NO_2 it is clear from the results within table 11 above, that it is unlikely that the 1 hour objective has been exceeded at any site during 2014 as all bias corrected means are below 60ug/m^3. However, certain sites assessed as part of this process showed an exceedence of the annual mean objective. This information will be relevant to inform the preliminary discussions and task groups that are meeting to produce design briefs for interested developers.

A map of those sites failing the annual mean objective and those with the potential to fail the annual mean objective from the 2013 passive diffusion tube data is given below as map 17.

Sites that have returned the ten highest bias corrected annual means are discussed below. For a greater understanding of conditions affecting the site/location a picture of the surrounding area is included.

[21] http://laqm.defra.gov.uk/documents/NO2relationship_report.pdf



Map 17- *Passive NO_2 Monitoring locations failing or having potential to fail annual mean objective 2014*

Site 121 (2014 annual bias corrected mean of 52.71ug/m^3) 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 6.4% of the flow during 2014. If the total LDV/HGV composition is taken into consideration, the figure rises to 11.7%. The traffic composition 2008-2014 is also shown below within table 13 for information. It may be coincidence that the bias corrected annual mean returned for 2014 shows an increase in concentrations over the past several years that also coincides with an overall increase in both bus composition and total LDV content.

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
2012	50.97	5.3	10.8
2013	50.57	5.9	11.3
2014	52.71	6.4	11.7

Table 13 - Site 121 Annual Bias mean corrected NO2 Passive Diffusion Tubes 2008-2014

On the 7th July 2014, the authority commissioned a real-time Teledyne NO_x analyser located roadside. The site location of the Teledyne NO_x analyser is described above within section 2.1.13. Provisional results between 7th July 2014 and 31st December 2014 are presented above within section 2.2.2 and are for information purposes only at present.

Photo 3 – Station Court, High Street Teledyne NO_x and NO_2 Passive Diffusion Tube Site 121

Site 59 (2014 annual bias corrected mean of 50.28ug/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 DOAS transmitter can be seen to the right of photo 4 below, fixed to the front façade of the property – site 59 is directly opposite in between the Post Office and a terraced property. The junction between Neath Road with Maliphant Street and Aberdyberthi Street are controlled via traffic control signals on each arm of the junction

These signals do hinder traffic flow down Neath Road for relatively few movements emanating from the side junctions. The annual mean returned from the real-time DOAS is 48.99µg/m^3 with only 1 exceedence of the hourly objective being seen within the 250m open path measurement length during 2014. Whilst there has been no exceedence of the 18 permitted 1-hour exceedences during 2014, 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.

Photo 4 – Passive Diffusion Site 59

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. Traffic counters are located to the north (ATC site 18 within section 3) and to the south (ATC site 6 within section 3). The total HGV content of the flows at these sites remains fairly constant at approx 8%.

Site 279 (2014 annual mean 49.83ug/m^3) is located on Llangyfelach Road, Hafod within the existing Swansea AQMA 2010 area. The diffusion tube site is located front façade of the terraced property by the signal crossing. Llangyfelach Road narrows at this location due to the railway bridge carrying the West Wales line. To the north is a junction with Courtney Street that itself has become heavily trafficked by traffic seeking a short cut to Cwmbwrla Roundabout with access to Carmarthen Road and the A483 leading to junction 47 of the M4. Within 20m of this junction of Courtney Street with Llangyfelach Road is a pedestrian crossing. To the south of the site is another junction with Pentremawr Road located approx 50m behind the railway bridge. Pentrehafod Comprehensive is located along Pentremawr Road. The area is heavily congested during the morning and pm periods.

Photo 5 – Passive Diffusion Site 279 Llangyfelach Road

Photo 6 – Courtney Street - View looking north towards sites 244 and 245

During 2014 sites 244 and 245, located front façade of terraced properties along the left of Courtney Street and which are within 80-100m of the junction with Llangyfelach Road, also breached the annual mean objective with bias corrected annual means of 44.02ug/m^3 and 42.03 ug/m^3 respectively - see photo 6 below looking up Courtney Street from its junction with Llangyfelach Road. Both of these sites lie within the Swansea AQMA 2010 area. On the 21st October 2014, the authority located a GPRS Automatic Traffic Counter on this section of Courtney Street, approximately 25m up from the junction with Llangyfelach Road – the ATC loops/site enclosure can be seen to the right front foreground of photo 6. All vehicles are accelerating up the hill leading to sites 244/245 with the

engines under considerable load.

Site 7 Gower Road Sketty (2014 annual bias corrected mean of 48.66ug/m^3) is located front façade to a terraced property close to the mini roundabout junction of Gower Road with De la Beche Road and is shown within photo 7 below.

Photo 7 – Site 7 Gower Road, Sketty

Approximately 200m north is the signal controlled junction at Sketty Cross. Significant congestion can be seen at peak times within the area. A major comprehensive school is located along De La Beche Road with over 1100 pupils on its role. A large proportion of the pupils are from outside of its natural catchment area resulting in pupils either being bussed in or dropped off by their parents. Photo 8 below, looking north towards Sketty Cross signal controlled junction includes a view of the mini roundabout at the junction of Gower Road with De La Beche Road. Site 7 can be seen to the left of photo 8 north of this junction.

Photo 8 – View looking north to site 7

Site 29 Morfa Terrace (B4603 Neath Road) (2014 annual bias corrected mean of 47.36ug/m^3) is located just off the Normandy roundabout, front façade of a terraced property. Photo 9 below is taken from the front façade looking north up the lower Swansea valley towards Normandy roundabout and the dual carriageway A4067

Photo 9 – Site 29 Morfa Terrace

past the Liberty stadium. The Hafod DOAS and passive diffusion tube site 59 are located approximately half a mile to the south of this location on the B4603.

Considerable traffic uses the B4603 past this location into/out of the city centre in preference to the A4607 Cross Valley Link road (to the right of the Liberty Stadium) over Whiterock bridges and down to Quay Parade bridges to access the city centre locations. It is this route that the authority intends to promote further as part of the Nowcaster forecast model project in preference to the B4603 route. However, old habits die hard as despite continual delays along the B4603 through the Hafod area of the city, motorists persist with this route into/out of the city centre.

Site 120 (2014 annual bias corrected mean of 47.24ug/m^3) is located along Orchard Street on the inner approaches to the city centre. Orchard Street is heavily trafficked and subject to congestion on the inbound lanes during the majority of the day. An outbound lane on the other side of the dual carriageway serves mainly service buses and the Metro Service. The inbound lanes receive traffic direct from the Dyfatty interchange leading from the Hafod and A483 Carmarthen Road. ATC site 7 Dyfatty Street is a proxy for this location for an indication of AADT flows (slight increase is received from High Street direction and Plymouth Street) which during 2014 was approximately 10,270 vehicles per day.

Photo 10 – View from site 120 Orchard Street

HGV content of the flow is given as 4.7% with buses 0.2% but the bus data is unreliable as the majority of buses enter Orchard Street via High Street and not from Dyfatty Street. Cars/light vans dominate the composition and account for over 94% of the flow. Photo 10 above is taken looking from tube site 120 towards a block of new flats. Unfortunately, there were no suitable direct monitoring points suitable on the flats front façade. However, additional monitoring points commencing January 2015 have now been located on the signal controls themselves as they are the nearest possible monitoring point to this new receptor location. The annual mean result for 2015 will be bias corrected and then back corrected to front façade of the flats.

The authority are aware of development proposals along Orchard Street as part of the initiative to redevelop the city centre and as such further monitoring locations have been established during 2015.

Site 123 High Street (2014 annual bias corrected mean of 47.00ug/m^3) lies just outside of the existing Swansea AQMA 2010. Within the USA 2012 submitted by the authority is was mentioned that whilst discussions had commenced with the Housing Association that manage a sheltered youth residence which forms the frontage to passive diffusion tube site 123 on High Street, that due to the budget restraints imposed, there was no budget to purchase either the required enclosure or Teledyne NO_x analyser. However, funding has now been obtained but due to siting problems/issues the funding has been used to site a real-time chemiluminescent analyser to the northern section of High Street outside passive diffusion tube site 121 (see section 2.1.13 above).

Photo 11 – Middle section of High Street showing passive diffusion tube site 123 and surrounding locale.

The authority is aware of further and additional preliminary proposals for redevelopment of old commercial premises at several locations in this vicinity as well as being aware of the developments along the lower section of High Street. These developments revolve around the desire to increase the footfall within the city centre.

Details of the Urban Village development seen to the right of photo 11can be found in section 5.2.10 of the Progress Report 2011 (http://www.swansea.gov.uk/media/pdf/d/4/Progress_Report_2011.pdf) but 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.

Site 18 (2014 annual mean 45.85ug/m^3) is located front façade on a mid terraced property at Cwm Level Road, Brynhyfryd, approximately 50m from the signal controlled junction at Brynhyfryd Square with Llangyfelach Road and Penfilia Road.

Photo 12 – Passive Diffusion Site 18 Cwm Level Road

The site is just within the boundary of the existing Swansea AQMA 2010. ATC site 2 is located several hundred meters away on Cwm Level Road opposite Cwm Level Park and is relevant for this tube location. ATC site 2 has an AADT during 2014 of 14,208.

Traffic queues along all arms of the signal controlled junction with significant queuing during peak times. Photo 12 shows a view down Cwm Level Road from Brynhyfryd Square. Llangyfelach Road runs left/right through the photo with Penfilia Road behind and to the left of the view

Site 131 (2014 annual bias corrected mean of 44.79ug/m^3) and **site 134** (2014 annual bias corrected mean of 42.65ug/m^3) are located along Dillwyn Street in the heart of the city centre and are intended to assess concentrations against the 1-hour NO_2 objective as no residential dwellings are known to exist within this section of Dillwyn Street. However, café type environments do exist at locations within 10m of the monitoring sites with outside seating for clientele provided adjacent to the busy carriageway as shown within photo 13 below.

Photo 13– Café type street scene Dillwyn Street

There are additional café type environments to the north of the photo to the other side of the junction where a Mediterranean style restaurant provides its clientele with outside seating during good weather. Immediately behind/south of photo 13 is yet another café type environment, again located roadside at the signal controlled junction of The Kingsway with Dillwyn Road/St Helens Road. Clientele are again provided with outside seating areas during good weather to consume not only food/coffee/tea etc but also alcoholic beverages. This location is shown below as photo 14.

Photo 14 – Café environment Kingsway/Dillwyn Street

However, as NO_2 passive diffusion tube concentrations during 2014 have not exceeded 60ug/m^3 there are therefore, no relevant receptor locations present, as the hourly NO_2 objective is unlikely to have been breached[22].

The above statement will change in the near future as the former office accommodation above the café type environment seen within photo 14 above has been identified for change of use to dwellings as part of the initiative to increase footfall within the city centre. Obviously, when this initiative is realised there will be receptor locations subject to the NO_2 annual mean objective within this local.

Site 127 (2014 annual bias corrected mean of 44.26ug/m^3) is located along the Kingsway in the heart of the city centre and was originally intended to assess concentrations against the 1-hour NO_2 objective. A café type environment exists within 10m of the monitoring site with outside seating for cliental provided adjacent to the busy carriageway as shown below within photo 15

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

Photo 15 – Passive Diffusion Tube site 127 The Kingsway

In addition, the upper floors of a commercial building virtually opposite the site have recently been converted into student accommodation and can be seen to the right of photo 15 above the bus stops. No monitoring is possible in this location due to a canopy extending over the retail food outlet. The former Kingsway Post Office building is located the same side of the carriageway as site 127 and is approximately 30 meters to the north. This building has also been converted into flats during 2012. It can be argued therefore that relevant exposure to the annual mean objective exists in this locale. Monitoring did not commence façade of the new flats during 2014 due to operational issues as indicated it would, within the Progress Report 2013/14. It is envisaged that this monitoring will commence during 2015 following a review of diffusion tube locations due to the city centre initiative mentioned elsewhere within this report.

A few other sites that have previously been highlighted within reporting are mentioned below as way of an update to that previous reporting.

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 when monitoring first commenced. 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 16 – 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.

Photo 17 – View looking north up 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 18) do not suffer from a similar situation, with sites 206, 209 and 211 and 213.

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 208 and 210. It was further reported that exceedences observed at sites on the opposite side of the road (left of photo 16 above) 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 2012 indicated that sites 206 and 207 were exceeding the annual mean objective with sites 208 and 209 being within 3ug/m^3 of exceeding the annual mean objective so in practical terms they were also taken to exhibit probable exceedence of the annual mean objective. Results from 2013 indicated that sites 206 (41.55ug/m^3) and site 209 (41ug/m^3) were exceeding the annual mean. All other sites along Newton Road indicated full compliance with the annual mean objective during 2013. It is interesting to note that once again, it is only those sites not directly under the commercial premises canopy that exceeded the annual mean objective during 2013.

Monitoring undertaken during 2014 indicate that sites 206 (42.5ug/m^3) and 209 (40.72ug/m^3) continue to exceed the annual NO_2 annual mean objective. Both of these sites are located to the left of Newton Road and are not influenced by poor dispersion underneath the canopy to the commercial premises.

Table 14 below summarises the annual mean concentrations at sites 206-213 since monitoring began in 2010. There is a pronounced overall downward trend at all sites, with, it can be argued, sites 206 and 209 now only marginally failing the annual mean objective. With this in mind, and in anticipation of the overall downward trend continuing to be seen in future years, it is proposed to adopt a “do nothing” attitude in respect of declaration of an AQMA certainly in the immediate future. However, the authority intends to introduce a Traffic Regulation Order to prohibit delivery of goods to the commercial premises along Newton Road during the peak hours of the day (morning, lunch and evening). Observations have established that indiscriminate parking of delivery vehicles inside and outside of the designated loading bay area’s causes considerable congestion and prevents private car parking within the designated parking areas. Photos 18 and 19 below, show typical conditions between 10am and 11am most mornings outside the commercial premises on Newton Road.

Photo 18 – Typical mid-morning conditions Newton Road

Photo 19 – Typical mid-morning conditions Newton Road

An update on the effectiveness of this measure will be available once the monitoring results for 2015 are available.

Site ID	Annual mean concentrations(mg / m^3) Adjusted for bias				
	2010	2011	2012	2013	2014
206	**51.37**	**47.05**	**45.60**	**41.55**	**42.50**
207	**45.70**	34.51	**41.17**	33.84	32.85
208	**46.18**	**37.59**	**37.48**	36.56	35.06
209	**46.87**	**44.72**	**39.40**	**41.00**	**40.72**
210	**43.61**	31.66	34.47	33.58	32.69
211	**39.49**	34.34	35.45	33.17	33.04
212	27.40	27.04	27.18	25.63	23.93
213	**40.24**	**37.79**	35.09	33.37	34.86

Table 14 – NO_2 annual means Newton Road 2010-2014

It is thought worthwhile to provide an update on site 291 (Vale of Neath Road) as within the Progress Report 2014 it was reported that the site had exceeded the annual mean objective. Data from 2014 is now indicating marginal compliance with a bias corrected annual mean of 39.73ug/m^3 (2013 annual bias corrected mean of 43.73ug/m^3). The site is located on the outbound A483 towards junction 42 of the M4, front facade of a terraced property that is within 4 meters of the A483 and close to a bus stop and is shown below to the right within photo 20.

Photo 20 – Site 291 Vale of Neath A483

It should be noted that few scheduled services stop and use the pull in lay- by 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 tube site 48 at Bevans Row. It is curious that during 2013 free flow conditions outside site 291 resulted in an exceedence of the annual mean objective whilst queuing traffic past site 48 Bevans Row resulted in compliance with the objective. Both sites are now indicating compliance with the annual mean objective during 2014. Some work has been undertaken on the phasing of the nearby signal controlled junction but at present it is too early to form any conclusions if this measure has improved conditions.

It was reported within the authorities Progress Report 2013 that the number of passive NO_2 diffusion tube locations along Bevans Row would increase to verify the findings. Unfortunately, due to operational issues this has not happened. However, it is now proposed to establish a real-time monitoring station at Bevans Row, in part due to the anticipated increase in HDV traffic resulting from the proposal to develop part of Swansea Bay as a tidal lagoon. This site is anticipated to be commissioned during May 2015 and will measure $PM_{2.5}$, PM_{10}, NO_x, NO, NO_2, CO and SO_2

Table 15 below details the annual NO_2 bias corrected annual means for sites 1-323 between 2008-2014. Those sites that have been decommissioned have been removed from the 2014 dataset reported (see also table 3). Whilst there is evidence of a slight overall downward trend with annual mean concentrations between 2008 and 2014, numerous sites still exhibit a breach of the annual mean objective with numerous others 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 2014 passive diffusion tube data is given above as map 17.

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations (mg / m^3) Adjusted for bias						
				2008	2009	2010	2011	2012	2013	2014
1	262046	196420		24.2	25.42	30.83	27.35	25.18	24.38	22.14
4	262497	192857	Y	30.8	33.25	35.07	29.97	29.73	29.92	29.78
5	262548	192943	Y	32.2	34.22	42.06	33.42	34.06	34.78	32.46
6	262612	192995	Y	29.8	28.71	34.62	29.29	29.20	30.65	28.52
7	262691	192852	Y	48.5	53.02	58.76	50.93	49.39	46.74	48.66
8	262990	195820	Y	42.4	44.59	46.81	41.81	41.80	44.77	41.76
9	263190	195205		28.6	29.00	31.41	27.65	26.63	30.03	27.89
10	263219	195513	Y	24.2	26.03	29.98	25.28	23.40	25.29	24.97
11	263344	195474	Y	37.8	37.08	43.92	37.21	34.03	39.45	37.58
12	263680	195103	Y	40.7	43.92	48.15	43.96	43.20	40.22	42.78
13	264830	193066		28.9	29.90	32.83	28.03	28.99	29.30	27.78
14	265285	192696		25.2	25.23	32.66	26.99	25.57	28.69	24.30
15	265334	192608		26.1	25.73	32.76	27.33	26.69	26.91	24.45
16	265339	192534		30.7	30.73	38.61	30.85	30.41	31.63	28.61
18	265526	195807	Y	44.9	47.87	51.23	49.10	44.74	47.01	45.85
19	265597	194061	Y	42.6	44.92	52.20	45.84	45.33	43.75	42.61
20	265594	194175	Y	39.9	42.42	45.51	37.41	36.65	36.50	37.74
21	265634	195316	Y	31.7	32.04	33.65	30.62	30.57	30.04	27.96
22	265682	195374	Y	35.7	34.57	37.93	33.73	31.23	33.89	31.43
23	265728	195494	Y	34.1	33.57	36.53	33.97	33.18	30.93	28.49
25	265845	195547	Y	27.7	29.82	31.43	28.91	28.83	27.88	27.06
26	265876	194318	Y	41.7	40.20	45.81	40.78	40.31	39.11	38.59
27	265922	194428	Y	37.8	43.14	45.39	39.95	37.05	38.03	39.25
28	265949	194891	Y	29.4	30.18	33.48	30.29	30.11	28.30	28.21
29	265973	195222	Y	56.3	52.00	53.38	53.48	47.60	43.86	47.36
31	266153	196003		32.4	32.39	37.79	31.70	33.26	30.81	31.70
32	266209	193867		31.3	32.11	38.82	33.24	31.53	35.24	33.38
33	266236	193488		31.0	30.86	38.09	32.11	32.59	31.09	31.33
34	266272	196168		32.7	31.18	39.60	34.47	31.39	31.11	29.80
35	266314	193298		35.9	36.23	40.67	40.39	33.46	31.27	32.21
36	266455	193300		31.0	30.03	34.42	33.58	31.65	30.12	27.49
38	266662	193181		33.1	35.34	39.05	37.23	35.40	33.56	31.05
40	266951	198278		28.2	28.71	31.80	27.77	30.47	28.19	27.42
41	266953	198085		37.3	41.59	41.38	40.54	38.32	36.54	35.33
43	267093	198063		34.4	36.19	42.60	34.88	38.01	38.62	36.22
44	267639	199543		29.0	29.71	28.37	30.01	28.67	25.69	27.35
45	267661	199451		35.5	37.79	43.87	33.82	33.84	32.06	30.78
48	268011	193101		25.2	23.88	27.08	23.98	23.52	23.43	21.72
49	268501	197329		29.6	29.43	32.35	28.28	26.67	27.74	26.77
50	268530	197419		35.3	37.99	41.14	35.38	33.84	32.89	36.43
51	268593	197434		32.2	30.98	34.19	30.31	30.54	27.94	28.81
54	268693	197416		34.6	35.44	33.14	36.31	34.66	31.88	33.93
55	268789	197420		35.3	33.50	36.93	36.10	33.36	32.39	32.31
56 *	269306	198661		23	22.80	22.4	21.70	22.30	21.20	22.00
58	264052	192884		33.6	34.90	41.7	32.50	37.90	32.50	29.70
59	265918	194463	Y	53.9	49.76	60.33	53.98	53.85	47.99	50.28
60	265036	192931		37.1	35.30	42.75	39.62	35.74	35.71	34.21
61	264959	192878		38.0	38.24	40.21	38.82	40.07	36.45	38.16
63	262675	192775	Y	21.6	22.00	25.9	23.20	21.80	22.10	21.00
64	262719	192840	Y	42.4	40.10	44.9	39.01	40.50	38.90	38.30
65	262735	192855	Y	27.0	26.47	29.59	25.49	24.69	22.92	24.77

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations (mg / m^3) Adjusted for bias						
				2008	2009	2010	2011	2012	2013	2014
66	262802	192829	Y	32.8	30.98	36.04	30.52	31.62	29.11	26.45
67	265903	193683	Y	38.2	39.80	46.3	39.40	35.40	36.20	35.60
68	265573	193432		34.4	34.64	41.51	39.26	39.68	35.72	36.13
69	265543	193450		42.1	43.60	50.9	40.80	42.30	36.70	40.30
70	266649	195435		23.3	22.90	25.7	24.40	24.30	24.30	24.80
71 **	266514	195485		19.9	19.80	20.9	20.10	23.40	29.00	25.00
72	264091	192900		25.1	23.86	31.40	25.52	25.53	24.91	23.58
73	264138	192868		34.0	34.62	35.36	33.17	33.09	28.81	29.60
74	264163	192853		28.9	28.76	32.85	28.19	29.01	26.65	28.41
75	264072	192869		35.1	42.09	45.19	42.01	41.09	38.41	39.99
76	263968	192880		26.1	26.30	31.70	27.01	27.86	27.76	27.61
78	263819	192948		27.5	27.83	33.17	29.09	29.80	27.88	25.69
79	263842	192896		33.0	33.95	37.13	36.77	31.84	31.04	30.07
83	262785	192838	Y	29.8	28.60	35.51	30.58	30.36	30.33	27.41
84	262714	192839	Y	37.3	37.57	39.42	36.44	36.82	32.73	35.13
85	262702	192847	Y	38.6	39.58	41.89	38.05	39.19	36.24	35.62
86	262704	192865	Y	30.8	28.90	33.25	27.94	29.33	28.18	25.51
87	262697	192798	Y	21.3	21.16	23.93	22.23	22.26	22.11	20.80
88	262605	192916	Y	37.3	35.21	38.27	32.19	33.63	30.73	28.21
89	262587	192956	Y	22.4	24.17	25.99	23.12	22.37	21.26	20.12
90	262631	192996	Y	34.2	35.74	37.93	34.43	32.77	33.29	32.61
91	262534	192950	Y	31.7	30.62	37.50	32.73	30.20	30.68	29.28
92	262545	192869	Y	32.0	34.62	33.7	28.70	26.10	27.10	23.70
93	263406	195534		29.9	30.94	33.38	31.39	27.27	29.25	29.21
94	263444	195572		29.6	31.05	30.34	29.38	28.63	28.26	28.09
95	262815	196090		29.1	28.88	34.29	28.64	26.57	25.85	25.23
96	262922	195950		27.9	28.99	31.05	29.46	25.87	27.50	26.20
97	262946	195902	Y	36.6	33.84	39.95	35.00	34.78	32.92	31.62
98	263142	195548	Y	40.5	40.62	41.01	37.29	36.92	36.67	36.21
99	263387	195332	Y	32.5	29.16	37.64	30.58	30.27	31.83	32.73
100	263470	195250	Y	28.7	28.13	31.78	26.06	27.97	27.43	24.02
101	263843	195047	Y	29.8	28.27	30.97	27.26	27.17	25.34	23.31
102	266379	193307		29.4	29.99	33.13	29.54	29.66	28.70	27.96
103	268526	197359		33.4	31.06	35.11	32.42	29.46	29.12	33.45
104	268538	197389		29.4	28.41	31.70	28.55	28.24	27.86	27.70
105	268562	197472		32.3	30.11	30.33	28.90	29.24	27.96	29.81
106	268496	197476		33.8	33.64	34.66	33.38	29.44	29.18	28.90
107	268765	197420		35.0	34.27	36.16	33.53	33.99	31.01	32.23
108	267608	199461		31.4	30.10	35.76	30.58	29.46	29.75	28.72
109	267510	199487		28.1	27.06	32.44	25.12	25.85	27.14	26.43
110	267369	199521		27.7	26.18	30.46	26.34	28.57	26.66	25.75
111	267705	199426		32.9	30.63	34.62	28.70	30.38	29.40	27.15
112	264868	192814		26.0	26.20	30.3	27.90	28.10	27.30	32.58
113	264654	192662		21.8	28.76	36.16	31.18	30.42	28.79	26.60
114	264622	192971		32.5	33.19	33.92	29.99	29.07	29.70	30.07
115	265031	193097		38.8	40.48	45.67	41.44	41.89	37.57	40.40
116	265192	193138		41.5	42.87	48.73	41.92	41.49	38.43	38.73
117	265288	193211		39.4	38.32	47.27	39.71	39.32	36.61	35.30
Ä118	265483	193385		29.3	32.02	38.58	32.96	31.76	29.18	29.33
119	265522	193390		32.2	35.43	40.81	36.56	31.75	32.51	34.78
120	265570	193366		46.5	44.16	57.75	51.29	44.81	44.94	47.24

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations (mg / m^3) Adjusted for bias						
				2008	2009	2010	2011	2012	2013	2014
121	265706	193662	Y	79.3	61.19	52.33	52.71	50.97	50.57	52.71
122	265694	193505		39.5	37.21	47.39	37.12	34.42	32.49	34.83
123	265655	193423		54.4	51.27	51.80	50.96	48.75	46.55	47.00
Ä124	265651	193253		44.1	46.68	51.72	45.58	41.93	36.50	38.43
Ä125	265641	193162		51.4	59.48	50.5	42.10	41.80	36.20	37.90
Ä126	265475	193144		38.9	48.41	62.03	41.96	41.64	40.71	40.64
Ä127	265348	193110		40.9	37.71	61.83	56.19	48.72	45.01	44.26
Ä128	265297	193085		41.1	42.82	51.71	42.37	43.18	40.36	38.82
Ä129	265153	193098		36.1	35.34	40.51	35.42	34.74	36.50	32.56
Ä130	265139	192912		53.5	42.92	43.92	43.32	42.05	41.29	39.17
131	265137	192846		58.3	46.69	50.19	46.62	45.86	44.33	44.79
132	265229	192753		32.7	32.39	39.43	36.82	34.97	33.81	27.11
133	265350	192566		26.8	27.05	33.15	30.34	21.46	26.57	25.28
Ä134	265113	192903		50.5	45.02	47.74	49.41	45.67	44.54	42.65
^136	262612	192995	Y	-	-	33.32	28.09	27.59	28.71	25.53
^137	262631	192996	Y	-	-	37.13	34.46	32.39	32.17	32.63
138	266779	199246		-	-	26.22	24.16	22.58	22.47	22.01
139	266867	199030		-	-	31.87	28.29	27.75	28.04	27.04
140	266863	199009		-	-	39.36	35.01	33.92	33.43	29.12
141	266979	198772		-	-	30.00	28.55	26.27	27.05	25.84
142	267017	198710		-	-	33.45	30.65	28.80	27.07	24.85
143	267089	198608		-	-	37.32	32.94	31.52	29.77	30.29
144	267141	198591		-	-	30.26	27.30	27.80	27.71	27.05
145	267139	198578		-	-	33.83	33.47	30.31	28.77	28.27
146	267156	198571		-	-	35.76	34.62	33.13	29.10	32.28
147	267165	198580		-	-	32.97	28.21	28.97	32.24	33.79
148	267170	198564		-	-	33.86	31.33	29.82	31.46	32.05
149	267204	198561		-	-	31.17	27.11	26.36	26.77	26.66
150	267205	198545		-	-	31.42	29.50	28.45	28.45	27.63
151	267192	198518		-	-	30.92	27.01	27.14	28.18	25.59
155	269009	201280		-	-	30.76	28.36	30.05	28.11	26.20
156	269059	201296		-	-	31.79	29.51	29.16	28.29	27.61
158	269480	201441		-	-	30.89	28.37	29.24	27.30	24.62
159	269171	201620		-	-	31.63	30.26	29.42	27.56	26.98
160	269049	201744		-	-	34.94	34.35	34.73	32.80	31.97
162	259553	203379		-	-	31.59	26.12	28.89	28.84	24.40
163	259287	203556		-	-	27.11	22.72	22.48	24.82	21.18
164	259195	203667		-	-	31.90	28.99	28.70	28.52	25.02
165	259149	203675		-	-	24.52	23.86	20.70	22.16	19.94
166	259148	203690		-	-	28.89	23.99	24.26	23.40	22.10
167	259126	203700		-	-	25.73	23.83	23.16	23.59	19.93
168	259115	203705		-	-	23.26	22.49	21.74	22.72	19.82
169	259013	203747		-	-	24.97	26.06	21.04	21.12	19.17
170	258971	203797		-	-	19.95	18.43	17.57	16.24	16.28
171	258917	203826		-	-	28.08	28.14	24.14	22.48	23.18
172	258887	203859		-	-	26.00	28.36	26.56	23.04	23.98
173	259250	203708		-	-	20.96	19.35	19.58	17.96	17.16
174	259253	203660		-	-	19.60	16.46	16.57	15.00	14.47
175	259251	203638		-	-	18.05	20.68	15.11	15.54	13.31
176	258872	203691		-	-	15.00	12.98	12.67	14.85	11.89
177	258896	203697		-	-	14.87	13.29	14.14	12.93	10.93

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations (mg / m^3) Adjusted for bias						
				2008	2009	2010	2011	2012	2013	2014
178	258986	203684		-	-	14.94	14.74	12.85	12.59	11.64
180	259064	197781		-	-	32.43	32.49	31.00	30.35	29.67
182	259050	197790		-	-	30.96	29.37	27.58	28.15	28.71
183	259036	197795		-	-	34.37	32.08	31.04	30.34	30.07
197	258797	198701		-	-	38.71	33.73	35.24	32.92	34.22
198	258811	198701		-	-	38.49	36.97	36.45	35.17	35.56
199	254703	195764		-	-	34.16	29.05	29.53	29.20	28.81
201	254522	195859		-	-	30.47	28.39	28.60	26.31	27.62
206	261565	188211		-	-	51.37	47.05	45.60	41.55	42.50
207	261561	188222		-	-	45.70	34.51	41.17	33.84	32.85
208	261541	188215		-	-	46.18	37.59	37.48	36.56	35.06
209	261534	188198		-	-	46.87	44.72	39.40	41.00	40.72
210	261516	188207		-	-	43.61	31.66	34.47	33.58	32.69
211	261501	188188		-	-	39.49	34.34	35.45	33.17	33.04
212	261486	188200		-	-	27.40	27.04	27.18	25.63	23.93
213	261490	188186		-	-	40.24	37.79	35.09	33.37	34.86
214	261315	188193		-	-	30.17	25.36	25.39	26.77	25.35
215	261299	188191		-	-	28.61	22.93	23.66	23.55	22.77
216	261276	188190		-	-	30.74	25.94	26.07	26.38	23.80
238	266902	197660		-	-	36.38	32.78	33.13	29.82	28.09
239	266181	196022		-	-	37.70	33.64	31.18	30.10	30.20
240	266169	195995		-	-	40.14	36.36	34.40	32.87	31.37
241	266159	196013		-	-	36.92	31.39	33.21	31.60	30.31
242	265655	193423		-	-	45.21	46.01	44.28	41.47	40.94
243	265474	194949		-	-	41.64	33.82	37.40	35.86	35.75
244	265466	194930	Y	-	-	47.92	38.33	43.78	40.14	44.02
245	265448	194922	Y	-	-	49.14	41.03	41.93	39.87	42.03
246	265425	194927		-	-	33.12	26.92	28.67	26.68	27.42
247	265394	194899	Y	-	-	39.76	35.47	29.76	32.88	35.00
248	265342	194894		-	-	31.71	25.22	27.35	27.71	29.13
249	265326	194871	Y	-	-	40.58	33.94	34.74	31.91	34.95
250	265274	194867		-	-	32.99	28.20	27.17	27.45	25.03
251	265263	194845	Y	-	-	38.17	30.76	31.94	33.95	31.52
252	265226	194830	Y	-	-	33.69	31.94	30.52	29.36	29.69
253	265194	194833		-	-	29.98	24.59	25.10	23.76	24.77
254	265142	194816		-	-	30.41	23.45	25.48	24.55	23.76
255	265098	194825		-	-	29.09	24.86	21.69	24.37	23.17
256	264995	194777		-	-	45.60	39.81	40.14	37.41	38.21
258	254906	189110		-	-	31.14	26.30	28.30	26.12	25.87
265	266375	198023		-	-	33.26	31.81	29.04	27.65	28.90
267	266382	198028		-	-	32.14	30.76	28.27	28.08	29.15
268	266419	198053		-	-	31.05	29.00	25.78	26.12	26.25
271	266879	198078		-	-	35.52	32.38	30.44	28.24	31.59
272	266888	198074		-	-	36.22	28.91	32.56	30.54	31.05
275	265658	194856	Y	-	-	-	26.00	25.20	24.50	22.60
276	265610	194871	Y	-	-	-	36.03	32.51	34.16	34.17
277	265596	194875	Y	-	-	-	37.05	39.35	34.23	36.72
278	265573	194882	Y	-	-	-	39.11	34.70	35.86	36.15
279	265555	194926	Y	-	-	-	50.24	55.51	47.59	49.83
280	265542	194980	Y	-	-	-	37.90	40.80	39.60	41.10
281	265542	194872	Y	-	-	-	36.00	36.70	36.50	33.40

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations (mg / m^3) Adjusted for bias						
				2008	2009	2010	2011	2012	2013	2014
282	265540	194840	Y	-	-	-	33.80	35.70	32.20	32.10
283	265436	195937		-	-	-	30.35	31.51	29.20	29.47
284	265452	195899		-	-	-	33.28	32.62	32.49	32.14
285	266955	197415		-	-	-	**37.51**	33.41	34.23	32.57
286	266938	197377		-	-	-	36.68	34.27	31.77	34.35
287	265715	193902	Y	-	-	-	30.76	29.72	31.87	29.53
288	265698	193878	Y	-	-	-	33.38	32.86	32.29	31.48
289	265702	193842	Y	-	-	-	**37.33**	35.86	34.15	32.95
290	263014	195737	Y	-	-	-	27.86	27.88	29.08	26.97
291	267952	193121		-	-	-	**41.79**	**45.22**	**43.73**	**39.73**
293	262302	196688		-	-	-	-	18.26	21.99	19.80
294	262342	196742		-	-	-	-	25.18	25.26	23.29
295	258998	198698		-	-	-	-	29.33	29.80	30.70
296	259054	198679		-	-	-	-	31.61	35.06	35.59
323	266765	193224		-	-	-	-	-	32.16	33.62
324	269815	197657		-	-	-	-	-	-	28.20

Table 15 – NO_2 Annual Mean concentrations 2008- 2014

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. As noted above, the supporting adjustment factor table has been updated in recent years with the latest update being published during June 2014. This revision of the adjustment factors now includes factors where the HDV content is <=10% and where HDV >=10% elsewhere in the UK meaning outside of London. It is the latest revision of the adjustment factors dated 19th June 2014 that have been used in the future projections within table 16 below.

The location of passive nitrogen dioxide tubes has been cross referenced with the GPRS ATC's operated by the authority. From the annual traffic data the % HDV flow has been calculated from the EUR6 classified data for each site. HDV in this instance is therefore defined within Swansea as Heavy Van, Mini bus. LGV,MGV,HGV, Articulated lorry, HGV+Trailer and Bus.

The only ATC site in Swansea where the HDV content (as described above) exceeds 10% and which is close to passive nitrogen dioxide tube monitoring is at site 22 High Street, Swansea where the figure is 11.7%. Therefore, the future year projections made for sites 121, 122, 124, 125, 242, 287, 288 and 289 which are sited along High Street and Castle Gardens use the factors associated with the >=10% elsewhere UK category.

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Future Years Projections – Rounded to nearest whole number in ug/m^3 LAQM.TG(09) June 2014 revised method						
				2015	2016	2017	2018	2019	2020	2025
1	262046	196420		22	21	20	19	17	16	14
4	262497	192857	Y	29	28	26	25	23	22	19
5	262548	192943	Y	32	30	29	27	26	24	20
6	262612	192995	Y	28	27	25	24	22	21	18
7	262691	192852	Y	48	46	43	41	38	36	31
8	262990	195820	Y	41	39	37	35	33	31	26
9	263190	195205		28	26	25	23	22	21	17
10	263219	195513	Y	25	23	22	21	20	18	16
11	263344	195474	Y	37	35	33	32	30	28	24
12	263680	195103	Y	42	40	38	36	34	32	27
13	264830	193066		27	26	25	23	22	21	17
14	265285	192696		24	23	22	20	19	18	15
15	265334	192608		24	23	22	20	19	18	15
16	265339	192534		28	27	25	24	23	21	18
18	265526	195807	Y	45	43	41	38	36	34	29
19	265597	194061	Y	42	40	38	36	34	31	27
20	265594	194175	Y	37	35	34	32	30	28	24
21	265634	195316	Y	28	26	25	23	22	21	18
22	265682	195374	Y	31	30	28	26	25	23	20
23	265728	195494	Y	28	27	25	24	22	21	18
25	265845	195547	Y	27	25	24	23	21	20	17
26	265876	194318	Y	38	36	34	32	30	29	24
27	265922	194428	Y	39	37	35	33	31	29	25
28	265949	194891	Y	28	26	25	24	22	21	18
29	265973	195222	Y	47	44	42	40	37	35	30
31	266153	196003		31	30	28	27	25	23	20
32	266209	193867		33	31	30	28	26	25	21
33	266236	193488		31	29	28	26	25	23	20
34	266272	196168		29	28	26	25	24	22	19
35	266314	193298		32	30	29	27	25	24	20
36	266455	193300		27	26	24	23	22	20	17
38	266662	193181		31	29	28	26	24	23	19
40	266951	198278		27	26	24	23	22	20	17
41	266953	198085		35	33	31	30	28	26	22
43	267093	198063		36	34	32	30	29	27	23
44	267639	199543		27	26	24	23	22	20	17
45	267661	199451		30	29	27	26	24	23	19
48	268011	193101		21	20	19	18	17	16	14
49	268501	197329		26	25	24	22	21	20	17
50	268530	197419		36	34	32	31	29	27	23
51	268593	197434		28	27	26	24	23	21	18
54	268693	197416		34	32	30	28	27	25	21
55	268789	197420		32	30	29	27	25	24	20
56	269306	198661		22	21	20	18	17	16	14
58	264052	192884		29	28	26	25	23	22	19
59	265918	194463	Y	50	47	45	42	40	37	32
60	265036	192931		34	32	30	29	27	25	21
61	264959	192878		38	36	34	32	30	28	24
63	262675	192775	Y	21	20	19	18	17	16	13
64	262719	192840	Y	38	36	34	32	30	28	24
65	262735	192855	Y	24	23	22	21	20	18	16

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Future Years Projections – Rounded to nearest whole number in ug/m^3 LAQM.TG(09) June 2014 revised method						
				2015	2016	2017	2018	2019	2020	2025
66	262802	192829	Y	26	25	23	22	21	20	17
67	265903	193683	Y	35	33	32	30	28	26	22
68	265573	193432		36	34	32	30	28	27	23
69	265543	193450		40	38	36	34	32	30	25
70	266649	195435		25	23	22	21	20	18	16
71	266514	195485		25	23	22	21	20	18	16
72	264091	192900		23	22	21	20	19	17	15
73	264138	192868		29	28	26	25	23	22	19
74	264163	192853		28	27	25	24	22	21	18
75	264072	192869		40	38	36	34	32	30	25
76	263968	192880		27	26	25	23	22	20	17
78	263819	192948		25	24	23	22	20	19	16
79	263842	192896		30	28	27	25	24	22	19
83	262785	192838	Y	27	26	24	23	22	20	17
84	262714	192839	Y	35	33	31	29	28	26	22
85	262702	192847	Y	35	33	32	30	28	26	22
86	262704	192865	Y	25	24	23	21	20	19	16
87	262697	192798	Y	21	20	18	17	16	15	13
88	262605	192916	Y	28	26	25	24	22	21	18
89	262587	192956	Y	20	19	18	17	16	15	13
90	262631	192996	Y	32	31	29	27	26	24	20
91	262534	192950	Y	29	27	26	25	23	22	18
92	262545	192869	Y	23	22	21	20	19	18	15
93	263406	195534		29	27	26	24	23	22	18
94	263444	195572		28	26	25	24	22	21	18
95	262815	196090		25	24	22	21	20	19	16
96	262922	195950		26	25	23	22	21	19	16
97	262946	195902	Y	31	30	28	27	25	23	20
98	263142	195548	Y	36	34	32	30	29	27	23
99	263387	195332	Y	32	31	29	27	26	24	21
100	263470	195250	Y	24	23	21	20	19	18	15
101	263843	195047	Y	23	22	21	20	18	17	15
102	266379	193307		28	26	25	23	22	21	18
103	268526	197359		33	31	30	28	26	25	21
104	268538	197389		27	26	25	23	22	20	17
105	268562	197472		29	28	26	25	24	22	19
106	268496	197476		29	27	26	24	23	21	18
107	268765	197420		32	30	29	27	25	24	20
108	267608	199461		28	27	26	24	23	21	18
109	267510	199487		26	25	23	22	21	20	17
110	267369	199521		25	24	23	22	20	19	16
111	267705	199426		27	25	24	23	21	20	17
112	264868	192814		32	31	29	27	26	24	20
113	264654	192662		26	25	24	22	21	20	17
114	264622	192971		30	28	27	25	24	22	19
115	265031	193097		40	38	36	34	32	30	25
116	265192	193138		38	36	34	32	31	29	24
117	265288	193211		35	33	31	30	28	26	22
118	265483	193385		29	28	26	25	23	22	18
119	265522	193390		34	33	31	29	27	26	22
120	265570	193366		47	44	42	40	37	35	30

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Future Years Projections – Rounded to nearest whole number in ug/m^3 LAQM.TG(09) June 2014 revised method						
				2015	2016	2017	2018	2019	2020	2025
121	265706	193662	Y	51	48	45	42	39	36	31
122	265694	193505		34	32	30	28	26	24	20
123	265655	193423		46	44	42	39	37	35	29
124	265651	193253		37	35	33	31	29	27	22
125	265641	193162		37	35	32	30	28	26	22
126	265475	193144		40	38	36	34	32	30	25
127	265348	193110		44	42	39	37	35	33	28
128	265297	193085		38	36	34	33	31	29	24
129	265153	193098		32	31	29	27	26	24	20
130	265139	192912		39	37	35	33	31	29	25
131	265137	192846		44	42	40	38	35	33	28
132	265229	192753		27	25	24	23	21	20	17
133	265350	192566		25	24	22	21	20	19	16
134	265113	192903		42	40	38	36	34	32	27
136	262612	192995	Y	25	24	23	21	20	19	16
137	262631	192996	Y	32	31	29	27	26	24	20
138	266779	199246		22	21	20	18	17	16	14
139	266867	199030		27	25	24	23	21	20	17
140	266863	199009		29	27	26	24	23	22	18
141	266979	198772		26	24	23	22	20	19	16
142	267017	198710		25	23	22	21	20	18	16
143	267089	198608		30	28	27	25	24	22	19
144	267141	198591		27	25	24	23	21	20	17
145	267139	198578		28	27	25	24	22	21	18
146	267156	198571		32	30	29	27	25	24	20
147	267165	198580		33	32	30	28	27	25	21
148	267170	198564		32	30	28	27	25	24	20
149	267204	198561		26	25	24	22	21	20	17
150	267205	198545		27	26	25	23	22	20	17
151	267192	198518		25	24	23	21	20	19	16
155	269009	201280		26	25	23	22	21	19	16
156	269059	201296		27	26	25	23	22	20	17
158	269480	201441		24	23	22	21	19	18	15
159	269171	201620		27	25	24	23	21	20	17
160	269049	201744		32	30	28	27	25	24	20
162	259553	203379		24	23	22	20	19	18	15
163	259287	203556		21	20	19	18	17	16	13
164	259195	203667		25	23	22	21	20	18	16
165	259149	203675		20	19	18	17	16	15	13
166	259148	203690		22	21	20	19	17	16	14
167	259126	203700		20	19	18	17	16	15	12
168	259115	203705		20	19	18	17	16	15	12
169	259013	203747		19	18	17	16	15	14	12
170	258971	203797		16	15	14	14	13	12	10
171	258917	203826		23	22	21	19	18	17	15
172	258887	203859		24	23	21	20	19	18	15
173	259250	203708		17	16	15	14	14	13	11
174	259253	203660		14	14	13	12	11	11	9
175	259251	203638		13	12	12	11	10	10	8
176	258872	203691		12	11	11	10	9	9	7
177	258896	203697		11	10	10	9	9	8	7

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Future Years Projections – Rounded to nearest whole number in ug/m^3 LAQM.TG(09) June 2014 revised method						
				2015	2016	2017	2018	2019	2020	2025
178	258986	203684		12	11	10	10	9	9	7
180	259064	197781		29	28	26	25	23	22	19
182	259050	197790		28	27	25	24	23	21	18
183	259036	197795		30	28	27	25	24	22	19
197	258797	198701		34	32	30	29	27	25	21
198	258811	198701		35	33	32	30	28	26	22
199	254703	195764		28	27	26	24	23	21	18
201	254522	195859		27	26	25	23	22	20	17
206	261565	188211		42	40	38	36	34	31	27
207	261561	188222		32	31	29	28	26	24	21
208	261541	188215		35	33	31	29	28	26	22
209	261534	188198		40	38	36	34	32	30	26
210	261516	188207		32	31	29	27	26	24	20
211	261501	188188		33	31	29	28	26	24	21
212	261486	188200		24	22	21	20	19	18	15
213	261490	188186		34	33	31	29	27	26	22
214	261315	188193		25	24	23	21	20	19	16
215	261299	188191		23	21	20	19	18	17	14
216	261276	188190		24	22	21	20	19	18	15
238	266902	197660		28	26	25	24	22	21	18
239	266181	196022		30	28	27	25	24	22	19
240	266169	195995		31	29	28	26	25	23	20
241	266159	196013		30	28	27	25	24	22	19
242	265655	193423		40	37	35	33	31	28	24
243	265474	194949		35	34	32	30	28	26	22
244	265466	194930	Y	44	41	39	37	35	33	28
245	265448	194922	Y	42	39	37	35	33	31	26
246	265425	194927		27	26	24	23	22	20	17
247	265394	194899	Y	35	33	31	29	28	26	22
248	265342	194894		29	27	26	24	23	22	18
249	265326	194871	Y	35	33	31	29	28	26	22
250	265274	194867		25	23	22	21	20	18	16
251	265263	194845	Y	31	30	28	26	25	23	20
252	265226	194830	Y	29	28	26	25	23	22	19
253	265194	194833		24	23	22	21	20	18	16
254	265142	194816		23	22	21	20	19	18	15
255	265098	194825		23	22	21	19	18	17	15
256	264995	194777		38	36	34	32	30	28	24
258	254906	189110		26	24	23	22	20	19	16
265	266375	198023		29	27	26	24	23	21	18
267	266382	198028		29	27	26	24	23	22	18
268	266419	198053		26	25	23	22	21	19	16
271	266879	198078		31	30	28	26	25	23	20
272	266888	198074		31	29	28	26	24	23	19
275	265658	194856	Y	22	21	20	19	18	17	14
276	265610	194871	Y	34	32	30	29	27	25	21
277	265596	194875	Y	36	34	33	31	29	27	23
278	265573	194882	Y	36	34	32	30	29	27	23
279	265555	194926	Y	49	47	44	42	39	37	31
280	265542	194980	Y	41	39	37	34	32	30	26
281	265542	194872	Y	33	31	30	28	26	25	21

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Future Years Projections – Rounded to nearest whole number in ug/m^3 LAQM.TG(09) June 2014 revised method						
				2015	2016	2017	2018	2019	2020	2025
282	265540	194840	Y	32	30	29	27	25	24	20
283	265436	195937		29	28	26	25	23	22	18
284	265452	195899		32	30	29	27	25	24	20
285	266955	197415		32	31	29	27	26	24	20
286	266938	197377		34	32	31	29	27	25	22
287	265715	193902	Y	29	27	25	24	22	20	17
288	265698	193878	Y	30	29	27	25	23	22	18
289	265702	193842	Y	32	30	28	26	25	23	19
290	263014	195737	Y	27	25	24	23	21	20	17
291	267952	193121		39	37	35	33	31	29	25
293	262302	196688		20	19	18	17	16	15	12
294	262342	196742		23	22	21	20	18	17	15
295	258998	198698		30	29	27	26	24	23	19
296	259054	198679		35	33	32	30	28	26	22
323	266765	193224		33	32	30	28	27	25	21
324	269815	197657		28	26	25	24	22	21	18

Table 16 - Future Years projections (2015-2025) NO_2 Annual Mean Concentrations

It was reported within the authority's Progress Report 2014 that using the LAQM.TG(09) revised April 2012 future years adjustment factors method that even during 2020, widespread exceedences of the annual mean objective would still be witnessed here in Swansea. **However, the latest June 2014 revision of the future year adjustment factors now indicates that full compliance with the annual mean objective may well be seen during 2019**.

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[23]. However, significant issues arose 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. Data capture since the replacement has increased significantly with all particulate monitoring at the AURN site. However due to budgetary concerns the FDMS unit remains operational at the Morriston Groundhog site until its replacement with a Bam1020 can be funded. It has to be said that recently there have been data quality concerns and data capture concerns with the Morriston FDMS system as the concentration data appears unrealistically low.

The FDMS unit provides hourly integration data and has 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 unit at Morriston 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

[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

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 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 2014 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 at Morriston is fully audited yearly by AEA Energy and Environment. As part of the service and maintenance contract with Enviro Technology Services Plc, each FDMS 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.[24]

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

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

various studies at diverse locations throughout the UK each deriving differing correction factors. These TEOM PM_{10} data pre 2006 have last been reported within the authorities Progress Report during May 2008. The date that the PM_{10} FDMS systems were installed / removed from the Swansea AURN site are given below within table 17 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.

For several years, the authority has indicated that it would undertake a basic PM_{10} screening exercise at some of the busier traffic junctions. However, this had previously proved impossible to undertake due to the unreliability of the instruments originally deployed on site. As mentioned in chapters 2.1.8 to 2.1.12 above, MetOne EBams have now been deployed at five sites during late 2012. Data for 2013-2014 are now reported here. It is important to again highlight, that the MetOne EBam has not demonstrated equivalency with the EU reference gravimetric method. However, as the intention is only to provide a basic screening assessment, their use is judged to be appropriate.

Site ID (see table 2 above)	Location	Within AQMA	Data Capture 2010 %	Data Capture 2011 %	Data Capture 2012 %	Data Capture 2013 %	Data Capture 2014 %	Annual mean concentrations (mg/m^3)				
								2010	2011	2012	2013	2014
1 *	Swansea AURN	Y	98.63	62.19	97.54	96.71	93.70	15.79	14.70	17.79	19.03	20.29
3 **	Morriston Groundhog	N	78.36	81.64	90.38	96.99	85.48	18.67	17.96	13.86	15.30	13.18
7 ð	Fforestfach Cross	Y	-	-	-	96.71	80.00	-	-	-	18.03	19.02
8 ð	Uplands Crescent	N	-	-	-	83.84	77.81	-	-	-	18.26	17.18
9 ð	Sketty Cross	Y	-	-	-	55.89	98.63	-	-	-	19.74	18.28
10 ð	Westway Quadrant Bus Station	N	-	-	-	94.79	98.36	-	-	-	18.91	17.27
11 ð	SA1 Junction Port Tennant	N	-	-	-	95.89	99.18	-	-	-	17.65	14.49

Table 17 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 27th October 2006*
ðMetOne EBam

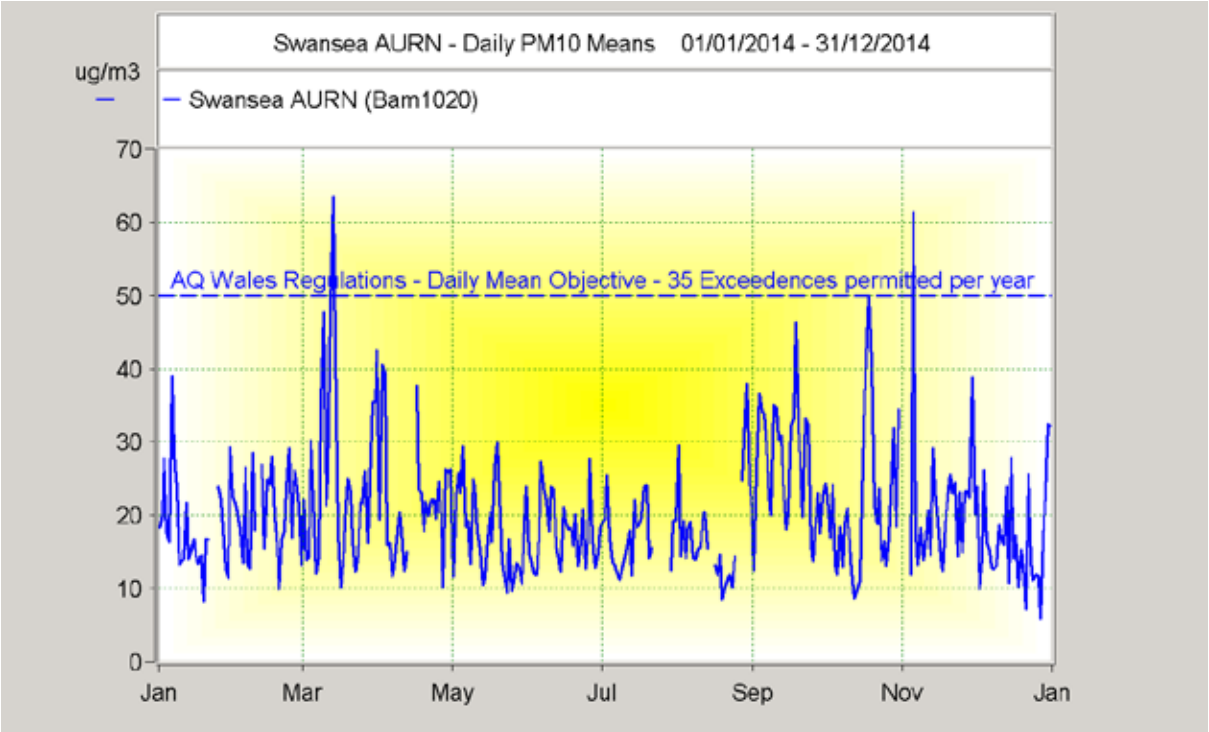
Site ID	Location	Within AQMA	Data Capture 2010 %	Data Capture 2011 %	Data Capture 2012 %	Data Capture 2013 %	Data Capture 2014 %	Number of Exceedences of 24-hour mean (50 µg/m³)				
								2010	*2011*	*2012*	*2013*	*2014*
1	Swansea AURN	**Y**	98.6	**62.1**	97.5	96.7	93.70	0	5 **(29.8)**	4	2	2
3	Morriston Groundhog	**N**	**78.3**	**81.6**	90.3	96.9	**85.48**	1 **(29.6)**	**8 (30.3)**	0	0	1 **(19.7)**
7	Fforestfach Cross	**Y**	-	**-**	**-**	96.7	**80.00**	-	**-**	**-**	2	5 **(27.9)**
8	Uplands Crescent	**N**	-	**-**	**-**	**83.8**	**77.81**	-	**-**	**-**	2 ***(28.5)***	1 ***(25.2)***
9	Sketty Cross	**Y**	-	**-**	**-**	**55.8**	98.63	-	**-**	**-**	4 **(34.0)**	3
10	Westway Quadrant Bus Station	**N**	-	**-**	**-**	94.7	98.36	-	**-**	**-**	*4*	*4*
11	SA1 Junction Port Tennant	**N**	-	**-**	**-**	95.8	99.18	-	**-**	**-**	*4*	*2*

Table 18 Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

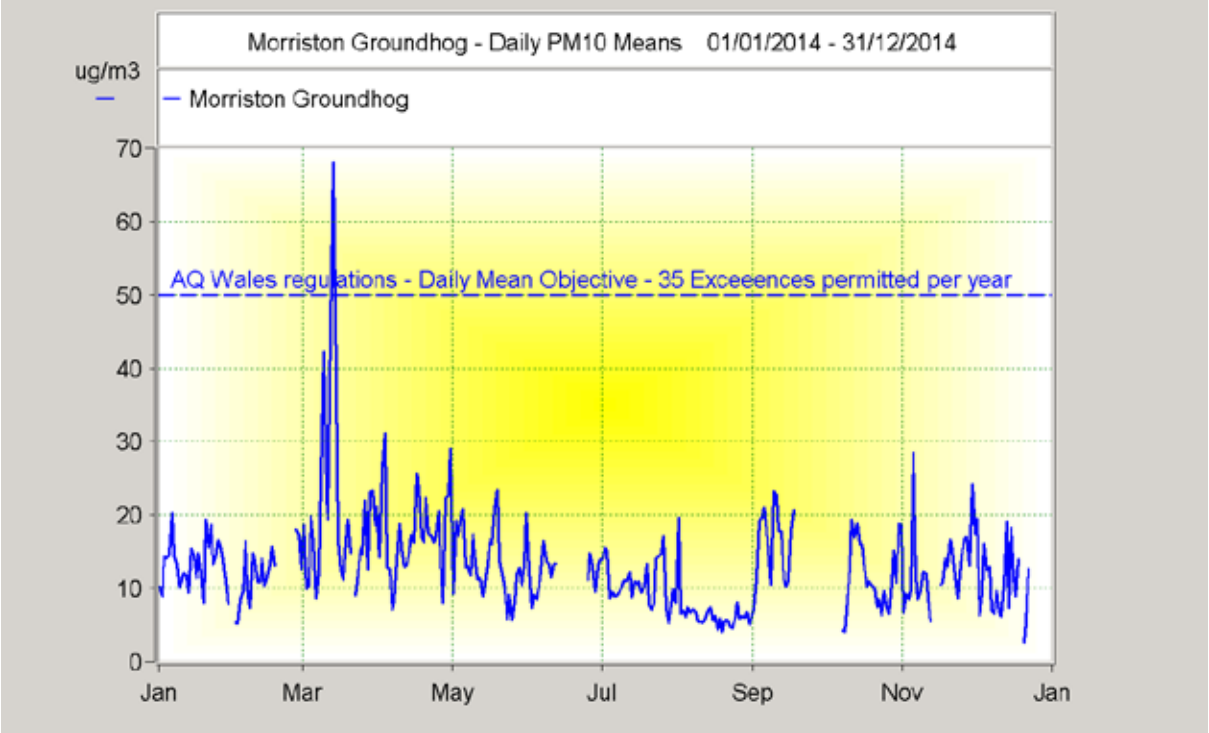
The 90th percentile's of the daily means of measurements made during 2010-2014 are presented in bold within brackets in table 18 where appropriate, as the data capture rates fall below the required 90%[25] at the Morriston Groundhog (FDMS) site and for completeness, the same approach has been taken with the low data capture rates at the Fforestfach Cross and Uplands EBam sites. Data capture from the Uplands Crescent site was compromised due to yet another external sensor problem and pump flow issues with the main circuit/logic board failing at the Fforestfach Cross EBam site.

Graphs 7 -13 below indicate the monitoring undertaken during 2014 with scatter plot 1 summarising the period of measurement for the Swansea AURN and Morriston Groundhog sites.

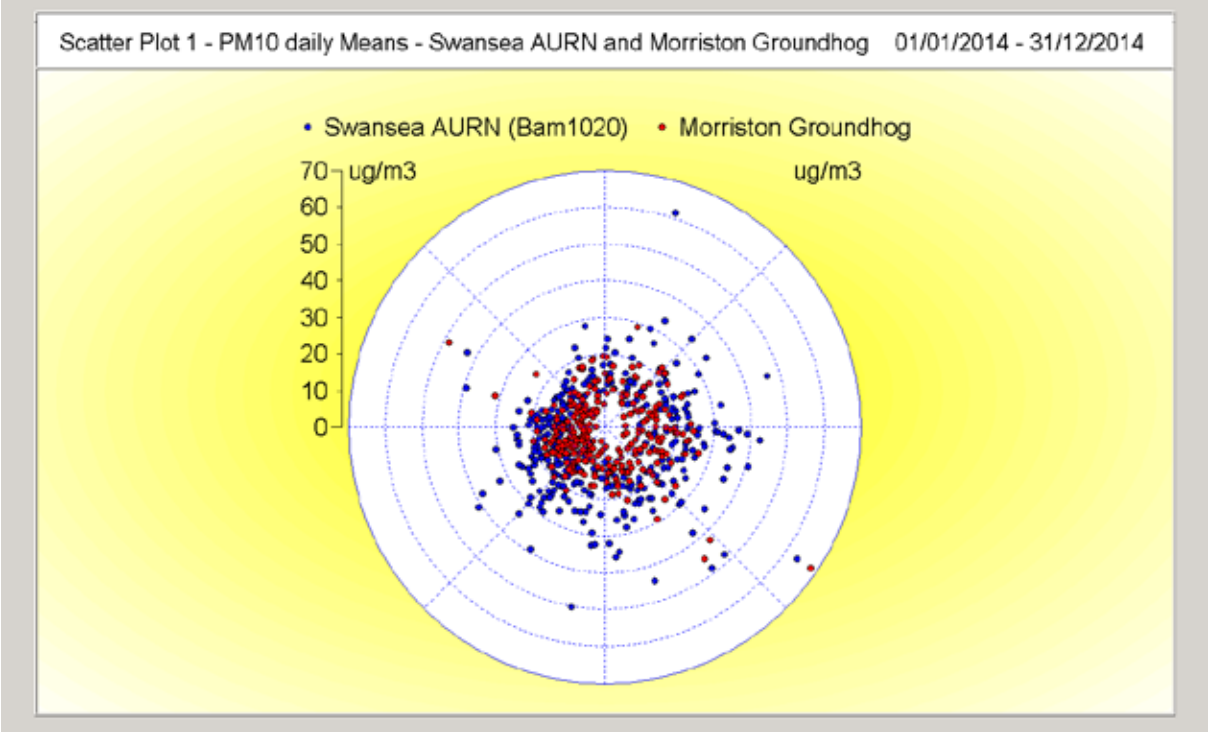
[25] LAQM TG(09) Annexe A1 – A1.157 page A1-34



Graph 7 – Swansea AURN 24-hour PM_{10} concentrations 2014

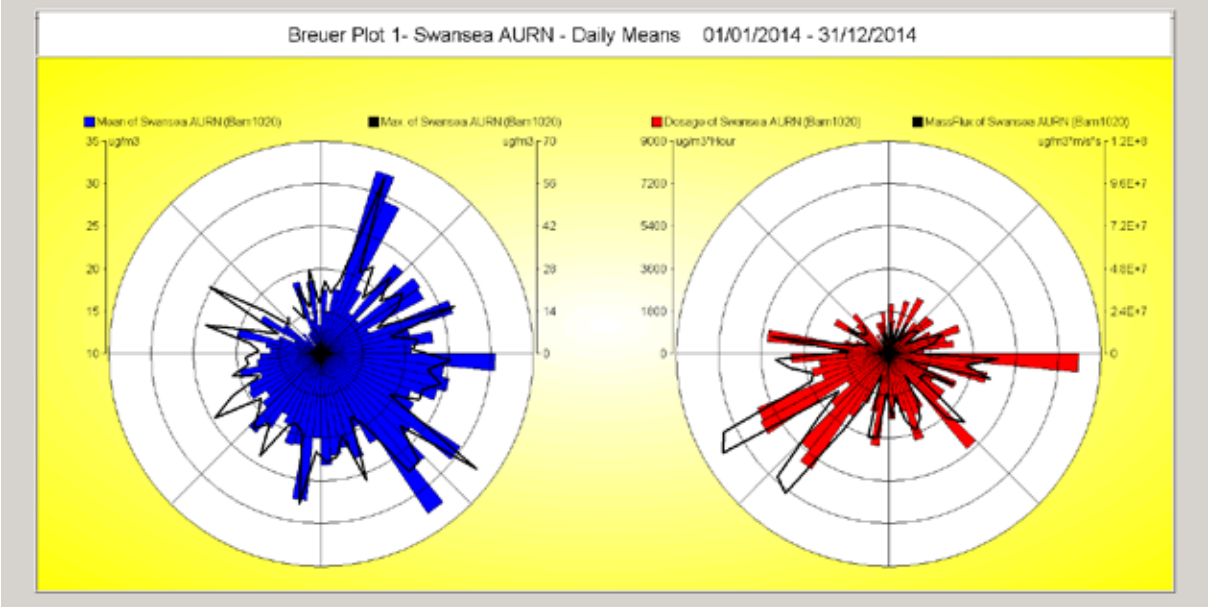


Graph 8 – Morriston Groundhog 24-hour PM_{10} concentrations 2014



Scatter Plot 1 - PM_{10} Daily Means 2014

Both the Swansea AURN and Morriston Groundhog PM_{10} monitoring recorded elevated levels during 10th – 14th March 2014. Back trajectories performed by Ricardo-AEAindicated that the air arriving in southern regions of the UK originated from central and northern Europe. This was compounded in some regions by poorly dispersed local emissions due to low wind speeds. This episode lasted for approximately 4-5 days and is evident within graphs 7 and 8 above but not easily detectable within scatter plot 1 above dueto the short period these conditions lasted. The other “spike” seen during 2014 occurred as expected on the 5th November and was visible at the Swansea AURN site (graph 7) but was barely detected at the Morriston Groundhog (graph 8).

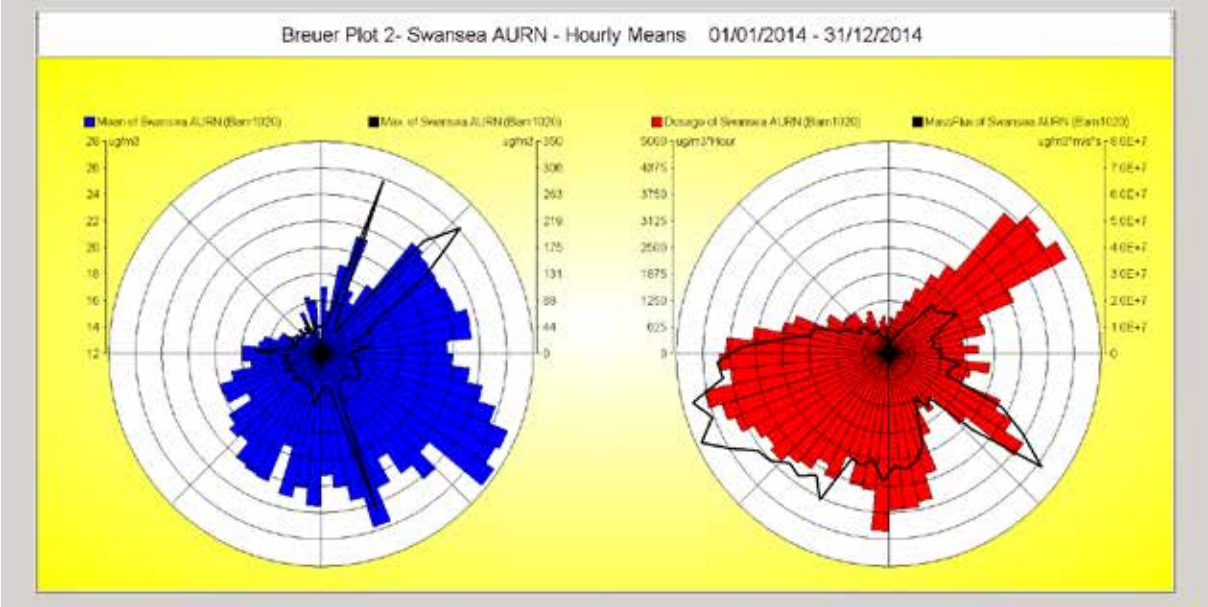


Breuer Plot 1 – Swansea AURN – PM_{10} Daily Means 2014

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.

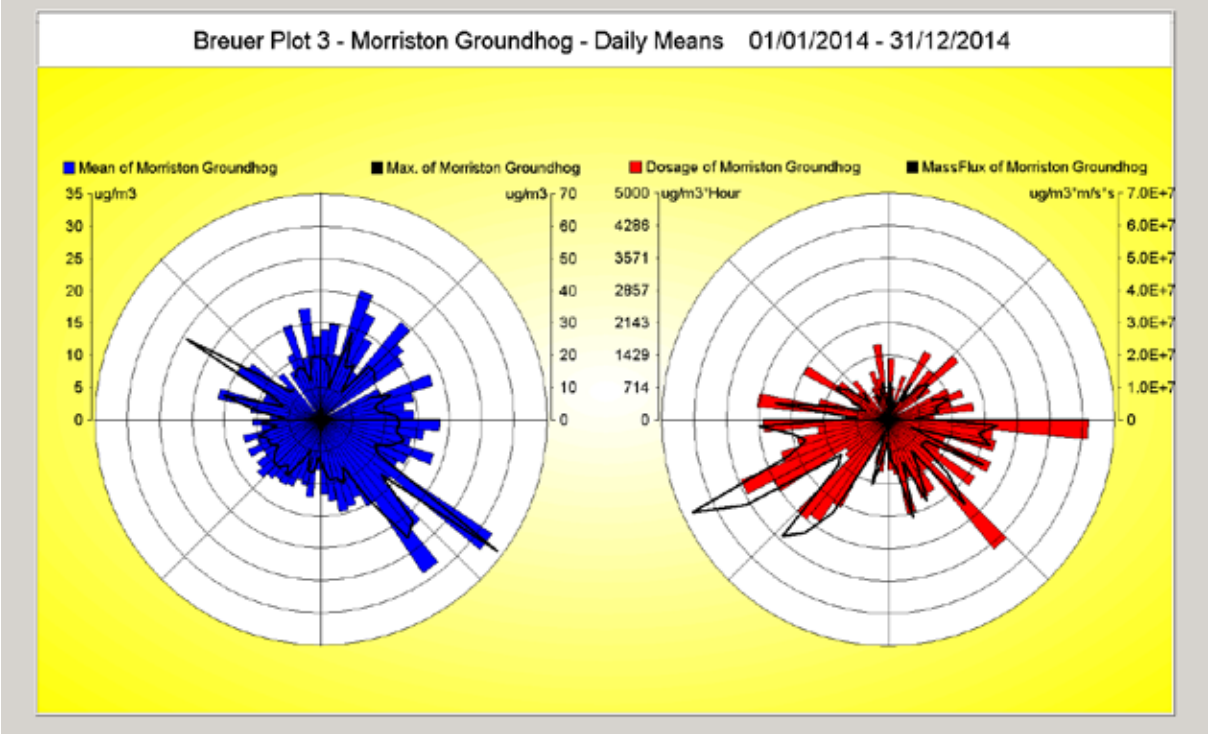
Breuer Plot 2 below presents the hourly mean concentrations at the Swansea AURN.

As has been reported in previous years, Breuer Plot 2 once again clearly indicates that mean hourly concentrations are dominated by sources to the south-east. However, maximum hourly concentrations are far more diverse being mainly from a north-east direction. It is thought that these maximum hourly concentrations along with dosage and mass flux probably reflect more local sources/influences during 2014 as has been seen during previous years

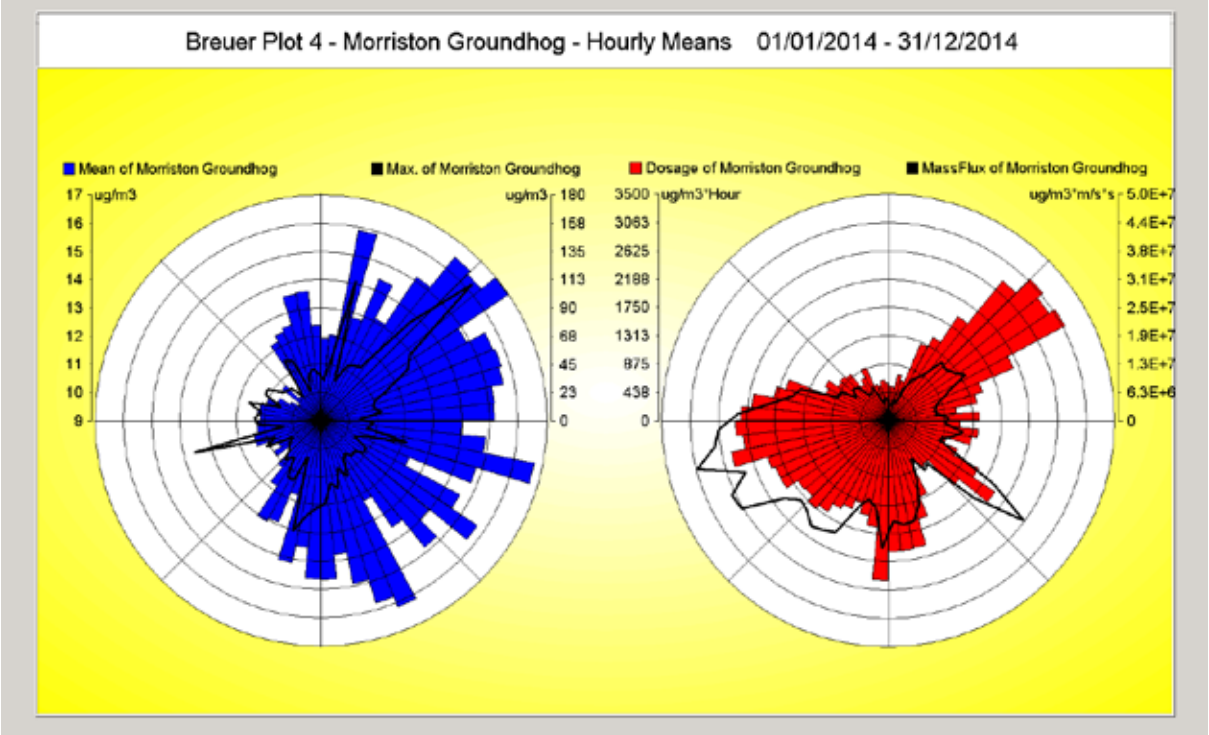


Breuer Plot 2 - Swansea AURN – PM_{10} Hourly Means 2014

Breuer Plots 3 and 4 below represent an identical analysis undertaken with data from the Morriston Groundhog for 2014



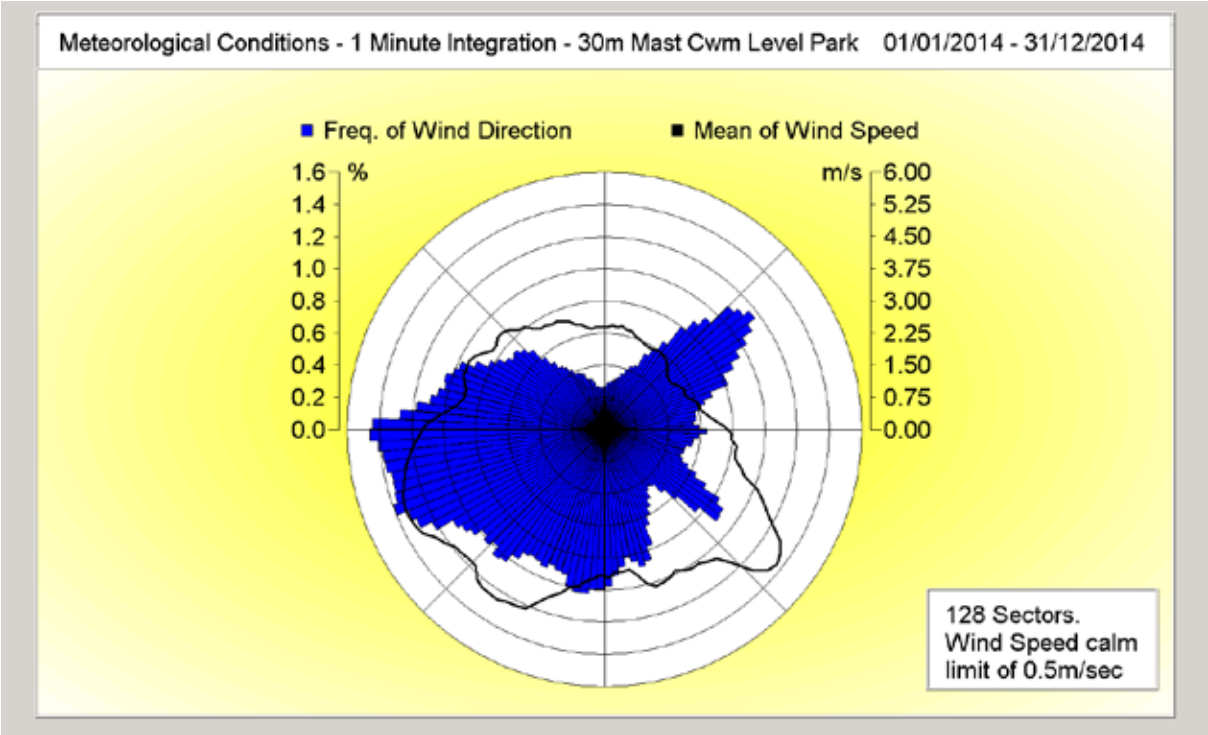
Breuer Plot 3 – Morriston Groundhog – PM_{10} Daily Means 2014



Breuer Plot 4 – Morriston Groundhog – PM_{10} Hourly means 2014

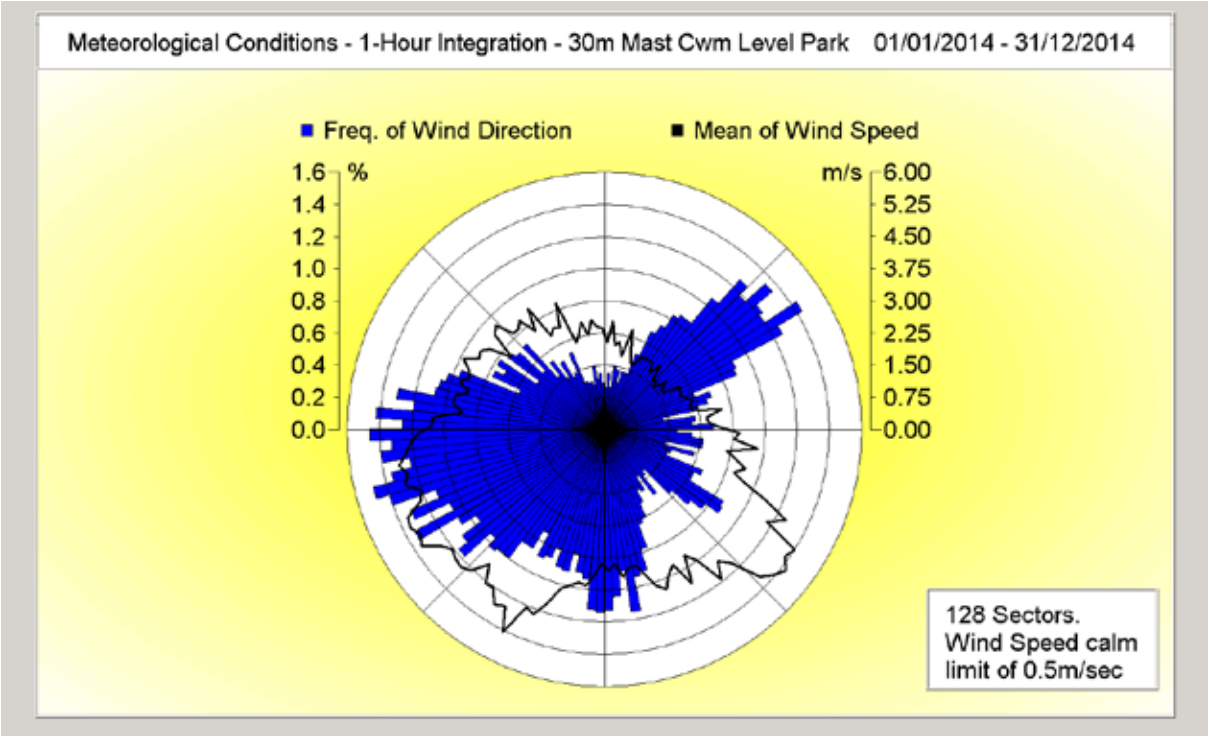
It should be noted that the hourly Breuer Plots 2 and 4 above show remarkable agreement and similarities.

Breuer Plots 5 and 6 below indicate meteorological conditions observed at the 30m Meteorological Mast at Cwm Level Park during 2014. 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 2014 – 1 Minute Integration Cwm Level Park

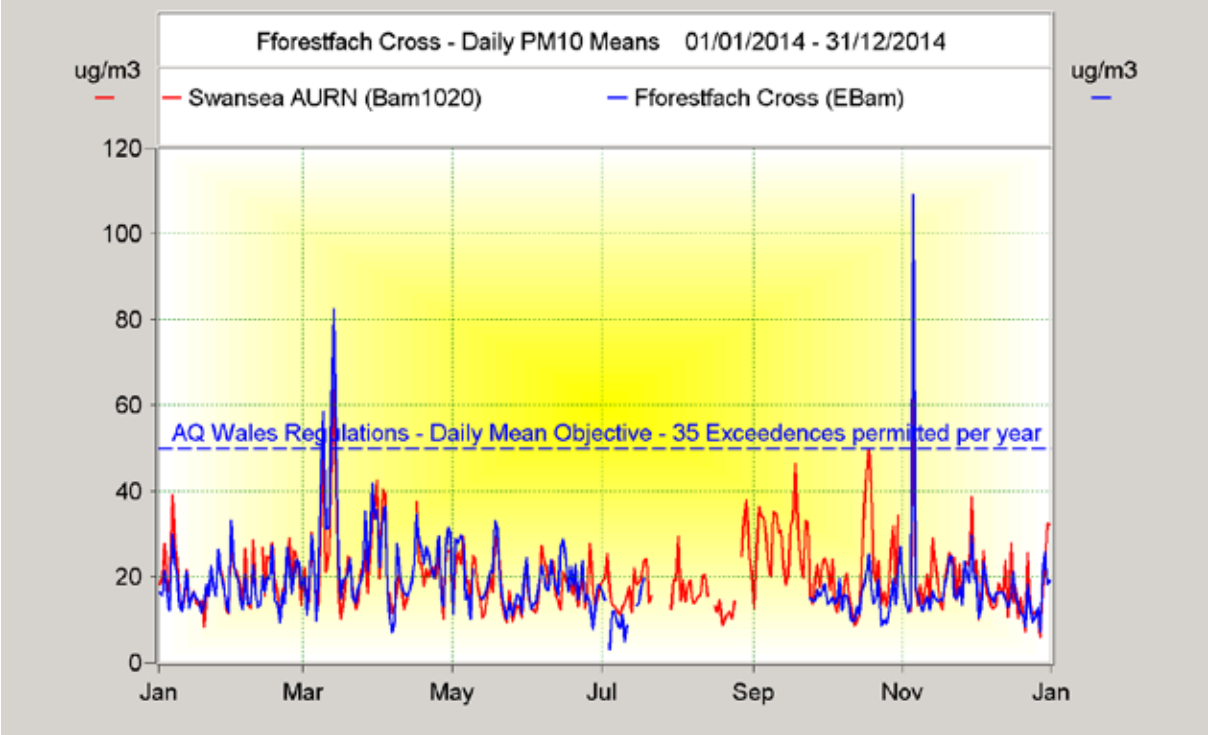
From Breuer Plots 5 above and Breuer Plot 6 below, it can be seen that 2013 can be considered meteorology as a typical or “normal” year with the wind direction being from a predominantly south-westerly / westerly direction. However, there is, once again, during winter months, significant periods of north-easterly winds. These periods of north-easterly winds have become prevalent during recent years are fairly indicative of the harsher winter conditions seen within the UK over the last couple of years.



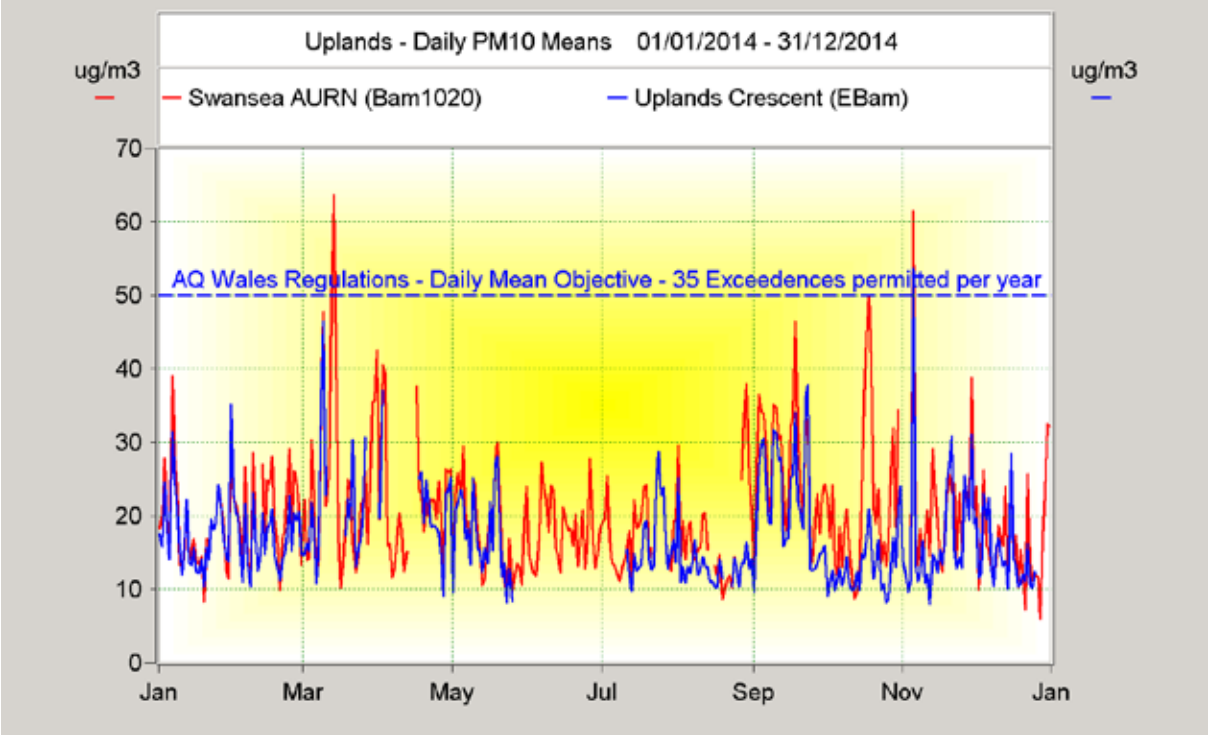
Breuer Plot 6 - Meteorological Conditions 2014 – 1 Hour Integration Cwm Level Park

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

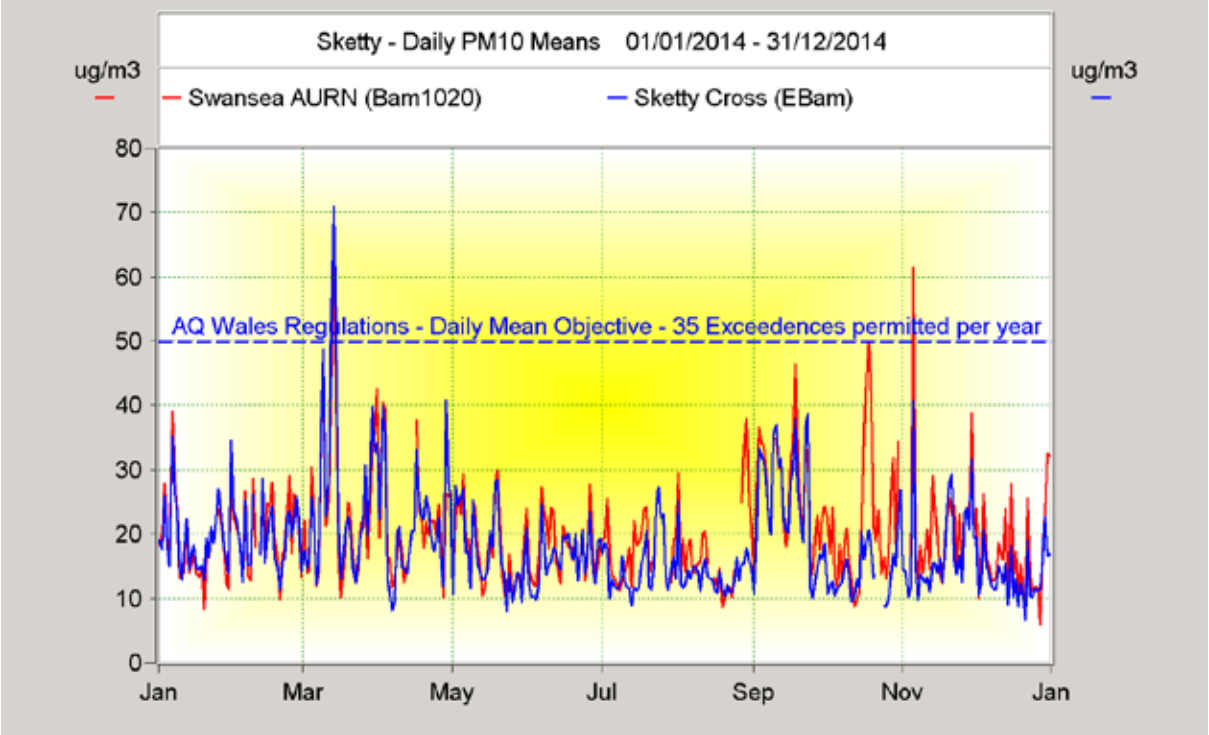
Charts 9 – 13 below represent the indicative monitoring undertaken at the five EBam locations. For comparativeness sake, the Swansea AURN Bam1020 EU reference equivalent monitoring is plotted against each site.



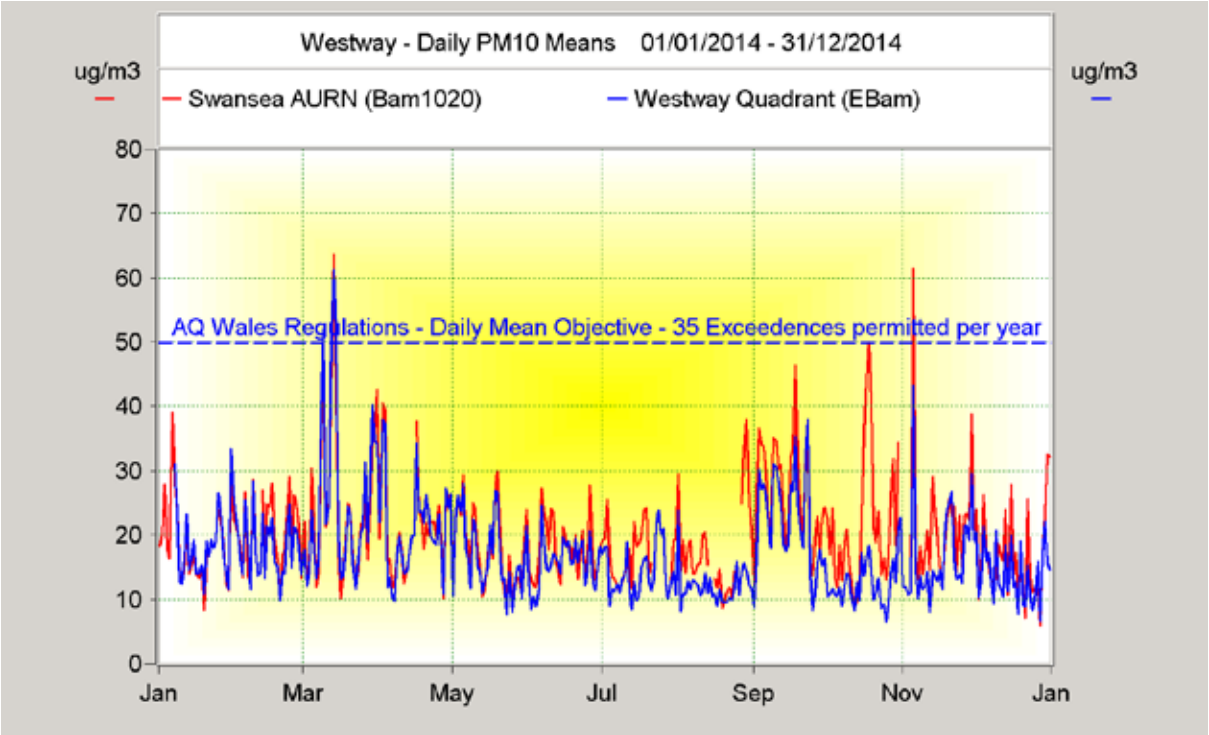
Graph 9 – Fforestfach Cross EBam 24-hour PM_{10} concentrations 2014



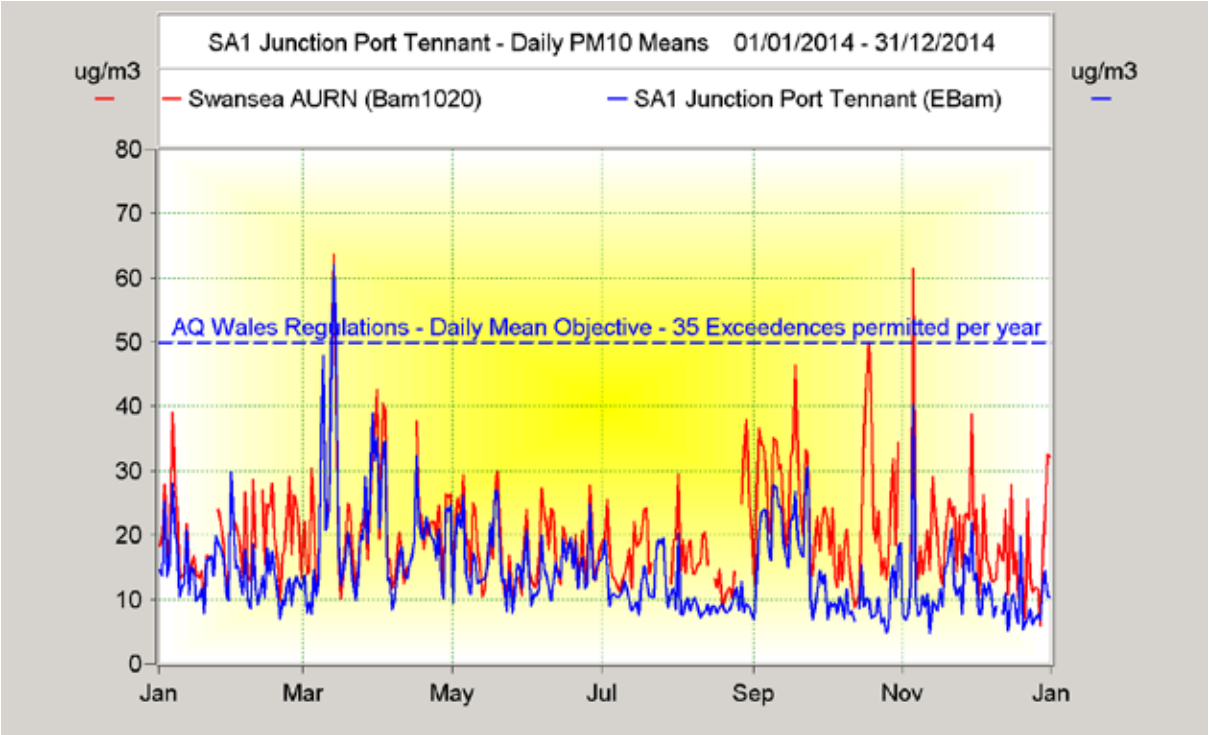
Graph 10 – Uplands EBam 24-hour PM_{10} concentrations 2014



Graph 11 – Sketty EBam – 24-hour PM_{10} concentrations 2014

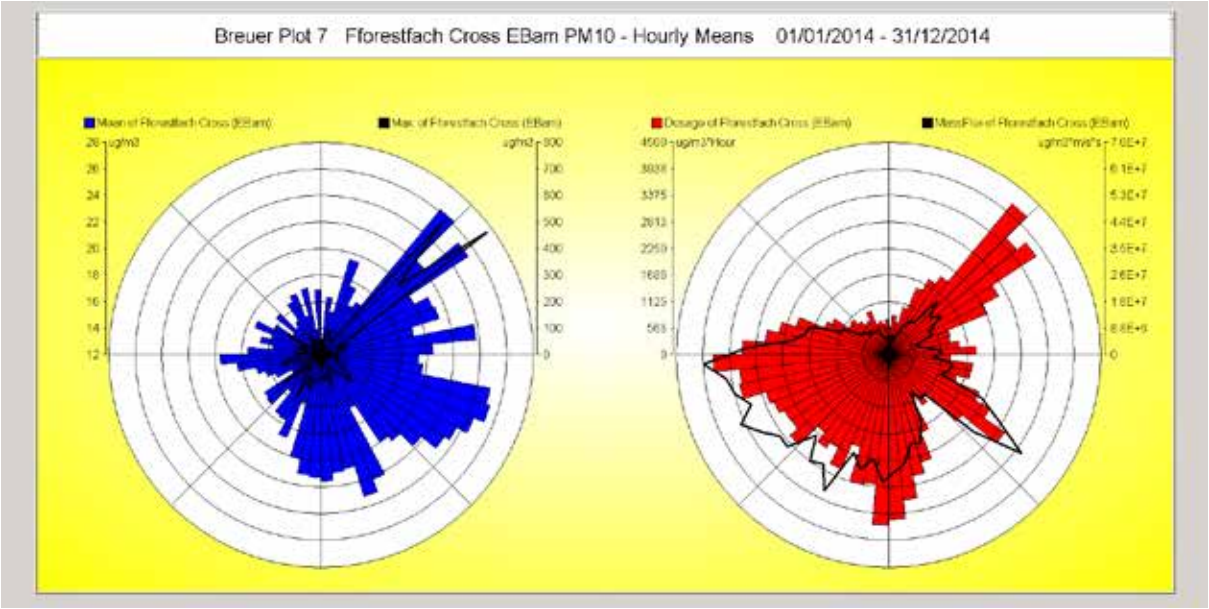


Graph 12 – Westway (Quadrant) EBam – 24-hour PM_{10} concentrations 2014

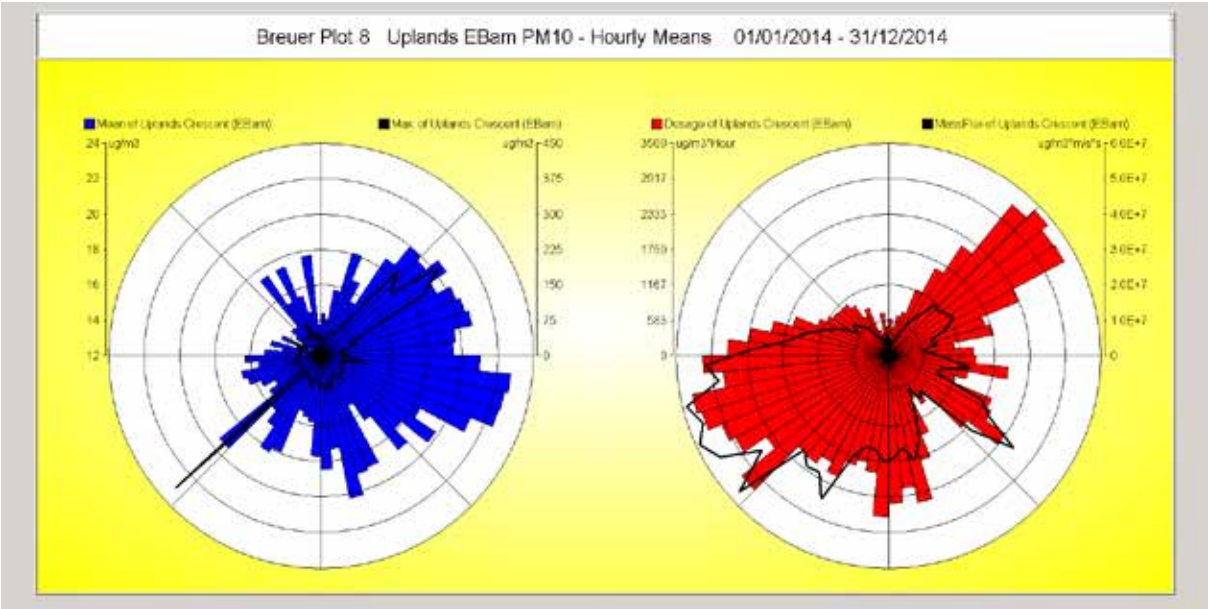


Graph 13 – SA1 Junction Port Tenant – 24-hour PM_{10} concentrations 2014

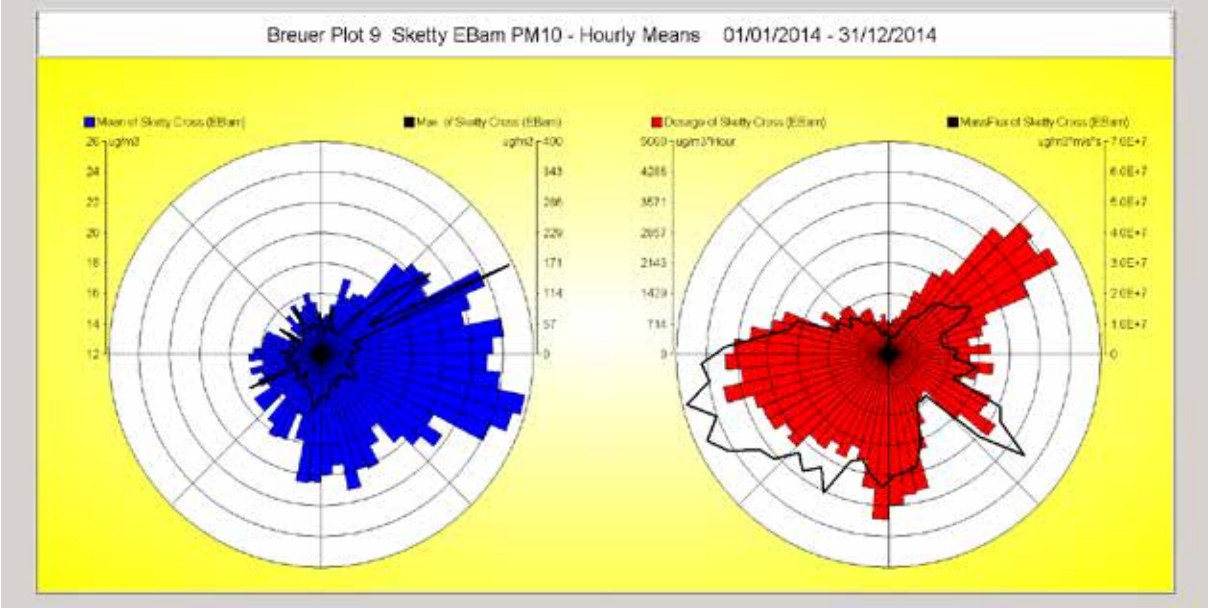
For completeness, hourly Breuer Plots from the hourly means returned from the EBam monitoring during 2013 are presented below as Breuer Plots 7-11.



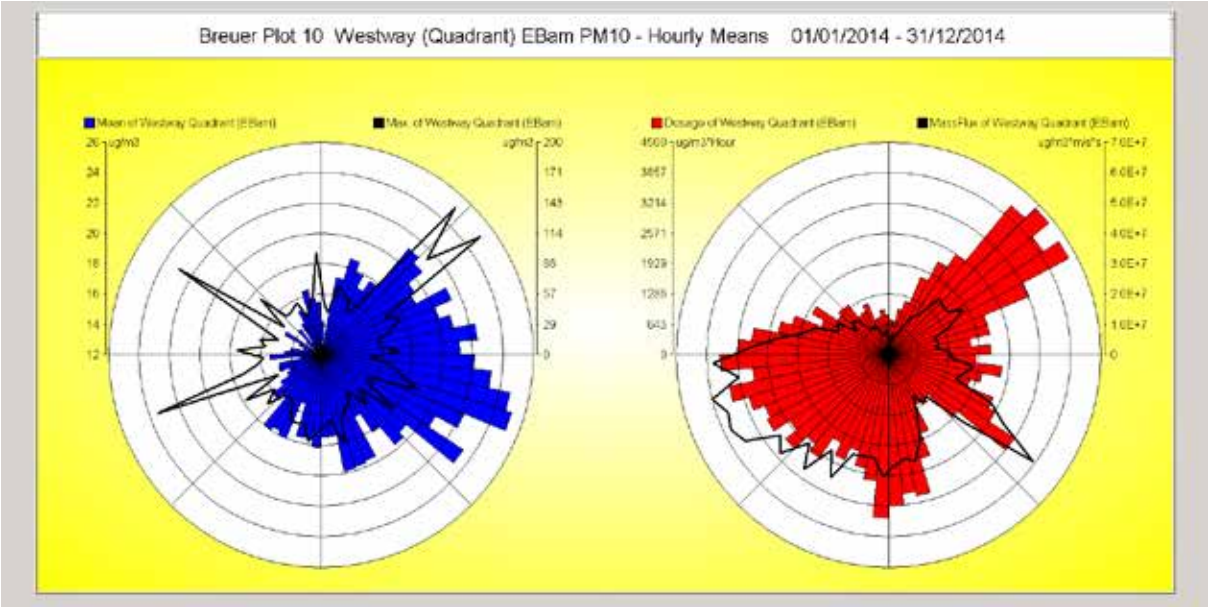
Breuer Plot 7 – Fforestfach Cross EBam - PM_{10} Hourly means 2014



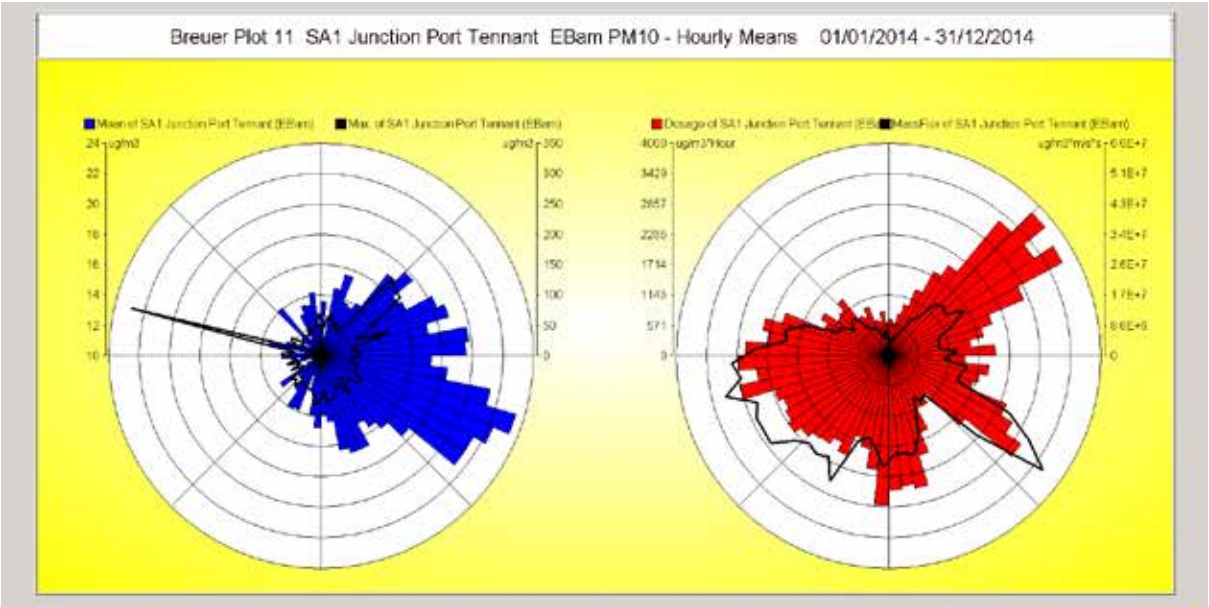
Breuer Plot 8 – Uplands EBam - PM_{10} Hourly means 2014



Breuer Plot 9 – Sketty EBam – PM_{10} Hourly concentrations 2014



Breuer Plot 10 – Westway (Quadrant) EBam PM_{10} – Hourly Means 2014



Breuer Plot 11 – SA1 Junction Port Tenant EBam PM_{10} Hourly concentrations 2014

There is a striking similarity to the hourly Breuer Plots produced for the Swansea AURN (Breuer Plot 2) and Morriston Groundhog (Breuer Plot 4) to Breuer Plots 7-11 above. This would seem to point to the fact that all EBam locations, despite being located around busy junctions and/or busy, congested streets, that the dominant

easterly source remains constant with local conditions having little or no effect on concentrations recorded. It will be interesting to see if this trend continues.

As can be seen from tables 17 and 18 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/m^3.**

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 6. 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.**

2.2.5 Sulphur Dioxide

There were major alterations to the authority's network of SO_2 analysers during 2010. These changes have been reported within the reports previously submitted but are repeated within this report for clarity. Due to budget restrictions and with 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 5-minute means have been compiled into 15-minute 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[26]. 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[27]

The data capture rates are presented within table 19 and, where applicable, the percentile value corresponding to the objective exceedence value is given should the data capture rate fall below 90%[28]

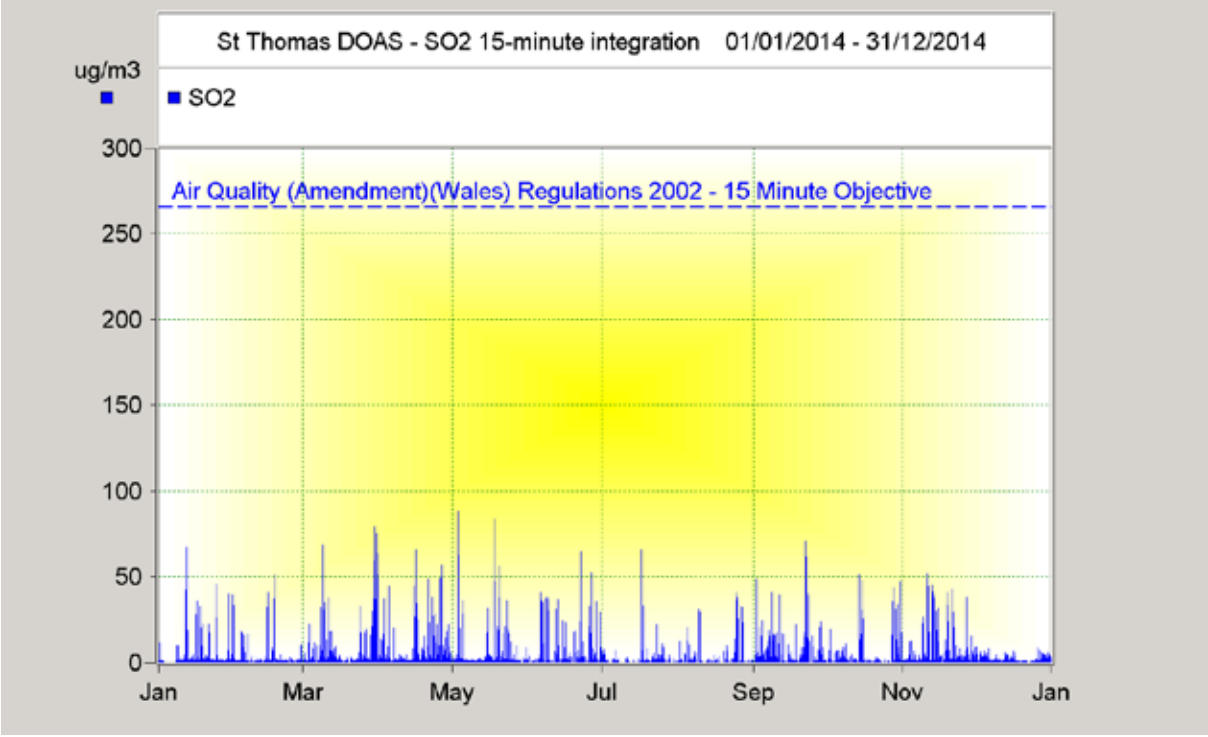
Graphs 14-16 are presented below, representing time series measurements made during 2014 with the accompanying Breuer plot 12 providing an insight into the more likely source direction.

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

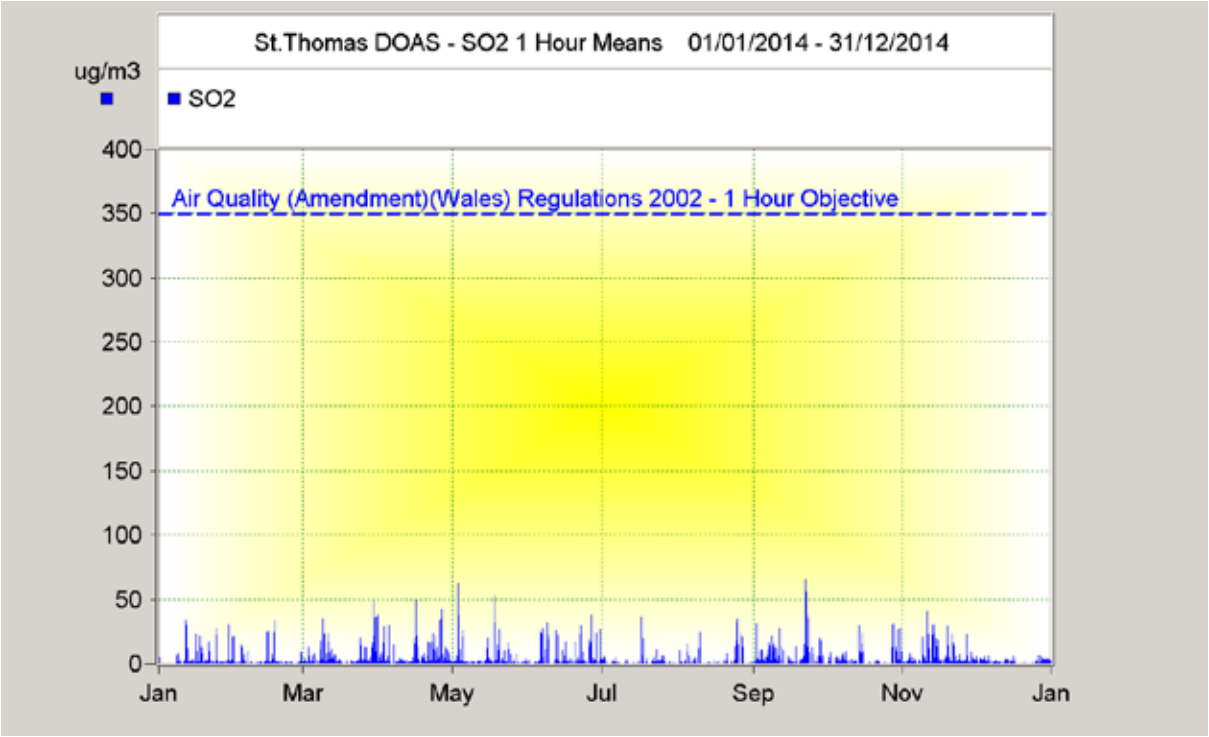
St.Thomas DOAS 2014	Max 15-Min Mean mg/m^3 (266mg/m^3)	Max 1-hour Mean mg/m^3 (350mg/m^3)	Max 24-Hour Mean mg/m^3 (125mg/m^3)
Data Capture %	70.16%	71.72%	59.18%
Concentration	88.58	65.59	21.86
Exceedences	0	0	0
Date of Max	3rd May 2014	22nd September 2014	22nd September 2014
Time of Max	08:15	14:00	-
2014 Percentiles	15 Minute	1 Hour	24-Hour
99.9th Percentile	60.01	-	-
99.7th Percentile	-	37.39	-
99th Percentile	-	-	17.74

Table 19- SO_2 Concentrations 2014 St.Thomas DOAS

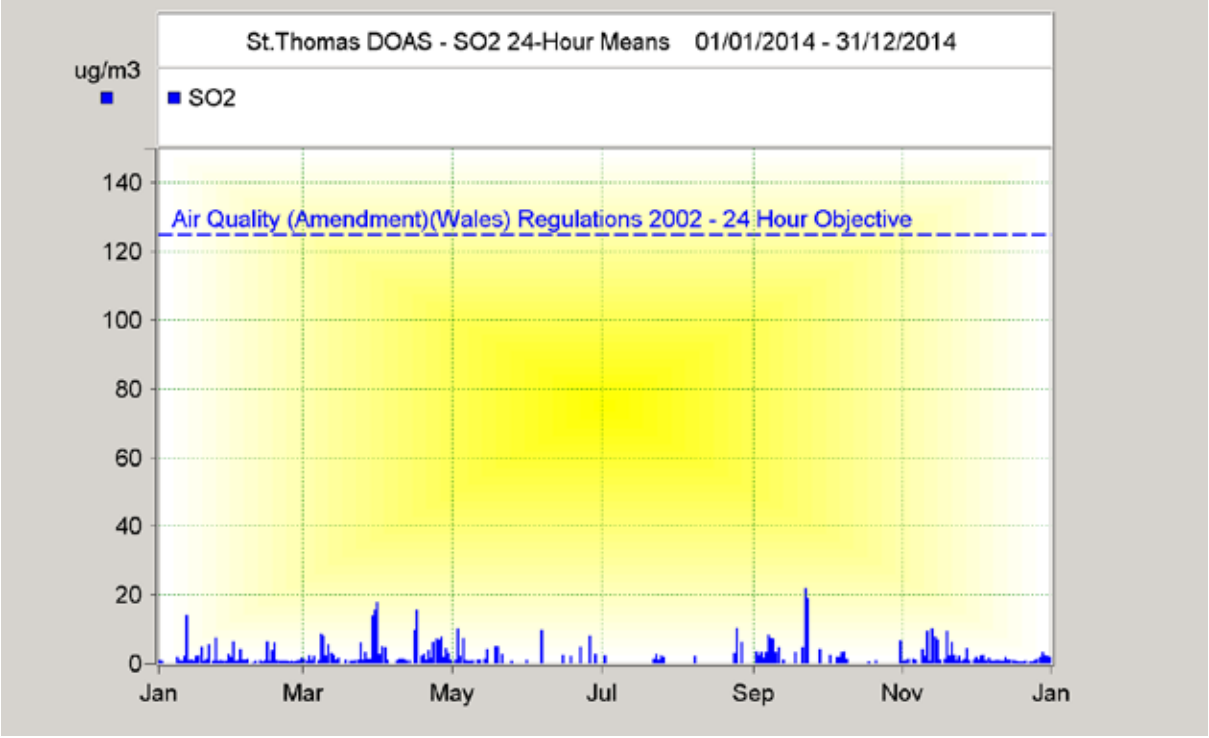
Looking at the data capture rates for 2014 within table 19 above, it could mistakenly be taken that there were operational issues with the equipment at the site. However, this impression would be incorrect. The reason for the quoted data capture rate is due to the QA/QC formulae used (see section 2.1.7 above). The SO_2 concentrations being measured during certain periods were very close to zero and therefore the detection limit and thus the measurement period has a standard deviation greater than twice the measured SO_2 concentration for that measurement period. Due to the standard deviation being greater than twice the measured concentration the period is rejected within the QA/QC rules due to the inherent uncertainty of the measurement.



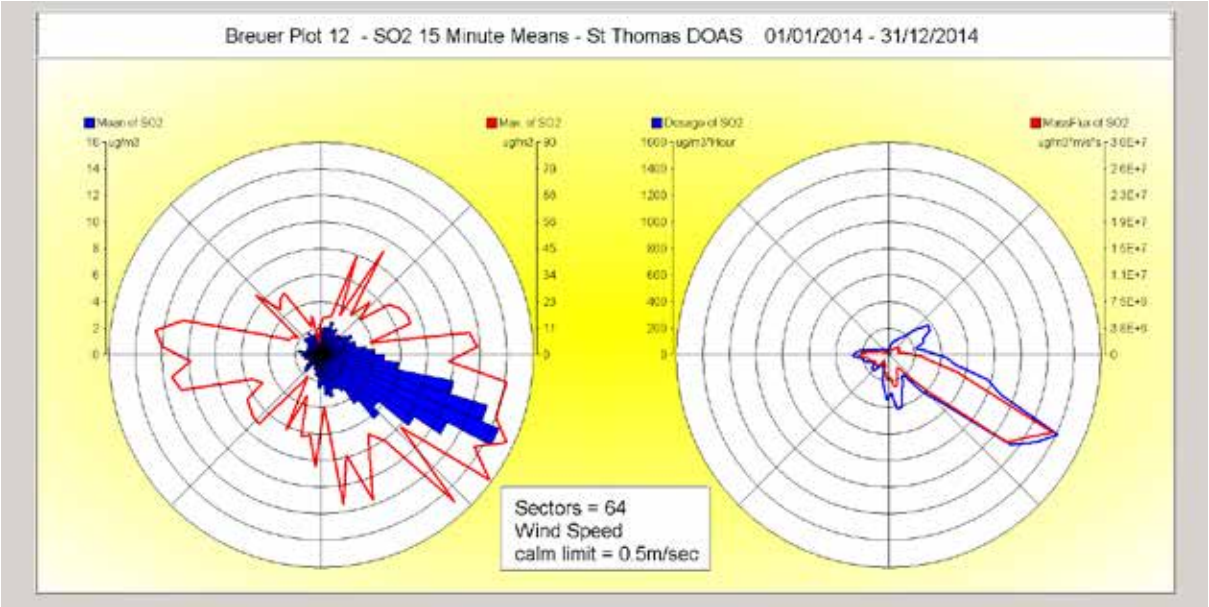
Graph 14 – 15-minute SO_2 means – St Thomas DOAS 2014



Graph 15 – 1-hour SO_2 means – St Thomas DOAS 2014

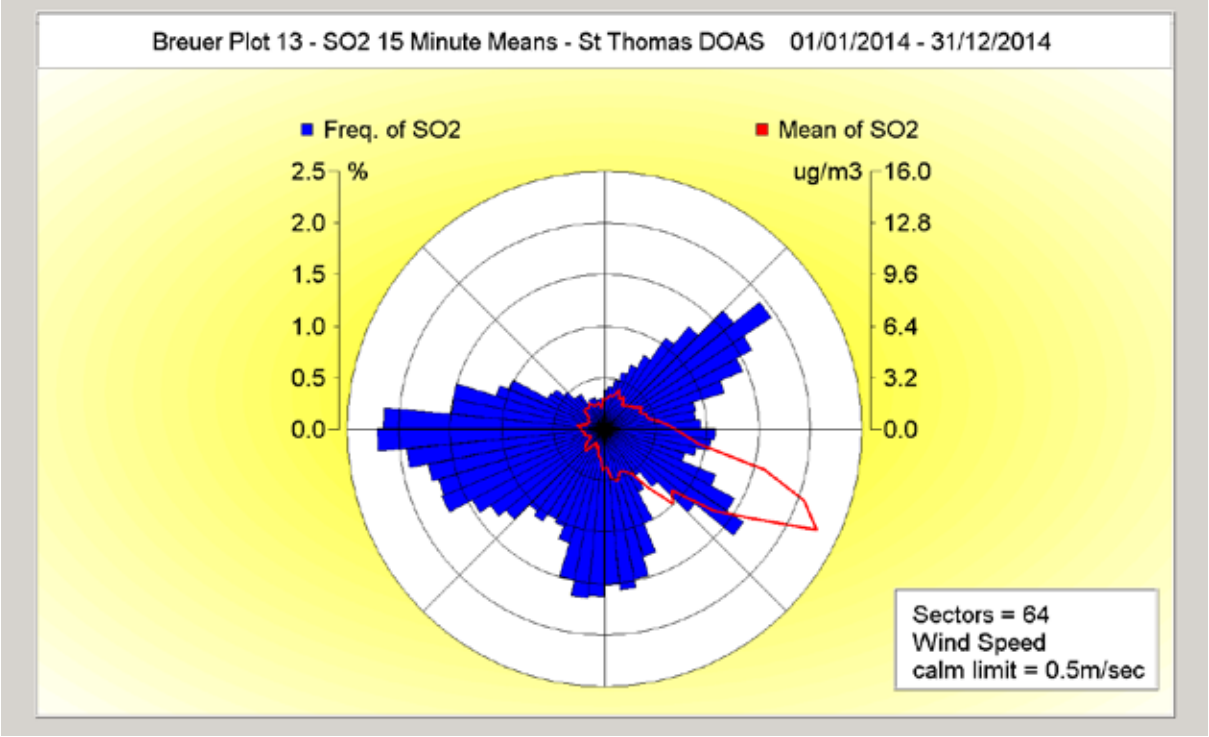


Graph 16 – 24-hour SO_2 means – St Thomas DOAS 2014



Breuer Plot 12 – St.Thomas DOAS 15-minute SO_2 concentrations 2014

From Breuer Plot 12 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. If the mean of SO_2 is replaced with the frequency of SO_2 as can be seen within Breuer Plot 13 below, a clearer picture of likely source direction is obtained.



Breuer Plot 13 – Frequency and Mean SO_2 Plot – St Thomas DOAS 2014

From Breuer Plot 13 above, during 2014 there would appear to be again an additional source as yet unidentified contributing to the frequency of concentrations from the north-west. However, from the frequency plot within Breuer Plot 13 above the vast majority of SO_2 originates from a westerly direction but are seen at low concentrations from this direction. Quay Parade bridges/A483 and the city centre are to the west of the ST Thomas DOAS. 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 the frequency and maximum concentrations seen from that direction. 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 2014 data this remains the case and is reinforced by examination of the dosage and Mass Flux plots within Breuer Plot 12. 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 2010-2014 are provided below within table 20.

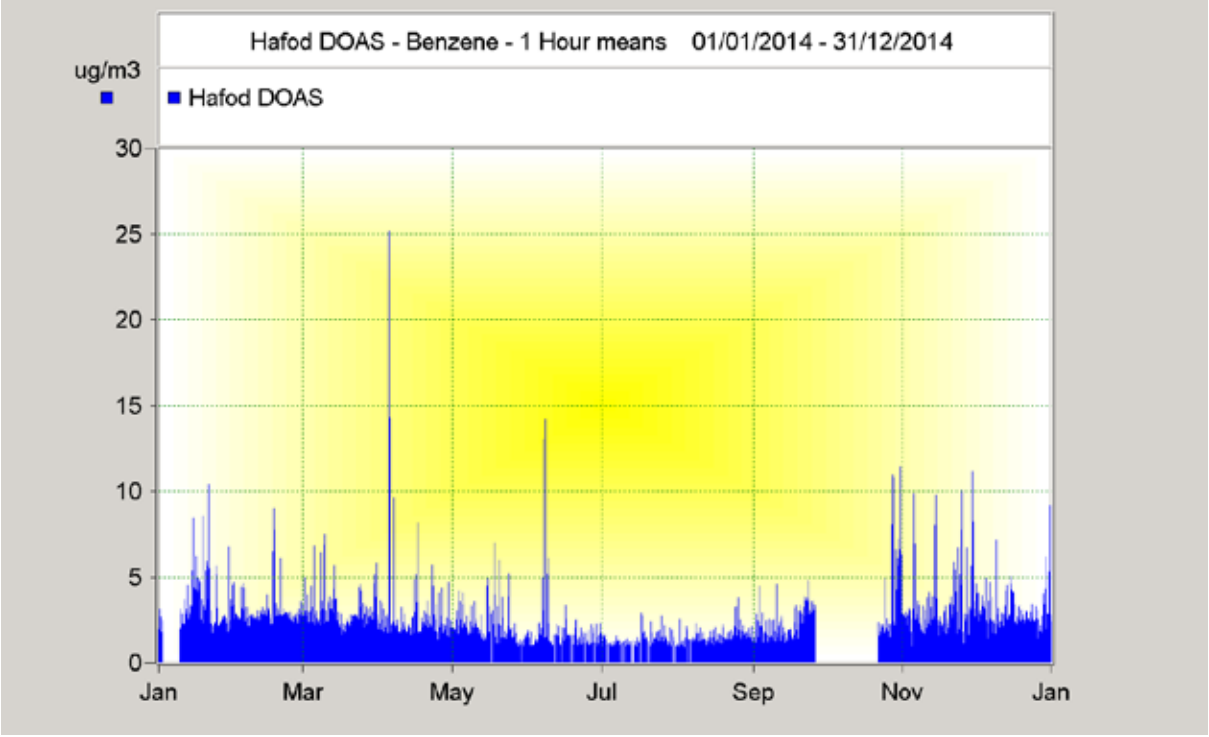
Site ID	Location	Within AQMA	Data Capt. 2010 %	Data Capt. 2011 %	Data Capt. 2012 %	Data Capt. 2013 %	Data Capt. 2014 %	Annual mean concentrations (µg/m^3)				
								2010	2011	2012	2013	2014
5	Hafod DOAS	Y	76%	75%	74%	73%	70%	3.69	3.10	2.66	2.23	2.01
6	St.Thomas DOAS	N	80%	81%	76%	73%	74%	3.58	3.09	2.55	2.30	2.56

Table 20 Benzene annual means 2010-2014

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 2014 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 the concentration measured.

Graphs 17 and 18 below illustrate some high hourly “spikes” of benzene throughout the year for short periods of time at both sites, and importantly around the same time, indicating a likelihood of the same source. However, these spikes during 2014 are much reduced from hourly spikes seen in recent years. Breuer Plots 14 and 15 provide additional information as to the source direction of measured concentrations.

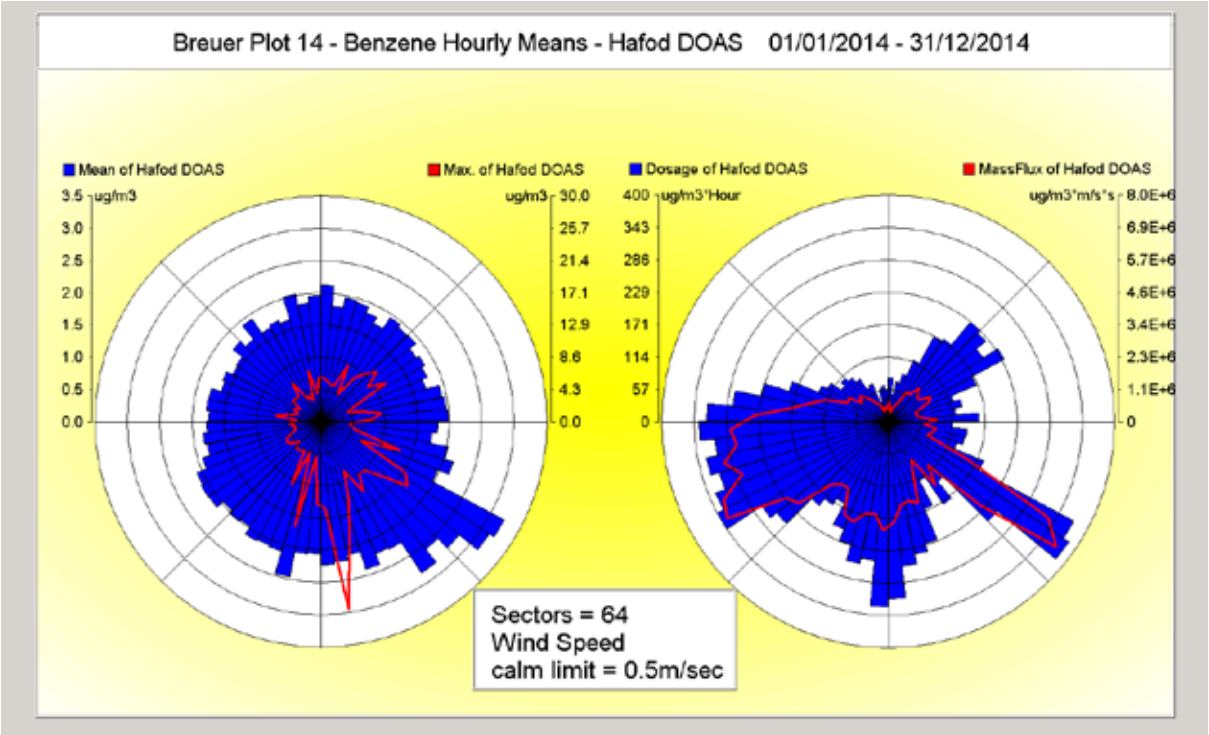
Both sites show an overall reduction trend over the last 5 years. Concentrations continue to remain below the annual mean objective level of 5mg/m^3. It is thought that the annual mean concentrations returned for 2010 were influenced by the atypical meteorological conditions experienced during 2010, particularly during the early winter months of late 2010. An influence on the annual mean concentrations during 2011 (and numerous exceptionally high hourly spikes) is thought to have been the tyre flock fire at a disused factory unit at Fforestfach which lasted for several weeks. No such incidents occurred during 2014 that could account for the numerous hourly spikes.



Graph 17 – Hafod DOAS Benzene 1-hour means 2014

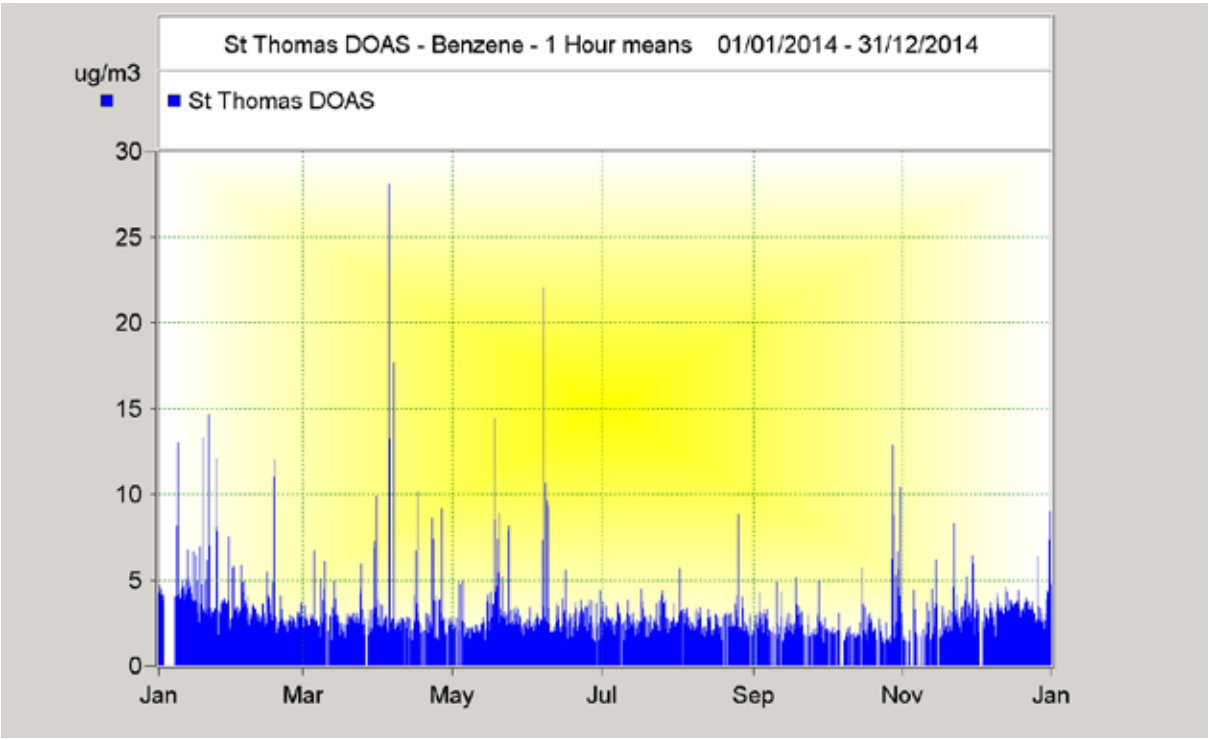
Interestingly, both of the larger hourly “spikes” within graph 17 from the Hafod DOAS above are also seen at the same time within chart 18 below at the St Thomas DOAS. This would imply a common source but it remains unknown at present.

Breuer Plot 14 below is fairly conclusive as to the dominant source of benzene being to the south-east, with the maximum concentrations being seen from a more southerly origin. This would suggest that these sources are the Tata Steelworks at Port Talbot and Swansea docks respectively.

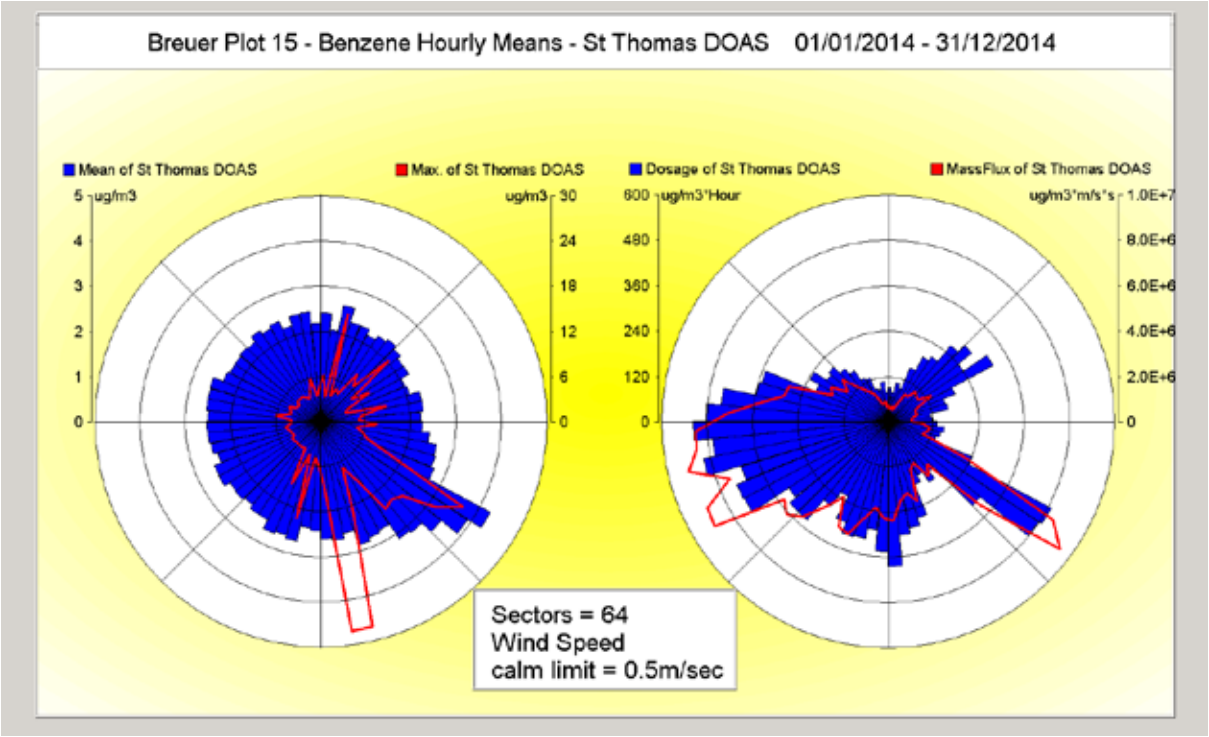


Breuer Plot 14 Hafod DOAS Benzene hourly concentrations 2014

Breuer Plot 15 below from St Thomas indicates definitively the primary source of mean and maximum hourly concentrations to be from source(s) mentioned above to to be the heavy industry located to the south-east of Swansea Bay at Tata Steelworks and Swansea docks to the south of the monitoring site.



Graph 18 – St Thomas DOAS – Benzene 1-hour means 2014



Breuer Plot 15 St Thomas DOAS Benzene hourly concentrations 2014

From table 20 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 continues to be measured at the Morriston Groundhog and the Hafod and St Thomas DOAS sites. Lastly, $PM_{2.5}$ was 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 PM_{10} and $PM_{2.5}$ 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).

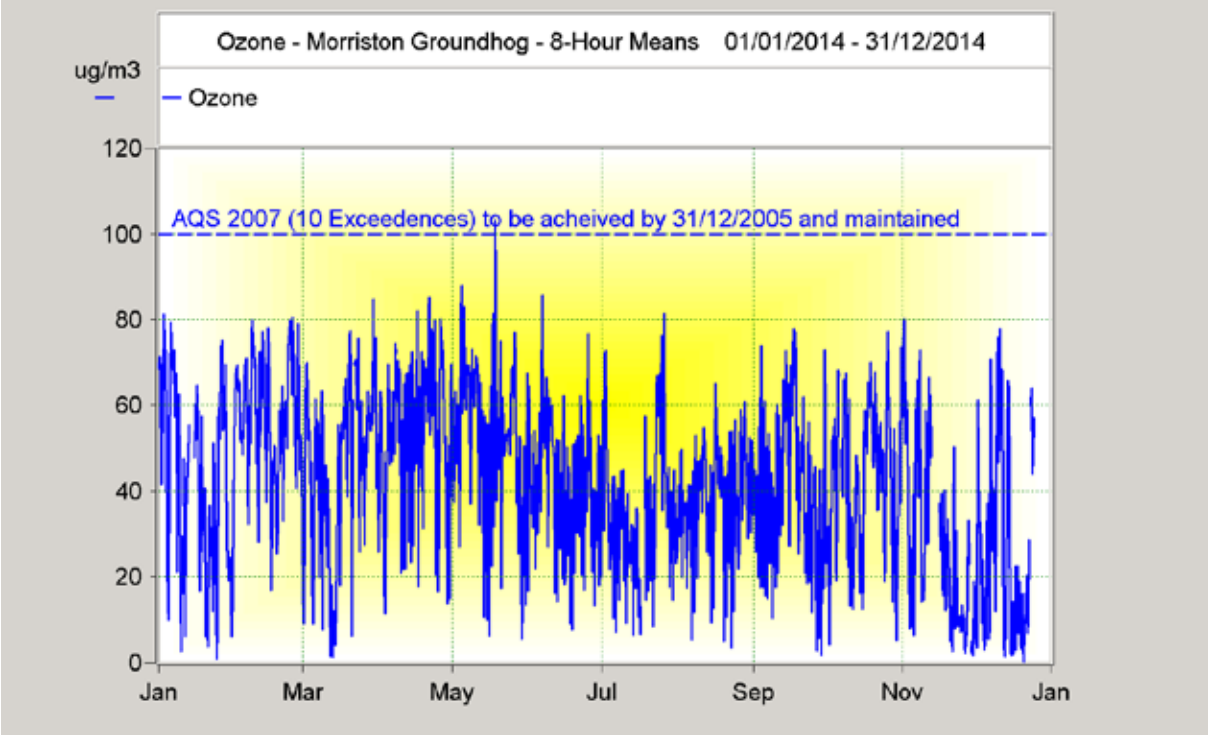
2.3.1 Ozone

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 2014. The objective for ozone is for the 8-hour means not to exceed 100$\mu g/m^3$ 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 technique providing the 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.

Ratified datasets have been downloaded from http://www.welshairquality.co.uk/data_and_statistics.php in relation to the ozone monitoring undertaken at the Morriston Groundhog and Cwm Level Park sites. 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

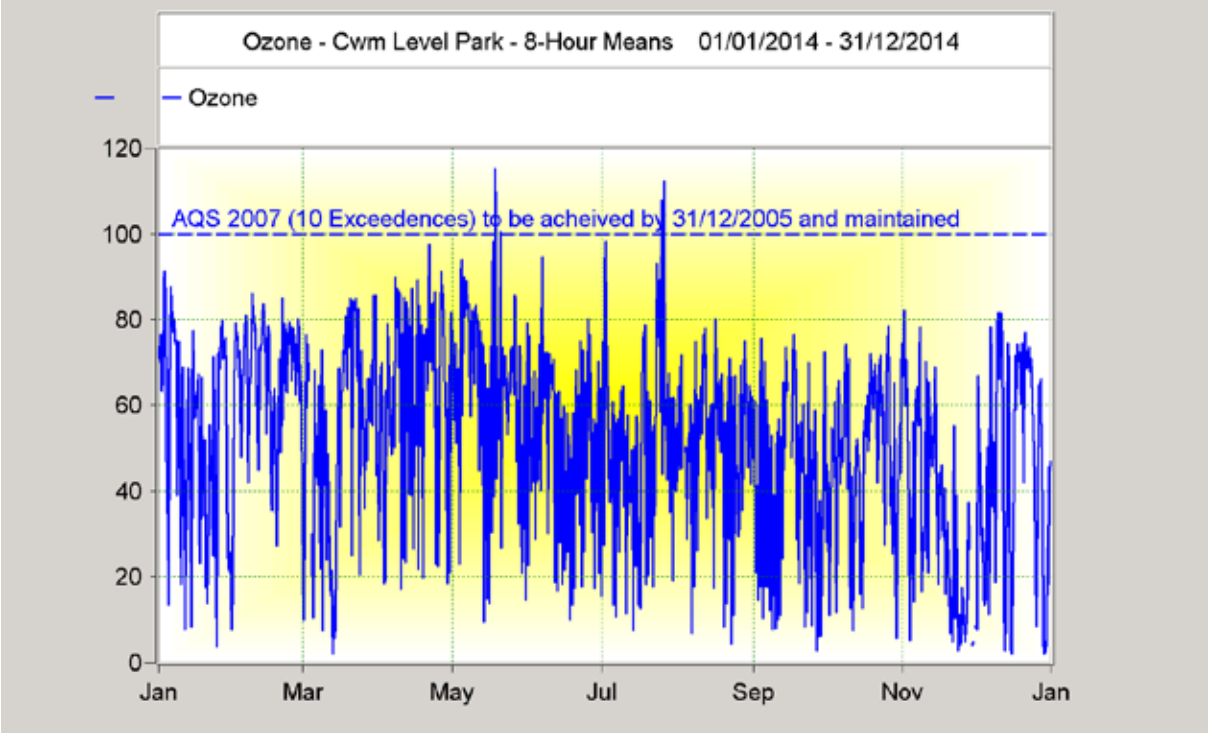
Hourly means have been used to calculate the 8-hour means. In order to form a valid 8-hour mean 75% of the hourly means were required to be present i.e. 6 out of every 8. Tables 20 - 23 detail the monitoring undertaken during 2014 along with previous years results.



Graph 19 – Morriston Groundhog – 8-hour Ozone means 2014

Morriston Groundhog	Max 8-hour Mean (mg/m^3)	Data capture (at 8 hour integration)	Exceedences of 8-hour objective 100mg/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
2012	126.50	97.63%	5
2013	111.00	93.42%	1
2014	103.25	95.71%	1

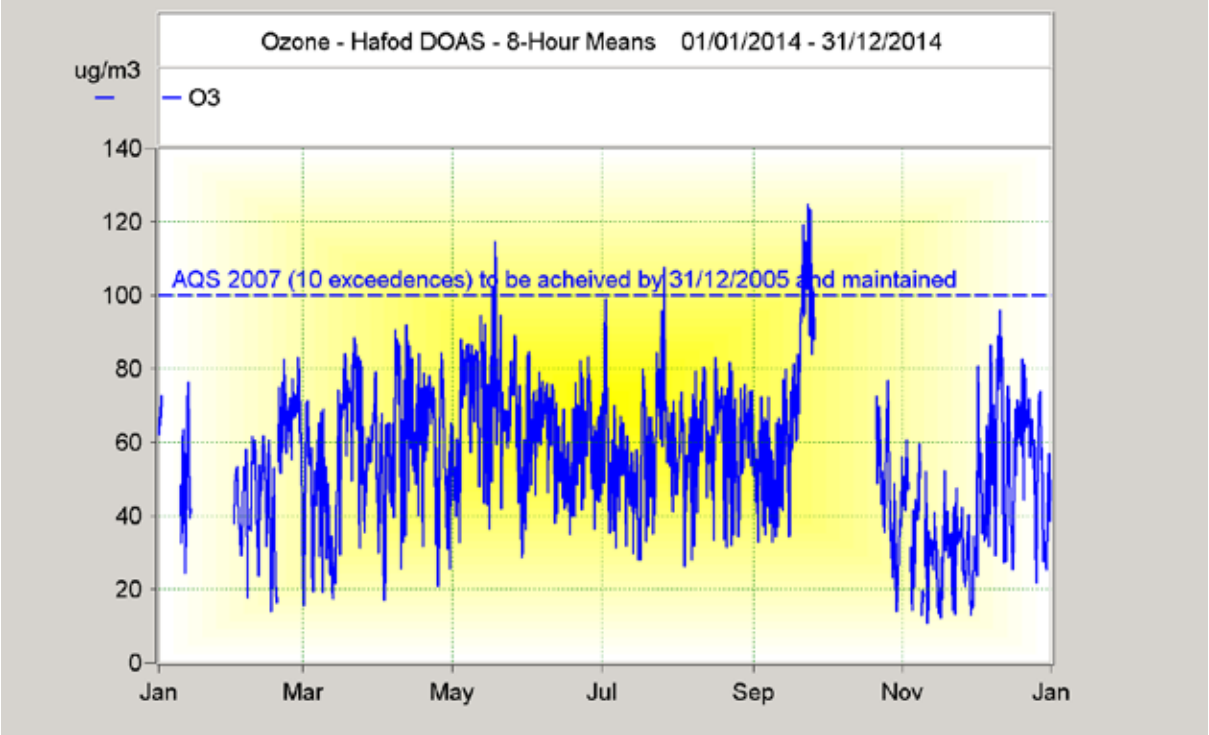
Table 20 - Morriston Groundhog – 8-hour Ozone means 2002-2014



Graph 20 – Cwm Level Park – 8-hour Ozone means 2014

Cwm Level Park	Max 8-hour Mean (mg/m^3)	Data capture	Exceedences of 8-hour objective 100mg/m^3 (10 permitted)
2009	100.75	92.6%	1
2010	106.5	98.26%	1
2011	112.0	98.63	5
2012	130.25	96.17%	5
2013	124.75	98.54%	23
2014	115.25	98.54%	5

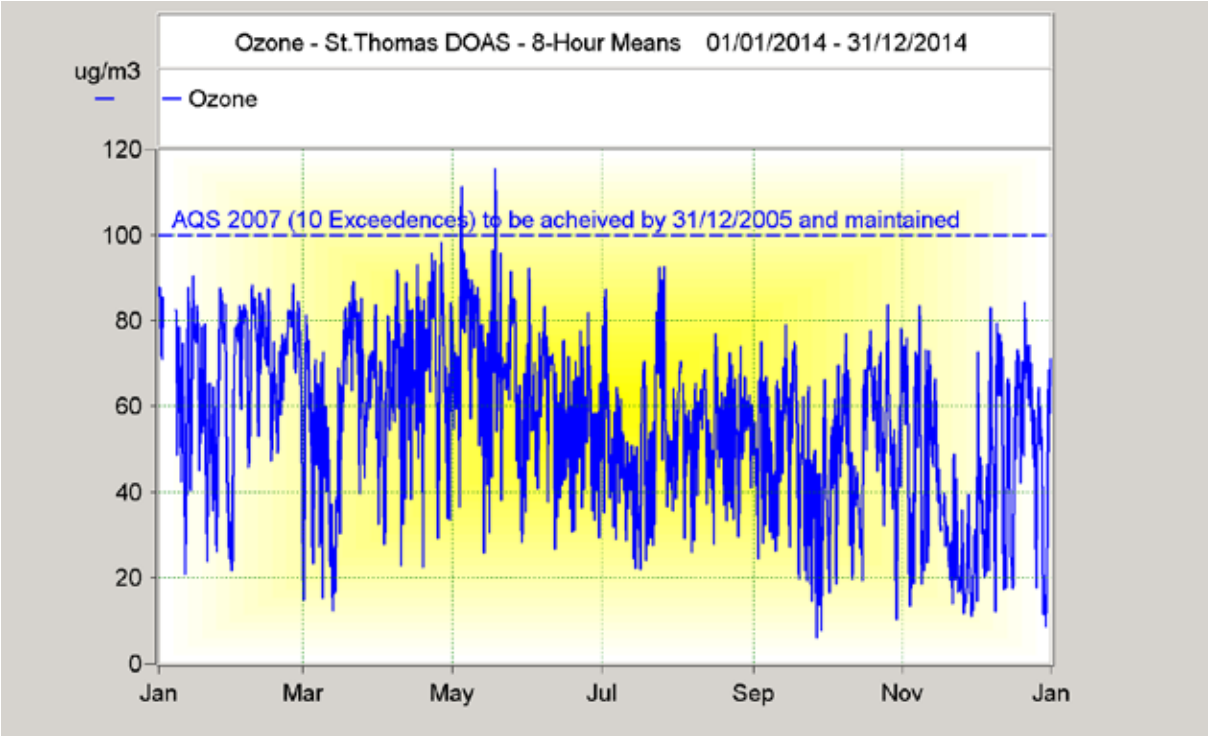
Table 21 – Cwm Level Park – 8-hour Ozone means 2009-2014



Graph 21 – Hafod DOAS – 8-hour Ozone means 2014

Hafod DOAS	Max 8-hour Mean (mg/m^3)	Data capture %	Exceedences of 8-hour objective 100mg/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
2012	141.71	99.6%	13
2013	112.60	99.1%	9
2014	124.70	85.57%	12

Table 22 – Hafod DOAS – 8-hour Ozone means 2006-2014



Graph 22 – St Thomas DOAS – 8-hour Ozone means 2014

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
2012	116.42	98.63%	4
2013	113.76	99.7%	22
2014	115.38	98.45%	4

Table 23 – St Thomas DOAS – 8-hour Ozone means 2006-2014

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.

.

Compliance is being seen at the Morriston Groundhog, Cwm level Park and St Thomas DOAS sites but at the Hafod DOAS site results from 2014 indicate an exceedence of the 10 permitted instances where the 8-hour means exceed 100ug/m^3.

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 its predecessor the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[29]. 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 referred to these parameters in different terminology. However, the FDMS unit would not directly produce a $PM_{2.5}$ mass concentration. The $PM_{2.5}$ mass concentration was obtained via post 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

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

minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present[30]. LAQM.TG(09) provides no direct guidance on $PM_{2.5}$,except for paragraphs 3.50 – 3.53.

There had 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 had been queried on many occasions as the $PM_{2.5}$ unit was reporting higher concentrations of $PM_{2.5}$ than PM_{10}. 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.

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.

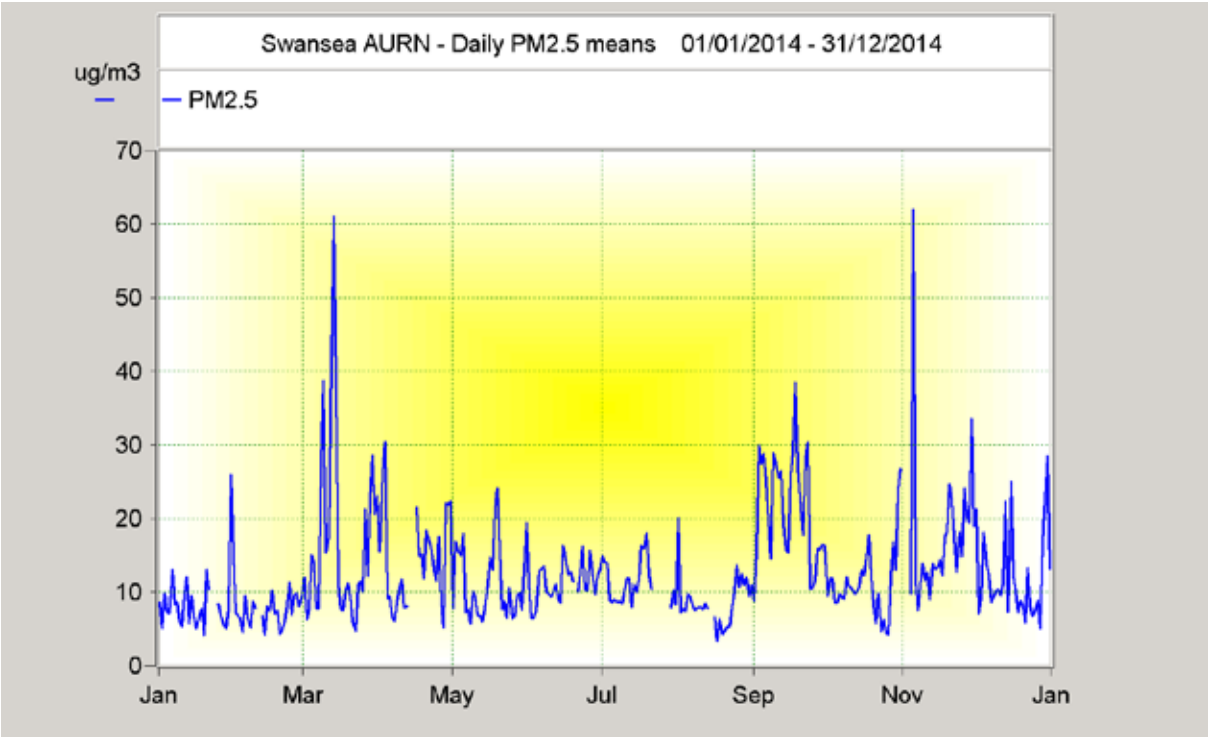
The Met One Bam $PM_{2.5}$ (smart Bam) is heated and has been determined to show equivalency to the EU reference method during recent trials without the need for the application of a correction factor.[31] [32]

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

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 was 28.66%. Graph 23 below present's daily mean data for 2014. Table 24 summarises $PM_{2.5}$ data between 2007 and 2014.

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



Graph 23 – Daily $PM_{2.5}$ means – Swansea AURN 2014

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

Swansea Roadside AURN $PM_{2.5}$	Data capture %	Annual Mean (25mg/m^3)	Max Daily Mean (mg/m^3)	Max 1-hour mean (mg/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 *
2012	97.27	11.45	56.17	199 *
2013	97.26	11.90	48.50	121
2014	94.25	12.80	61.92**	327*

Table 24 – Swansea AURN $PM_{2.5}$ daily means 2007-2014

Max 1-hour means 2011, 2012 and 2014 all occurred on 5th November

** ***Max 24-hour mean 2014 occurred on 5th November***

The $PM_{2.5}$ monitoring recorded elevated levels during the 8th - 14th March 2014. Back trajectories performed by Ricardo-AEA indicated that the air arriving in southern regions of the UK originated from central and northern Europe. This was compounded in some regions by poorly dispersed local emissions due to low wind speeds. This episode lasted for several days and is also evident within the PM_{10} monitoring within graphs 7 and 8 above.

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 25mg/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 6.

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 Reporting undertaken online at http://www.swansea.gov.uk/article/2850/Local-air-quality-management-reports

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 2008-2013 representing the last 6 years of monitoring. Additional factors should be taken into account when viewing the monitoring data. Due to the economic downturn, Vale have operated in previous years 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 previously unrecognised local, and now deemed significant sources of nickel within Pontardawe. These sources within Pontardawe were previously being masked and have 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, Ricardo AEA , 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 25.

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

Table 25 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Significant changes have occurred to the heavy metals monitoring network within Swansea during 2013 and the early part of 2014. Due to recurring issues with the equipment deployed at the Glais School site and the imposed budget restrictions the authority is operating under, monitoring ceased at Glais School on the 1st April 2013. In addition, whilst the equipment remains operational at YGG Gellionnen, a decision has been taken that due to the costs of the heavy metals analysis previously funded by the authority that monitoring would cease in January 2014. Whilst regrettable, this decision at least enabled a full year of monitoring to be completed at YGG Gellionnen.

As previously mentioned, the full monthly datasets from each of the four heavy metal monitoring locations within the authority's area have been fully reported within previous reporting.

Nickel annual mean data for the **Coed-Gwilym Cemetery site** w and the **Morriston Groundhog** y site during 2014 is presented below within table 26 which, for completeness also details the nickel annual mean results from Glais and YGG Gellionnen stations during 2002 – 2013/14. All results are expressed in ng/m^{-3}

Please note that the data for 2014 from Gellionnen Cemetery and Morriston Groundhog sites have not, as yet, completed the final data ratification procedures by NPL and is therefore subject to change at a later date.

Year	* Glais Primary School v	Coed-Gwilym Cemetery w	** YGG Gellionnen x	Morriston Groundhog y
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
2012	6.79	8.51	6.04	5.64
2013	* 4.15	7.78	** 7.53	6.51
2014	-	12.39	-	9.38

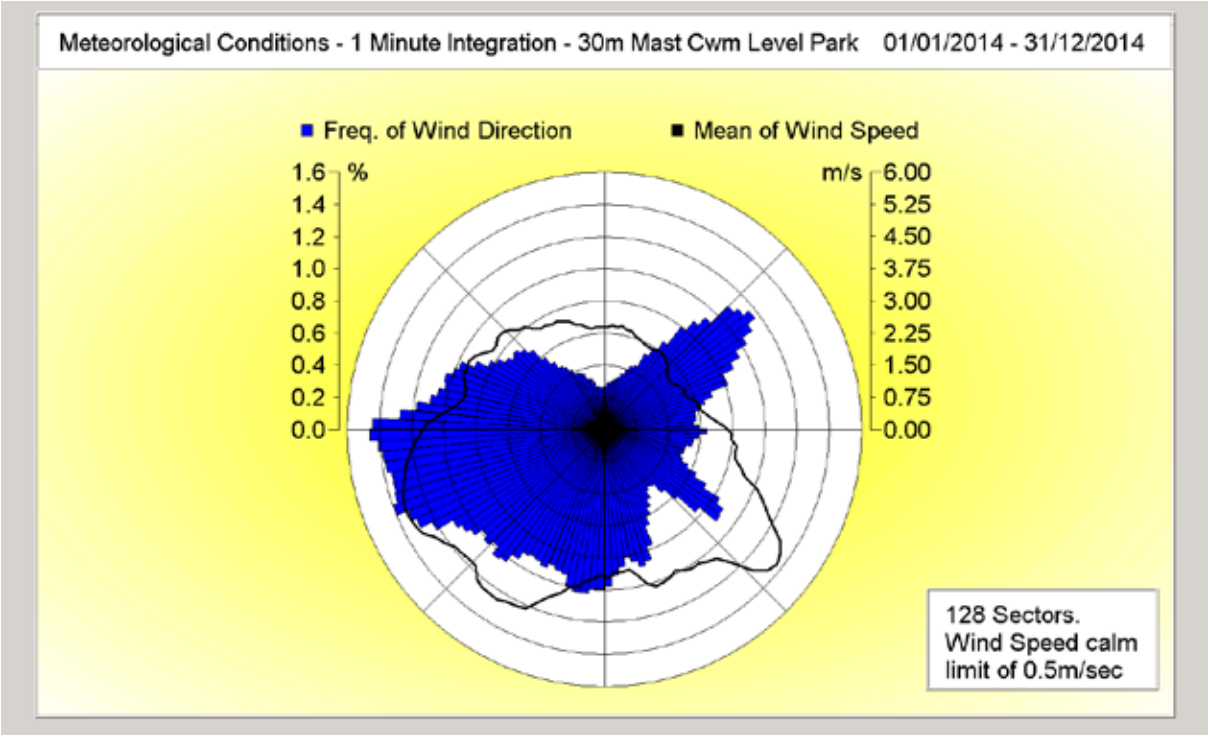
Table 26 – Swansea Nickel Annual Means 2002 – 2014

** Site ceased monitoring April 2013*

*** Site ceased monitoring January 2014*

The debate on what impacts the newly identified nickel sources further up the Swansea Valley within Pontardawe have on the monitoring stations within Swansea is still ongoing but the effect of the improved abatement at the high discharge point within the Vale was visible year on year up to 2014. It is not clear at present why the previously confirmed downward trend has ceased during 2014. Please bear in mind that the 2014 dataset awaits final ratification but it is not envisaged that completion of the ratification process will amend the data for 2014 in any significant way..

Breuer Plot 16 below shows the meteorological conditions recorded during 2014 at Cwm Level Park in the lower Swansea Valley



Breuer Plot 16 – meteorological Condition – Cwm level Park 2014 – 1 minute integration

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 (primarily during the winter months) 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.

From the data available within table 26 it is clear that nickel compliance has been achieved at all UK Network monitoring sites during 2014 and at all sites since 2008

Annual mean data between 2008 and 2014 for **arsenic (As) and cadmium (Cd)** is presented below within table 27**.** All results are expressed in ng/m^{-3}

Please note that the data for 2014 from Gellionnen Cemetery and Morriston Groundhog sites have not, as yet, completed the final data ratification procedures by NPL and is therefore subject to change at a later date.

Year	Glais Primary School v		Coed-Gwilym Cemetery w		YGG Gellionnen x		Morriston Groundhog y	
	As	Cd	As	Cd	As	Cd	As	Cd
2008	0.64	0.22	0.49	0.17	0.34	0.21	0.51	0.30
2009	0.52	0.15	0.61	0.20	0.59	0.16	0.87	0.30
2010	0.58	0.19	0.76	0.19	0.60	0.18	0.88	0.30
2011	0.50	0.23	0.50	0.17	0.44	0.19	0.78	0.33
2012	0.57	0.21	0.44	0.18	0.34	0.16	0.61	0.37
2013	*0.60	*0.19	0.62	0.22	0.52	0.24	0.83	0.51
2014	-	-	0.64	0.26	-	-	0.78	0.47

Table 27 – Annual Mean Arsenic and Cadmium data 2008-2014

*** Data capture 19%**

From table 27 above, it is clear that annual mean concentrations for arsenic and cadmium at all monitoring locations fall well below the 4th Daughter Directive Target Values.

Annual mean data from all monitoring stations between 2008 and 2014 for **lead** is presented within table 28 below**. All results are expressed in ng/m^{-3}**

Please note that the data for 2014 from Gellionnen Cemetery and Morriston Groundhog sites have not, as yet, completed the final data ratification procedures by NPL and is therefore, subject to change at a later date.

Year	Glais Primary School v	Coed-Gwilym Cemetery w	YGG Gellionnen x	Morriston Groundhog y
2008	10.21	8.0	9.04	20.5
2009	7.27	10.2	10.06	17.4
2010	9.1	8.4	8.4	18.1
2011	9.95	7.88	8.38	21.40
2012	10.0	6.20	6.0	11.6
2013	* 14.09	10.47	8.15	15.38
2014	-	9.2	-	16.71

Table 28 – Annual Mean Lead data 2008-2014

***** Data capture 19%

From the data available within table 28, 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 has continued throughout 2014. Results of all compounds measured from 2007 to December 2013 can be found by following link at:

http://uk-air.defra.gov.uk/data/non-auto-data?site_id=SWALP&network=paha&s=View+Site#site_id=SWALP&view=data - select the year i.e. 2012 and the pollutant of interest from the drop down list – each pollutant is displayed individually. However, it would appear that the data for 2014 is not available at the above site as yet. Please note that PAH Digitel (solid phase) should be selected in the PAH Network dropdown box. The ability to download the monthly data exists via the “Download this data as CSV” link at the bottom right of the data table on display.

2.4 Summary of Compliance with AQS Objectives

The City & County of Swansea has measured concentrations of nitrogen dioxide during 2014 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 2012. This view is substantiated by the knowledge that over the past years, numerous enquiries have been received from developers and other professionals requesting sight of the latest Updating Screening Assessment. Given this view, the details presented have been updated from those submitted within the USA 2012. This rational is also followed elsewhere within this Progress Report.

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,[33] the emissions database (EDB) which has been under development over the last several years was first examined. 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[34] 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

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

congested street with residential properties within 2m of the carriageway on at least one side of the road.

Following this exercise, the streets listed below within table 29 were identified. These roads were not previously thought likely to present problems with the nitrogen dioxide annual mean objective but were brought back into the scope of assessment due to the AADT requirement. The identified roads suffer congestion as defined within LAQM [35] 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 29 – Identified narrow Streets with AADT > 5000

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 complete years of monitoring undertaken. Therefore, further monitoring has ceased at those sites that

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

had exhibited bias corrected annual means concentrations consistently below 30ug/m^3.

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 2011-2014. This monitoring 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. However, it should be noted that the observed annual mean concentrations at all sites are reducing significantly. **The authority's intentions with regard to Newton Road are outlined within section 8 – Conclusions and Proposed Actions**.

Monitoring within the Pontardulais area has ceased as from the returned annual means it is apparent that the major retail store development has not created conditions where any site has exceeded the nitrogen dioxide annual mean objective of 40ug/m^3.

Monitoring commenced during 2012 at additional sites within the Gorseinon area. A request was received from the Traffic Management Group Leader to assess the impact of a traffic calming scheme designed to reduce and remove queuing traffic along High Street, Gorseinon and direct traffic down adjacent narrow residential streets. This work ceased during early 2014 as all locations remain below the nitrogen dioxide annual mean objective.

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

Assessments within the city centre have already commenced following the introduction of the Metro scheme and associated changes to the city centre road network and policy initiatives' to attract people to live within the city centre. The monitoring details are included within section 2.3 above and the results contained within table 11.

From the passive NO_2 tube survey work undertaken within the city centre during 2010/2011, 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.[36] These locations are either close to, or adjacent to, café environments situated on the pavement area alongside the busy roadway. However, during 2011 - 2014, 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 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 ideal monitoring points. However,

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. Numerous café type environments alsonow exist along The Kingsway and Westway and these are discussed above in section 2.3.

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. 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 city centre will see considerable change in the coming years following the review into the road network/layout currently being undertaken. The probable outcome will

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

see considerable alteration of the recently modified road network – in particular along the Kingsway / Orchard Street and High Street routes. It is too early in the process to comment further as all options remain open at present. This review is looking into the commercial activities within the city centre and aims to increase footfall within the city centre by increasing the number of dwellings within the city centre

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

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

The authority now operate 51 GPRS traffic counters that have been configured to produce a vehicle classification split into the EUR 6 basic categories as detailed below within table 30. **Their location can be seen within Annexe 7**. These tend to be within the lower Swansea Valley area in and around the Swansea AQMA 2010 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, significant, rapid expansion is unlikely with any expansion more likely to reflect that seen during recent years with just the addition of two or three sites.

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 30 – EUR6 Classification scheme

Data from the ATC network has been analysed for the years 2005 – 2014 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 31-33. Table 34 summarises the total HDV flows.

Class 4 L/M/HGV	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Site 1	5.2	4	5.1	4.8	4.1	3.5	3.6	3.8	**4.1**	4.4	4.4
Site 2	6	5.9	6.4	6.1	6.6	6.1	6.2	6.4	**6.2**	6.3	6.4
Site 3	4.1	3.2	4.3	4.5	7.4	16.2	4.7	4.8	**5.0**	5.2	5.4
Site 4	4	3.9	4.4	4.4	4.4	4.4	4.5	4.7	**4.7**	4.9	4.8
Site 5	5.6	5.3	5.6	5.8	5.9	5.4	5.6	5.5	5.8	5.5	5.9
Site 6	6.1	6.3	6.9	7.4	7.4	7.2	7.5	7.4	7.4	7.5	7.5
Site 7	3.9	3.8	4.2	4.5	4.8	4.6	4.7	4.8	4.9	5.2	4.9
Site 8	29.4	30	29.9	29.8	30.3	29.8	29.9	30.6	30	30.3	31.3
Site 9	6.4	6.2	6.4	6.6	6.2	5.8	6	6.2	6.2	6.5	6.8
Site 10	5	4.8	4.8	4.8	4.6	4.3	4.3	4.4	4.4	4.5	4.5
Site 11	5.8	5.8	6	6.5	6.9	6.3	6.9	6.5	6.9	6.9	7.1
Site 12	5.2	4.7	5.1	4.9	4.8	4.6	4.7	4.6	4.6	4.9	5
Site 13	4.9	4.5	4.7	4.6	4.5	4.3	4.6	4.5	4.3	4.5	4.6
Site 14	5.2	5.2	5.6	5.7	5.9	5.4	5.6	5.6	5.7	5.8	5.9
Site 15	5.4	13.5	8.4	14.4	6.1	6.1	6	6.2	6.1	6	6
Site 16	5.7	4.7	4.6	4.8	4.8	4.6	4.6	4.7	4.7	4.8	5
Site 17	2.2	2	4.3	4.1	5.3	5.1	5.3	5.4	5.4	5.5	5.7
Site 18	5	11	6.7	6.4	6.3	6.5	6.5	6.5	6.5	6.7	6.4
Site 19	5.6	5.4	5.6	5.7	5.7	5.4	5.6	5.7	5.6	5.7	5.7
Site 20	6	5.7	4.9	4.6	4.3	3.9	4.2	4.3	4.2	4	4.3
Site 21	6.1	5.8	6.4	6.5	6.7	6.5	6.5	6.7	6.8	6.8	6.9
Site 22	6.1	6.2	6.9	7	6.9	6.7	6.1	5.8	5.3	5.2	5.1
Site 23	4.7	4.5	4.8	5	4.9	4.5	4.6	4.7	4.8	4.9	5
Site 24	-	5.5	5.7	5.7	5.5	5.5	5.9	6.1	6	6.1	6
Site 25	-	4.1	4.5	6.2	6.0	5.6	5.9	6.0	5.8	6.1	6.2
Site 26	4.8	5.1	5.5	5.7	5.6	5.4	5.6	5.9	5.9	6.1	6.2
Site 27	4.3	4.5	5.1	5.5	5.7	15.6	4.5	4.6	4.4	4.5	4.7
Site 28	4.2	4.3	4.8	4.9	4.9	4.6	4.4	4.6	4.6	4.8	4.9
Site 29	4.7	4.4	4.7	4.9	4.7	4.7	4.8	5	4.8	4.8	5.2
Site 30	-	12.6	6.6	4.1	4.2	3.9	4.2	4.1	4.2	4.4	4.3
Site 31	4.1	4.1	4.4	4.6	4.7	4.7	4.8	5.1	5.1	4.7	4.7
Site 32	-	16.8	8.2	3.8	3.8	3.9	3.9	3.9	4.1	4.3	4.1
Site 33	4.1	3.9	4.2	4.4	4.4	4.5	4.6	4.5	4.6	4.6	4.6
Site 34	-	13.2	6.8	4.3	4.4	4.4	4.2	4.1	4.1	4	4.1
Site 35	-	37.5	13.9	5.3	5.7	4.8	5	5.1	5.2	5.4	5.7
Site 36	-	-	-	-	-	-	-		-	-	
Site 37	-	3.8	3.4	3.8	3.9	3.5	3.6	3.8	3.5	3.6	5.2
Site 38	-	5.9	6.4	6.5	6.3	5.8	8.6	18.8	7	6	6.4
Site 39	-	4.5	4.7	4.6	5.2	4.9	5.2	5	4.8	4.7	4.5
Site 40	3	3.1	3.5	3.8	3.9	4.0	3.8	3.9	3.9	4	4.1
Site 41	-	2.9	2.9	2.7	3.4	3.0	3.1	3.2	3.1	3.1	3.2
Site 42	-	10.9	6.9	5.2	5.1	5.0	4.8	4.9	5	5.1	5.3
Site 43	-	4.8	5.1	5.6	5.6	5.3	5.5	5.8	6	6.1	5.9
Site 44	-	-	-	6.1	6.1	5.8	6.0	6.1	6.0	6.2	6.1
Site 50	-	-	-	-	-	-	-	-	-	3.7	3.6
Site 51	-	-	-	-	-	-	-	-	-	4.2	4.3
Site 52	-	-	-	-	-	-	-	-	-	4.5	4.4
Site 53	-	-	-	-	-	-	-	-	-	4.7	4.5
Site 54	-	-	-	-	-	-	-	-	-	6.2	6.2
Site 55	-	-	-	-	-	-	-	-	-	7.0	7.1

Table 31– EUR6 Classification scheme 2004-2014 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 2005/2006 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.

During October 2014 a further two ATC sites were established at:

- Site 56 Courtney Street, Manselton
- Site 57 Lower High Street, City Centre

No data is presented for these two new sites as only just over two months of data is available for 2014.

Class 5 Artic HGV + Trailer	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Site 1	0.3	0	0.2	0	0	0.2	0.2	0.2	0.2	0.2	0.2
Site 2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Site 3	0	0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0
Site 4	0	0	0.0	0.0	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	0.3	0.3	0.3
Site 6	0.6	0.6	0.8	0.8	0.8	0.7	0.4	0.6	0.5	0.5	0.4
Site 7	0.2	0.1	0.1	0.1	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	2.2	1.5	0
Site 9	0.5	0.5	0.6	0.4	0.4	0.4	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	0.2	0.2	0.2
Site 11	0	0	0	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	0.1	0.1	0.1
Site 13	0.5	0.4	0.4	0.4	0.2	0.2	0.2	0.4	0.2	0.2	0.2
Site 14	0.2	0.2	0.3	0.3	0.1	0.2	0.3	0.3	0.2	0.2	0.3
Site 15	0	0.3	0.1	0.3	0.1	0.2	0.5	0.4	0.4	0.5	0.4
Site 16	0.3	0.2	0.2	0.2	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	0.2	0.2	0.2
Site 18	0.3	0.8	0.2	0.4	0.2	0.5	0.6	0.6	0.5	0.5	0.4
Site 19	0.3	0.4	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Site 20	0.8	0.8	0.7	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Site 21	0.4	0.3	0.2	0.2	0.2	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	0.2	0.2	0.2
Site 23	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.2
Site 24	-	0	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Site 25	-	1.1	0.5	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Site 26	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Site 27	0.2	0.3	0.3	0.2	0.4	0.3	0.4	0.2	0.2	0.2	0.2
Site 28	0	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.4	0.4	0.4
Site 29	0	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2
Site 30	-	0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2
Site 31	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 32	-	0	0.1	0	0	0.0	0	0	0.2	0.2	0
Site 33	0.2	0.2	0.2	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	0.1	0.1	0.1
Site 35	-	1.2	0.7	0.2	0.4	0.2	0.2	0.4	0.4	0.4	0.4
Site 36	-	-	-	-	-	-	-	-	-	-	-
Site 37	-	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.3	0.4	0.8
Site 38	-	0	0.3	0	0.3	0.3	0.3	0.5	0.3	0.3	0.3
Site 39	-	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3
Site 40	0	0	0	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	0.2	0.3	0.3
Site 42	-	0.4	0.2	0.2	0.2	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	1	1	1
Site 44	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Site 50	-	-	-	-	-	-	-	-	-	0.0	0
Site 51	-	-	-	-	-	-	-	-	-	0.4	0.4
Site 52	-	-	-	-	-	-	-	-	-	0.2	0.2
Site 53	-	-	-	-	-	-	-	-	-	0.1	0.1
Site 54	-	-	-	-	-	-	-	-	-	0.0	0.2
Site 55	-	-	-	-	-	-	-	-	-	1.2	1.1

Table 32 – EUR6 Classification scheme 2004-2014 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

During October 2014 a further two ATC sites were established at:

- Site 56 Courtney Street, Manselton
- Site 57 Lower High Street, City Centre

No data is presented for these two new sites as only just over two months of data is available for 2014

Class 6 Bus	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Site 1	0.3	0.3	1.2	1.6	1.4	1	0.8	0.6	0.4	0.2	0.2
Site 2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.2
Site 3	0.2	0.2	0.5	0.5	0.6	0.6	0.6	0.6	0.2	0.2	0.2
Site 4	0	0.3	0.5	0.7	0.7	0.7	0.7	0.5	0.2	0.0	0
Site 5	0	0	0.0	0.0	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	0.2	0.2	0.1
Site 7	0.5	0.4	0.6	0.8	1	0.7	1.4	0.6	0.5	0.4	0.2
Site 8	1.5	1.4	0	1.1	0	0.0	0	0	0	0	0
Site 9	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2
Site 10	0.4	0.3	0.7	0.9	0.5	0.2	0.2	0.2	0.4	0.5	0.6
Site 11	0.8	0.8	2.7	2.9	3.4	2.9	2.9	2.9	2.9	3.4	3.5
Site 12	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2
Site 13	0.6	0.4	0.2	0.2	0.4	0.4	0.2	0.2	0.2	0.2	0.4
Site 14	1.5	1.3	2	2.2	1.9	1.3	1	0.9	0.8	0.6	0.6
Site 15	0.9	1	1.1	1.2	1.1	0.9	0.6	0.5	0.5	0.5	0.4
Site 16	0.7	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.2	0.3	0.3
Site 17	0.3	0.2	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2
Site 18	1	1.6	2.1	2.1	1.7	1.3	1.3	1	0.9	0.9	1.1
Site 19	1.2	1.2	2.5	3.3	3.6	3.3	3.1	2.9	3	3	3
Site 20	1.1	1.1	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1
Site 21	0.2	0.3	0.5	0.5	0.3	0.3	0.3	0.3	0.2	0.2	0.2
Site 22	3.6	3.2	6.7	8.4	8.7	7.4	6.5	5.6	5.3	5.9	6.4
Site 23	0.5	0.4	0.7	0.9	0.9	0.8	0.8	0.8	0.9	1.1	1.3
Site 24	-	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.8	0.8
Site 25	-	0.7	0.5	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Site 26	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.4
Site 27	0.5	0.4	0.5	0.6	0.6	0.6	0.4	0.4	0.3	0.4	0.4
Site 28	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Site 29	0	0.3	1.3	1.7	1.7	1.7	1.6	1.4	1.2	1.8	1.2
Site 30	-	0.8	0.8	0.8	0.8	0.8	0.6	0.7	0.7	0.7	0.7
Site 31	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.3	0.3	0.3
Site 32	-	1.3	1.3	1.4	1.4	1.2	1.2	1	1	1	0.9
Site 33	0.2	0.5	1.1	1.5	1.3	1.3	1.3	1	1.1	0.9	1
Site 34	-	1.5	1.5	1.7	1.7	1.6	0.9	0.3	0.3	0.3	0.4
Site 35	-	2	1.6	1.5	1.4	1.2	1	0.9	1	1	0.9
Site 36	-	-	-	-	-	-	-	-	-	-	-
Site 37	-	0.9	0.8	0.7	0.8	0.8	0.7	0.8	0.6	0.8	1.2
Site 38	-	0.7	1.6	2.1	1.8	1.0	1.2	1.8	0.8	0.8	0.8
Site 39	-	0.2	0.4	0.7	0.8	0.8	0.9	0.7	0.8	0.9	0.9
Site 40	0	0.3	0.7	0.7	0.7	0.7	0.8	0.5	0.5	0.5	0.5
Site 41	-	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.6
Site 42	-	0.8	1	1.1	1.1	1.1	1	0.8	0.8	0.9	0.8
Site 43	-	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4
Site 44	-	-	-	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9
Site 50	-	-	-	-	-	-	-	-	-	0.4	0.4
Site 51	-	-	-	-	-	-	-	-	-	0.7	0.8
Site 52	-	-	-	-	-	-	-	-	-	1.1	1.3
Site 53	-	-	-	-	-	-	-	-	-	0.3	0.3
Site 54	-	-	-	-	-	-	-	-	-	0.7	0.9
Site 55	-	-	-	-	-	-	-	-	-	0.4	0.3

Table 33 – EUR6 Classification scheme 2004-2014 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 **site19** Carmarthen Road which leads directly into High Street

During October 2014 a further two ATC sites were established at:

- Site 56 Courtney Street, Manselton
- Site 57 Lower High Street, City Centre

No data is presented for these two new sites as only just over two months of data is available for 2014

HDV as % of Traffic Flow	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Site 1	5.8	4.3	6.5	6.4	5.5	4.7	4.6	4.6	4.7	4.8	4.8
Site 2	6.4	6.3	6.6	6.3	6.9	6.4	6.6	6.7	6.4	6.7	6.8
Site 3	4.3	3.4	4.8	5	8	17	5.3	5.4	5.2	5.4	5.6
Site 4	4	4.2	4.9	5.1	5.1	5.1	5.2	5.2	4.9	4.9	4.8
Site 5	5.6	5.3	5.9	6.1	6.2	5.7	5.9	5.5	6.1	5.8	6.2
Site 6	8.1	8.2	9.5	10.1	9.9	8.9	8.5	8.3	8.1	8.2	8
Site 7	4.6	4.3	4.9	5.4	5.9	5.4	6.2	5.5	5.5	5.7	5.2
Site 8	33.8	34.3	31.8	32	32.1	31.9	32.2	33	32.2	31.8	31.3
Site 9	7.4	7	7.4	7.4	7	6.6	6.8	7	6.8	7.1	7.4
Site 10	5.8	5.5	5.7	5.9	5.3	4.7	4.7	4.8	5	5.2	5.3
Site 11	6.6	6.6	8.7	9.4	10.3	9.2	9.8	9.4	9.8	10.3	10.6
Site 12	5.8	5.5	5.4	5.2	5	4.8	4.9	4.8	4.8	5.3	5.3
Site 13	6	5.3	5.3	5.2	5.1	4.9	5	5.1	4.7	4.9	5.2
Site 14	6.9	6.7	7.9	8.2	7.9	6.9	6.9	6.8	6.7	6.6	6.8
Site 15	6.3	14.8	9.6	15.9	7.3	7.2	7.1	7.1	7	7	6.8
Site 16	6.7	5.1	5.1	5.3	5.4	5.1	5	5.1	5.1	5.3	5.5
Site 17	2.6	2.4	4.9	4.7	5.9	5.6	5.7	5.8	5.8	5.9	6.1
Site 18	6.3	13.4	9	8.9	8.2	8.3	8.4	8.1	7.9	8.1	7.9
Site 19	7.1	7	8.3	9.2	9.4	8.9	8.9	8.8	8.8	8.9	8.9
Site 20	7.9	7.6	6.6	6	5.7	5.2	5.5	5.6	5.5	5.3	5.7
Site 21	6.7	6.4	7.1	7.2	7.2	7	7	7.2	7.2	7.2	7.3
Site 22	10.4	10	14	15.8	16	14.3	13	11.7	10.8	11.3	11.7
Site 23	5.5	5.1	5.7	6.1	6	5.4	5.6	5.7	5.8	6.1	6.5
Site 24	-	6.1	6.6	6.6	6.4	6.6	7	7.2	7.2	7.2	7.1
Site 25	-	5.9	5.5	7.4	7.1	6.7	7.2	7.3	7.1	7.4	7.5
Site 26	5.8	5.9	6.2	6.5	6.4	6	6.3	6.6	6.6	6.7	6.8
Site 27	5	5.2	5.9	6.3	6.7	6.5	5.3	5.2	4.9	5.1	5.3
Site 28	4.6	4.9	5.5	5.6	5.6	5.4	5.2	5.4	5.4	5.6	5.7
Site 29	4.7	5	6.2	6.8	6.6	6.6	6.6	6.6	6.2	6.9	6.6
Site 30	-	13.7	7.6	5	5.1	4.8	5	4.9	5.1	5.3	5.2
Site 31	4.7	4.6	5.1	5.3	5.4	5.4	5.5	5.8	5.6	5.2	5.2
Site 32	-	18.1	9.6	5.2	5.2	5.1	5.1	4.9	5.3	5.5	5
Site 33	4.5	4.6	5.5	6.1	5.9	6	6.1	5.7	5.9	5.7	5.8
Site 34	-	15.3	8.6	6.2	6.2	6.1	5.9	4.5	4.5	4.4	4.6
Site 35	-	40.7	16.2	7	7.5	6.2	6.2	6.4	6.6	6.8	7
Site 36	-	-	-	-	-	-	-	-	-	-	-
Site 37	-	5.1	4.6	5	5.2	4.8	4.8	5.2	4.4	4.8	7.2
Site 38	-	6.6	8.3	8.6	8.4	7.1	10.1	21.1	8.1	7.1	7.5
Site 39	-	4.9	5.4	5.6	6.3	6	6.4	6	5.8	5.8	5.7
Site 40	3	3.4	4.2	4.5	4.6	4.7	4.6	4.4	4.4	4.5	4.6
Site 41	-	3.3	3.3	3.1	3.8	3.5	3.7	3.8	3.7	3.8	4.1
Site 42	-	12.1	8.1	6.5	6.4	6.3	6	5.9	6	6.2	6.3
Site 43	-	6.3	6.4	6.9	7	6.5	6.9	7	7.3	7.4	7.3
Site 44	-	-	-	7.4	7.4	7.1	7.4	7.4	7.3	7.5	7.4
Site 50	-	-	-	-	-	-	-	-	-	4.1	4
Site 51	-	-	-	-	-	-	-	-	-	5.3	5.5
Site 52	-	-	-	-	-	-	-	-	-	5.8	5.9
Site 53	-	-	-	-	-	-	-	-	-	5.1	4.9
Site 54	-	-	-	-	-	-	-	-	-	6.9	7.3
Site 55	-	-	-	-	-	-	-	-	-	8.6	8.5

Table 34– HDV composition from EUR6 Classification scheme 2004-2014

During October 2014 a further two ATC sites were established at:

- Site 56 Courtney Street, Manselton
- Site 57 Lower High Street, City Centre

No data is presented for these two new sites as only just over two months of data is available for 2014

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 32 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 has change significantly within the last year. Residential development at the former Unit Superheaters site commenced during mid 2011 mainly with single storey “town housing/link houses” to the southern/eastern edge of the site. The majority of these properties are now occupied. During 2012 and into 2013, the developer constructed blocks of flats within the middle section of the site and occupation has taken place during late 2014. Development has now focused on the remaining areas of the site that border both New Cut Road and Morfa Road directly behind the authorities’ main transport depot. There are proposals to dispose off/sell-off the authority’s transportation depot in the near future and relocate the activities undertaken. However, this has not progressed with no alternative location being confirmed at present although several are under consideration. At present therefore, the HDV content existing along Morfa Road will remain, become significant and therefore guidance within LAQM.TG(09) box 5.3 will become relevant once the final block of flat are constructed along Morfa Road . As part of a Section 106 agreement entered into with the developer a real-time chemiluminescent analyser is to be installed along the façade of proposed student flats fronting Morfa Road/New Cut Road. As time progresses, details from this new monitoring location will be incorporated within the authorities reporting.

Morfa Road falls within the development proposals of The Tawe Riverside Development Corridor. These proposals include residential developments northwards 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 but it is inevitable that works will commence at some stage 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.

As part of the aspiration to provide a “Morfa Distribution Route”, forming part of the Tawe Riverside Corridor developments, the lower section of Morfa Road from the entrance to the authorities Pipehouse Wharf depot to its junction with New Cut Road has been widened and upgraded to a signal controlled junction, being completed during the early part of 2014. This work has meant that the ATC at site 8 has been removed during late 2013 and is was relocated during June 2014. Care has been taken to ensure the new chosen location is representative of its current location so that fair comparisons to the past/present traffic flows can be made whilst ensuring high data quality. This ATC will allow monitoring of the composition during the transition of the area from a commercial/industrial area to primarily, a residential area. Phase 2 of the Morfa Distributor Road commenced early spring 2014.

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 post 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 had already been identified as the proposed site at Westway but a recent investigation into real-time ATC provision has indicated that a minimum of three ATC sites will be required to monitor all lanes and movements.

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. However, following a review of the data monitoring has been scaled back around the Nantyffin Road area of Llansamlet as numerous sites have consistently returned bias corrected nitrogen dioxide annual means below 30ug/m^3.

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 ETypes samplers proved unreliable in operation. Major problems have been experienced with pump failures and other operational issues. The plans to utilise these samplers has now changed and funding was provided to source a different analyser.

The unit chosen was the MetOne EBam PM_{10} [37] (similar in operation to the MetOne PM_{10} Bam1020) but not referenced for equivalency to the EU gravimetric method. As outlined within sections 2.1.8 – 2.1.12 five EBam PM_{10} units have been installed at :-

- Fforestfach Cross
- Uplands Crescent
- Sketty Cross
- Westway
- SA1 Junction Port Tennant Road

Monitoring results for 2014 are presented within table 17 with charts 9-13 and Breuer Plots 7-11 providing additional information.

The remaining 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:

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

a) Oystermouth Road
b) Llansamlet Cross
c) Quay Parade Bridges
d) Dyfatty Junction

Whilst it has been possible to report the results of the NO_2 monitoring around these junctions, reliable long term PM_{10} monitoring has not proved possible due to the issues described above. It is not known if/when funding will be available to permit installation of EBams at the four remaining locations listed above.

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

With the exception of the information provided above in section 3.1.3 in relation to the developments with the Morfa Distributor/Relief road the authority confirms there are no new//proposed roads within the authority's area.

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 2006-2014 but only data from 2011 is presented below within tables 35-38 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 35-38 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 at the ATC site is total.

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 35 – GPRS ATC Classification split 2011

2012	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1		1.2	93.9	0.2	4.1	0.2	0.4	**11712**	**12456**
Site 2		0.7	92.8	0.2	6.2	0.0	0.2	**13944**	**14928**
Site 3		0.4	94.2	0.2	5.0	0.0	0.2	**12888**	**13680**
Site 4		0.7	94.3	0.0	4.7	0.0	0.2	**9672**	**10248**
Site 5		1.3	92.7	0.0	5.8	0.3	0.0	**7512**	**8064**
Site 6		1.6	90.2	0.2	7.4	0.5	0.2	**15480**	**16344**
Site 7		0.8	93.5	0.1	4.9	0.1	0.5	**20424**	**21744**
Site 8		5.6	62.2	0	30	2.2	0	**2184**	**2784**
Site 9		0.6	92.4	0.2	6.2	0.4	0.2	**11928**	**12648**
Site 10		0.4	93.9	0.7	4.4	0.2	0.4	**19824**	**21072**
Site 11		0.6	89.7	0	6.9	0	2.9	**4224**	**4416**
Site 12		0.8	94.2	0.1	4.6	0.1	0.1	**18768**	**20256**
Site 13		0.8	94.4	0.2	4.3	0.2	0.2	**12408**	**14112**
Site 14		1.1	92	0.3	5.7	0.2	0.8	**15864**	**16728**
Site 15		0.9	92	0.1	6.1	0.4	0.5	**22080**	**23616**
Site 16		0.7	94	0.2	4.7	0.2	0.2	**26208**	**27768**
Site 17		0.7	93.3	0.2	5.4	0.2	0.2	**29112**	**30888**
Site 18		1.7	90.3	0.2	6.5	0.5	0.9	**15840**	**16824**
Site 19		0.8	90.2	0.1	5.6	0.2	3	**20832**	**21696**
Site 20		1.1	93.3	0.2	4.2	0.4	0.9	**31704**	**33480**
Site 21		0.8	91.8	0.2	6.8	0.2	0.2	**29640**	**31800**
Site 22		0.7	88.4	0.2	5.3	0.2	5.3	**10512**	**10656**
Site 23		0.6	93.5	0.1	4.8	0.1	0.9	**20736**	**22056**
Site 24		3	89.9	0	6	0.3	0.9	**8040**	**8568**
Site 25		0.9	91.9	0.2	5.8	0.4	0.9	**13320**	**14040**
Site 26		0.6	92.6	0.2	5.9	0.2	0.5	**20784**	**22008**
Site 27		0.3	94	0.7	4.4	0.2	0.3	**20688**	**22104**
Site 28		0.4	93.6	0.6	4.6	0.4	0.4	**12408**	**13176**
Site 29	2.9	0.7	89.8	0.2	4.8	0.2	1.2	**9912**	**10512**
Site 30		0.9	93.7	0.2	4.2	0.2	0.7	**20424**	**21816**
Site 31		1.1	93	0.3	5.1	0.2	0.3	**14712**	**15216**
Site 32		0.6	94	0.2	4.1	0.2	1	**15072**	**15864**
Site 33		0.8	93.2	0.1	4.6	0.2	1.1	**20472**	**21360**
Site 34		0.4	93.9	1.2	4.1	0.1	0.3	**16464**	**17496**
Site 35		1.3	91.9	0.2	5.2	0.4	1	**12480**	**13008**
Site 36									
Site 37		0.8	93.8	1	3.5	0.3	0.6	**29736**	**31176**
Site 38		0.5	90.1	1.3	7	0.3	0.8	**8952**	**9600**
Site 39		1.3	92.7	0.2	4.8	0.2	0.8	**21960**	**22968**
Site 40		0.8	94.8	0	3.9	0	0.5	**9264**	**9888**
Site 41		0.5	95.6	0.3	3.1	0.2	0.4	**28680**	**30480**
Site 42		0.9	92.9	0.2	5	0.2	0.8	**15192**	**16272**
Site 43		1.3	90.9	0.5	6	1	0.3	**28080**	**30456**
Site 44		0.9	91.5	0.2	6.0	0.4	0.9	**12720**	**13488**
*Site 50		1.9	93.8	0.6	3.7	0	0	**3888**	**3840**
*Site 51		0.9	93.8	0.1	4.2	0.4	0.6	**18864**	**20040**
*Site 52		0.7	93.3	0.4	4.5	0	1.1	**6408**	**6768**
*Site 53		0.8	93.5	0.6	4.8	0	0.4	**12072**	**12672**

Table 36 – GPRS ATC Classification split 2012

* AADT Data should be treated with caution as sites installed during May 2012 and do not represent a full year of monitoring

2013	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	1	93.9	0.2	4.4	0.2	0.2	**11424**	**12192**
Site 2	0.0	0.8	92.4	0.2	6.3	0.2	0.2	**14184**	**15240**
Site 3	0.0	0.4	94.1	0.2	5.2	0.0	0.2	**13008**	**13848**
Site 4	0.0	0.7	94.4	0.0	4.9	0.0	0.0	**9840**	**10440**
Site 5	0.0	1.0	93.2	0.0	5.5	0.3	0.0	**7416**	**7920**
Site 6	0.0	1.4	90.3	0.2	7.5	0.5	0.2	**15336**	**16176**
Site 7	0.0	0.8	93.4	0.1	5.2	0.1	0.4	**20376**	**21792**
Site 8	0.0	6.1	62.1	0	30.3	1.5	0	**1584**	**2040**
Site 9	0.0	0.8	92	0.2	6.5	0.4	0.2	**12552**	**13368**
Site 10	0.0	0.4	93.6	0.8	4.5	0.2	0.5	**20376**	**21720**
Site 11	0.0	0.6	89.1	0	6.9	0	3.4	**4200**	**4368**
Site 12	0.0	0.7	93.9	0.1	4.9	0.1	0.3	**18072**	**19488**
Site 13	0.0	0.8	94.1	0.2	4.5	0.2	0.2	**12192**	**13848**
Site 14	0.0	0.9	92.2	0.3	5.8	0.2	0.6	**15648**	**16488**
Site 15	0.0	0.9	91.9	0.1	6	0.5	0.5	**18096**	**19272**
Site 16	0.0	0.7	93.8	0.2	4.8	0.2	0.3	**26496**	**28032**
Site 17	0.0	0.7	93.2	0.2	5.5	0.2	0.2	**29064**	**30816**
Site 18	0.0	2.5	89.3	0.2	6.7	0.5	0.9	**15504**	**16416**
Site 19	0.0	0.8	90.2	0.1	5.7	0.2	3	**21048**	**22032**
Site 20	4.5	1	89	0.2	4	0.4	0.9	**32232**	**34128**
Site 21	0.0	0.7	91.9	0.2	6.8	0.2	0.2	**29736**	**31896**
Site 22	0.0	0.5	88.2	0	5.2	0.2	5.9	**9792**	**9936**
Site 23	0.0	0.6	93.2	0.1	4.9	0.1	1.1	**21168**	**22584**
Site 24	0.0	2.1	90.6	0	6.1	0.3	0.8	**8976**	**9624**
Site 25	0.0	0.9	91.6	0.2	6.1	0.4	0.9	**13464**	**14280**
Site 26	0.0	0.4	92.6	0.2	6.1	0.2	0.4	**22056**	**23472**
Site 27	0.0	0.3	93.8	0.7	4.5	0.2	0.4	**21456**	**22944**
Site 28	0.0	0.4	93.5	0.6	4.8	0.4	0.4	**12600**	**13368**
Site 29	1.3	0.8	91.3	0.3	4.8	0.3	1.8	**9408**	**10008**
Site 30	0.0	0.9	93.5	0.2	4.4	0.2	0.7	**20256**	**21624**
Site 31	0.0	0.8	93.7	0.3	4.7	0.2	0.3	**14784**	**15336**
Site 32	0.0	0.5	93.9	0.2	4.3	0.2	1	**14568**	**15288**
Site 33	0.0	0.8	93.3	0.1	4.6	0.2	0.9	**20640**	**21576**
Site 34	0.0	0.4	93.9	1.2	4	0.1	0.3	**16632**	**17664**
Site 35	0.0	1.3	92	0	5.4	0.4	1	**12528**	**13128**
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.1	93	1	3.6	0.4	0.8	**37824**	**39528**
Site 38	0.0	0.5	91	1.4	6	0.3	0.8	**8760**	**9432**
Site 39	0.0	1.1	92.9	0.2	4.7	0.2	0.9	**22032**	**23112**
Site 40	0.0	0.7	94.8	0	4	0	0.5	**9744**	**10416**
Site 41	0.0	0.6	95.4	0.3	3.1	0.3	0.4	**28292**	**30168**
Site 42	0.0	0.8	92.9	0.2	5.1	0.2	0.9	**15168**	**16296**
Site 43	0.0	1.3	90.7	0.5	6.1	1	0.3	**28224**	**30672**
Site 44	0.0	0.9	91.4	0.2	6.2	0.4	0.9	**12792**	**13608**
Site 50	0.0	1.5	93.8	0.7	3.7	0.0	0.4	**6576**	**6552**
Site 51	0.0	0.9	93.7	0.1	4.2	0.4	0.7	**32184**	**34416**
Site 52	0.0	0.6	93.3	0.2	4.5	0.2	1.1	**11112**	**11832**
Site 53	0.0	0.7	93.7	0.5	4.7	0.1	0.3	**20904**	**22152**
* Site 54	0.0	2.9	90.1	0.0	6.2	0.0	0.7	**6600**	**6792**
* Site 55	0.0	0.6	90.7	0.2	7.0	1.2	0.4	**12408**	**13272**

Table 37 – GPRS ATC Classification split 2013

2014	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0	1	94	0.2	4.4	0.2	0.2	0	1
Site 2	0	0.8	92.2	0.2	6.4	0.2	0.2	0	0.8
Site 3	0	0.6	93.9	0	5.4	0	0.2	0	0.6
Site 4	0	0.7	94.5	0	4.8	0	0	0	0.7
Site 5	0	1	92.8	0	5.9	0.3	0	0	1
Site 6	0	1.5	90.3	0.1	7.5	0.4	0.1	0	1.5
Site 7	2.5	0.8	91.3	0.1	4.9	0.1	0.2	2.5	0.8
Site 8	0	0	68.8	0	31.3	0	0	0	0
Site 9	0	0.8	91.6	0.2	6.8	0.4	0.2	0	0.8
Site 10	0	0.6	93.2	0.8	4.5	0.2	0.6	0	0.6
Site 11	0	0.6	88.8	0	7.1	0	3.5	0	0.6
Site 12	0	0.7	93.8	0.1	5	0.1	0.2	0	0.7
Site 13	0	0.8	93.8	0.2	4.6	0.2	0.4	0	0.8
Site 14	0	1	91.9	0.3	5.9	0.3	0.6	0	1
Site 15	0	0.9	92.1	0.1	6	0.4	0.4	0	0.9
Site 16	0	0.7	93.7	0.1	5	0.2	0.3	0	0.7
Site 17	0	0.7	93.1	0.2	5.7	0.2	0.2	0	0.7
Site 18	0	1.4	90.4	0.4	6.4	0.4	1.1	0	1.4
Site 19	0	0.8	90.2	0.1	5.7	0.2	3	0	0.8
Site 20	0	1.1	93.1	0.2	4.3	0.4	1	0	1.1
Site 21	0	0.7	91.8	0.2	6.9	0.2	0.2	0	0.7
Site 22	0	0.4	87.8	0	5.1	0.2	6.4	0	0.4
Site 23	0	0.6	92.8	0.1	5	0.2	1.3	0	0.6
Site 24	0	2.1	90.8	0	6	0.3	0.8	0	2.1
Site 25	0	0.9	91.5	0.2	6.2	0.4	0.9	0	0.9
Site 26	0	0.4	92.5	0.2	6.2	0.2	0.4	0	0.4
Site 27	0	0.4	93.5	0.7	4.7	0.2	0.4	0	0.4
Site 28	0	0.4	93.4	0.6	4.9	0.4	0.4	0	0.4
Site 29	0	0.7	92.4	0.2	5.2	0.2	1.2	0	0.7
Site 30	0	1	93.5	0.2	4.3	0.2	0.7	0	1
Site 31	0	0.8	93.8	0.2	4.7	0.2	0.3	0	0.8
Site 32	0	0.5	94.4	0.2	4.1	0	0.9	0	0.5
Site 33	0	0.7	93.4	0.1	4.6	0.2	1	0	0.7
Site 34	0	0.4	93.8	1.1	4.1	0.1	0.4	0	0.4
Site 35	0	1.5	91.4	0.2	5.7	0.4	0.9	0	1.5
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0	1.4	90.3	1.1	5.2	0.8	1.2	0	1.4
Site 38	0	0.5	90.6	1.3	6.4	0.3	0.8	0	0.5
Site 39	4	1.2	89	0.1	4.5	0.3	0.9	4	1.2
Site 40	0	0.8	94.6	0	4.1	0	0.5	0	0.8
Site 41	0	0.6	95	0.3	3.2	0.3	0.6	0	0.6
Site 42	0	0.8	92.8	0.2	5.3	0.2	0.8	0	0.8
Site 43	0	1.2	91	0.4	5.9	1	0.4	0	1.2
Site 44	0	0.9	91.4	0.2	6.1	0.4	0.9	0	0.9
Site 50	0	1.4	93.9	0.7	3.6	0	0.4	0	1.4
Site 51	0	0.9	93.5	0.2	4.3	0.4	0.8	0	0.9
Site 52	0	0.6	93.3	0.2	4.4	0.2	1.3	0	0.6
Site 53	0	0.7	93.9	0.4	4.5	0.1	0.3	0	0.7
Site 54	0	2.8	89.6	0.2	6.2	0.2	0.9	0	2.8
Site 55	0	0.5	90.7	0.3	7.1	1.1	0.3	0	0.5

Table 38 – GPRS ATC Classification split 2014

To assess if the AADT has changed significantly over the period 2006-2012, data is presented below in table 39.

Site	AADT 2011	AADT 2012	AADT 2013	AADT 2014	% Diff 2014 over 2011	% Diff 2014 over 2012	% Diff 2014 over 2013
1	12000	11712	11424	11496	-4.20	-1.84	**0.63**
2	14376	13944	14184	14208	-1.17	**1.89**	**0.17**
3	12984	12888	13008	12984	0.00	**0.74**	-0.18
4	9720	9672	9840	9984	**2.72**	**3.23**	**1.46**
5	7440	7512	7416	7344	-1.29	-2.24	-0.97
6	15888	15480	15336	16272	**2.42**	**5.12**	**6.10**
7	20832	20424	20376	20400	-2.07	-0.12	**0.12**
8æ	2040	2184	1584	-	-	-	
9	10848	11928	12552	12288	**13.27**	**3.02**	-2.10
10	19440	19824	20376	20184	**3.83**	**1.82**	-0.94
11	4080	4224	4200	4104	**0.59**	-2.84	-2.29
12	18072	18768	18072	19392	**7.30**	**3.32**	**7.30**
13	12216	12408	12192	12024	-1.57	-3.09	-1.38
14	16200	15864	15648	16656	**2.81**	**4.99**	**6.44**
15¿	22536	22080	18096	22008	-2.34	-0.33	**21.62**
16	26208	26208	26496	26256	**0.18**	**0.18**	-0.91
17	29472	29112	29064	29256	-0.73	**0.49**	**0.66**
18æ	16320	15840	15504	-	-	-	-
19	21192	20832	21048	21120	-0.34	**1.38**	**0.34**
20	30888	31704	32232	31824	**3.03**	**0.38**	-1.27
21	30240	29640	29736	30288	**0.16**	**2.19**	**1.86**
22	9504	10512	9792	10824	**13.89**	**2.97**	**10.54**
23	20568	20736	21168	20904	**1.63**	**0.81**	-1.25
24	8976	8040	8976	9144	**1.87**	**13.73**	**1.87**
25	13128	13320	13464	13512	**2.93**	**1.44**	**0.36**
26	19800	20784	22056	22248	**12.36**	**7.04**	**0.87**
27	19392	20688	21456	21528	**11.01**	**4.06**	**0.34**
28	12360	12408	12600	12696	**2.72**	**2.32**	**0.76**
29	9984	9912	9408	10080	**0.96**	**1.69**	**7.14**
30	20424	20424	20256	20592	**0.82**	**0.82**	**1.66**
31	15600	14712	14784	14424	-7.54	-1.96	-2.44
32	16080	15072	14568	15984	-0.60	**6.05**	**9.72**
33	21144	20472	20640	21408	**1.25**	**4.57**	**3.72**
34	16896	16464	16632	17472	**3.41**	**6.12**	**5.05**
35	13152	12480	12528	13104	-0.36	**5.00**	**4.60**
36	-	-	-	-	-	-	-
37æ	45288	29736	37824	-	-	-	-
38	9168	8952	8760	8952	-2.36	0.00	**2.19**
39	22632	21960	22032	21840	-3.50	-0.55	-0.87
40	9144	9264	9744	9408	**2.89**	**1.55**	-3.45
41	27336	28680	28292	26160	-4.30	-8.79	-7.54
42	15192	15192	15168	15288	**0.63**	**0.63**	**0.79**
43	28752	28080	28224	27600	-4.01	-1.71	-2.21
44	12936	12720	12792	12888	-0.37	**1.32**	**0.75**
*** 50**	-	3888	6576	6696	-	**-**	**1.82**
*** 51**	-	18864	32184	31008	-	**-**	-3.65
*** 52**	-	6408	11112	11520	-	**-**	**3.67**
*** 53**	-	12072	20904	21840	-	**-**	**4.48**

Table 39 AADT Percentage Growth 2011-2014

* No significance on growth figures should be implied as sites established May 2012 ¿ Site recut following resurfacing works 2013

æSites affected by highway improvements/resurfacing during 2014

No significance should be taken from the data presented within table 39 above for sites 6, site 22 or 30 for 2010 data comparisons as these sites were affected by either gas main replacement works or resurfacing works with total data loss for significant periods. Similarly, site 37 data for 2012 and 2014 has been affected by highway alterations as part of the phasing of the Boulevard scheme and is not indicative of any trend.

Similarly, site 8 was removed during late 2013 to permit phase 1 of the Morfa Distribution Road to be undertaken whilst site 15 was affected by resurfacing works during 2013.

Site 24 has seen an increase I flow during 2013 but again, no significance can be placed on the growth rate due to gas main replacement works along Carmarthen Road during 2012 distorting the AADT. The AADT for 2013 has retuned to normal during 2013.

Sites 50-53 are presented for information only and no significance should be placed on the growth figures for 2013 as these are based on an incomplete picture for the base year of 2012.

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%. There is no evidence to determine that such an increase has been seen at any of the GPRS ATC’s.

The details relating to the Swansea Metro project have been reported previously as significant highway alterations were undertaken to permit operation of the Metro service. The likelihood is that the metro route will be significantly altered within the city centre as part of the ongoing review.

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.

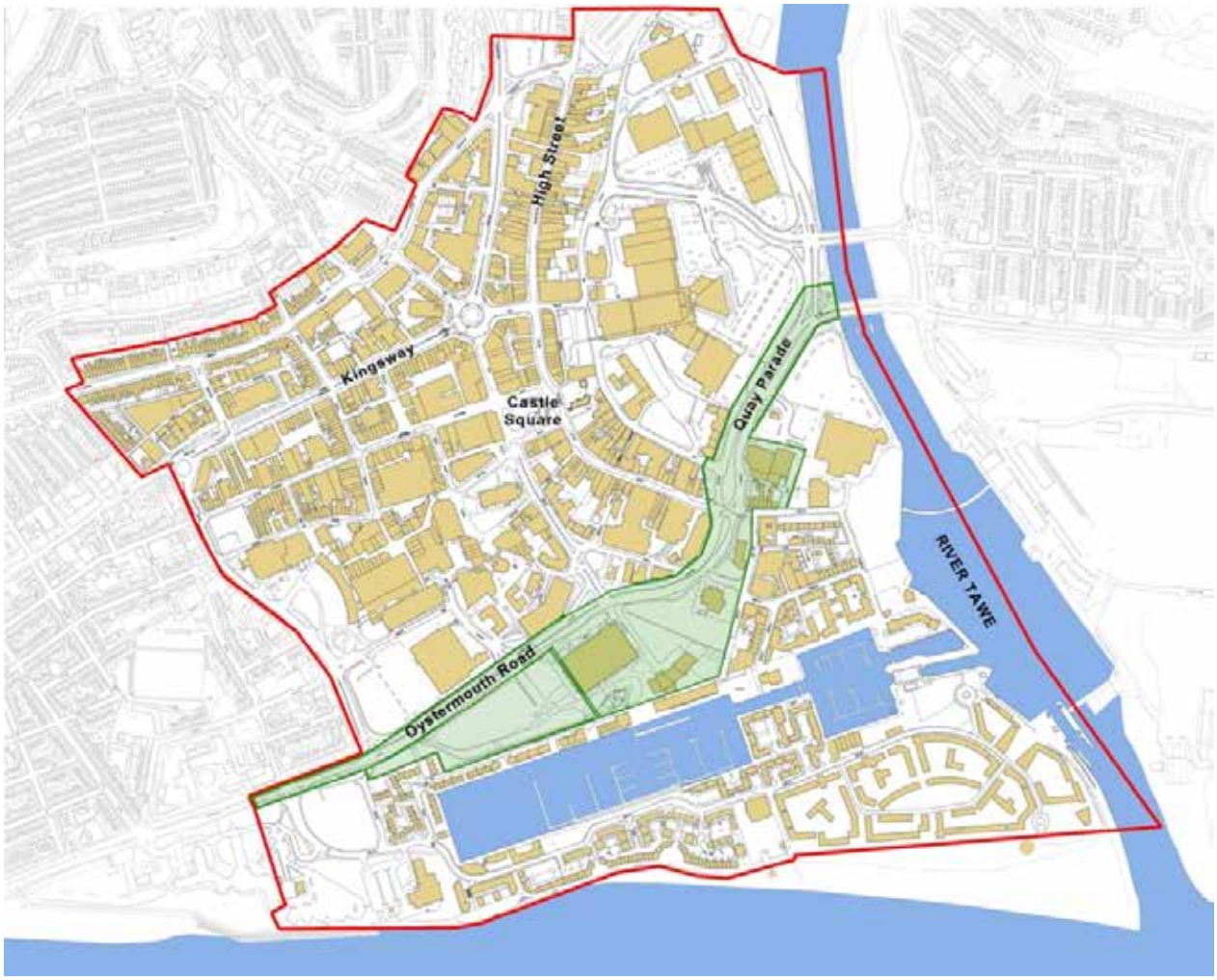
The project is to create a "boulevard" from the river bridges to the Civic Centre which provides a step change in perceptions of this gateway corridor from an urban freeway to a vibrant tree lined city street which allows the connection of the City Centre to the Maritime Quarter. The Boulevard will encourage 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 commenced in January 2013 and covered the section between the Leisure Centre to Wind Street and was completed December 2013. Phase 3 commenced during January 2014 covering Wind Street to the Tawe Bridges.

The works to Phase 2 and 3 provided 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



Map 18 *Swansea Boulevard project*

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All works in relation to the Boulevard project were completed during late October/early November 2014. GPRS ATC site 37 Quay Parade was reinstated during October 2014.

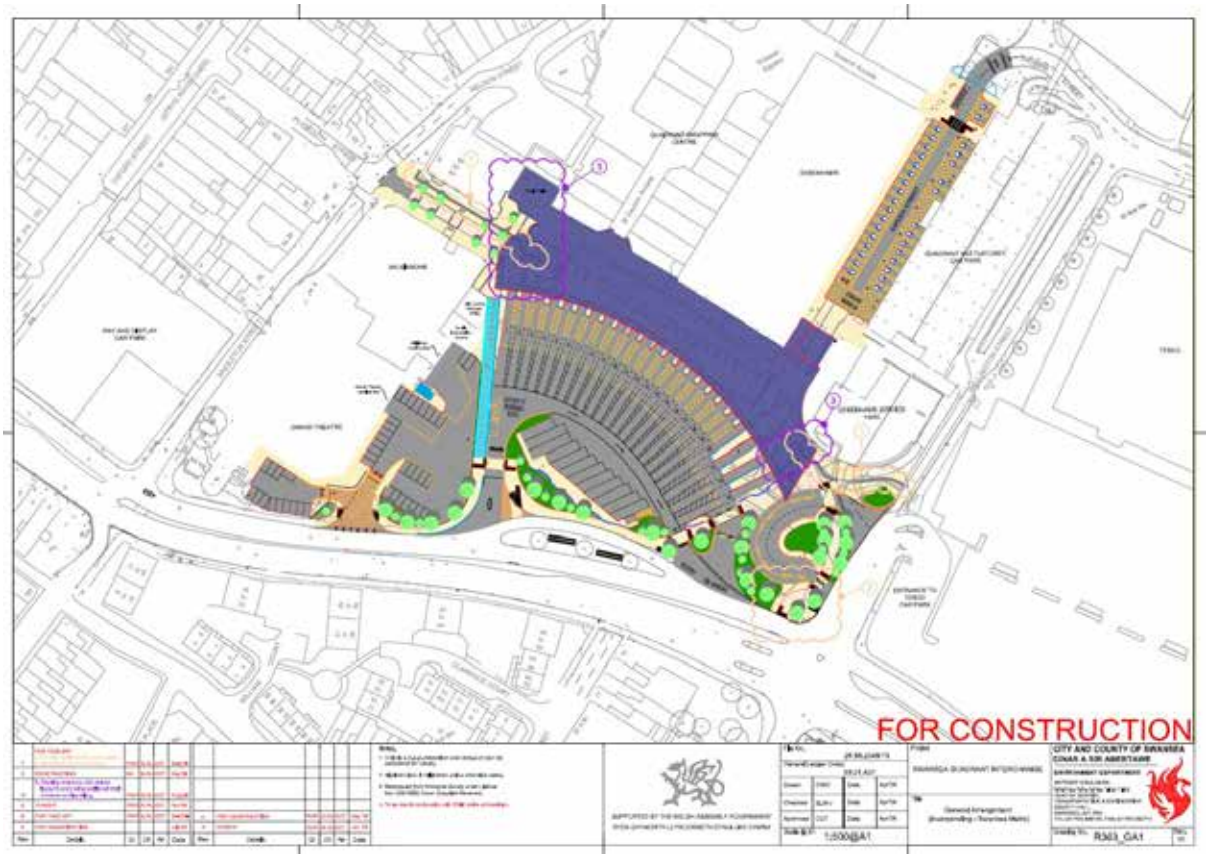
The City and County of Swansea confirms that there are no new/newly identified roads with significantly changed traffic flows.

3.7 Bus and Coach Stations

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.

.A plan of the development area is given below as map 19.



Map 19 – *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 PM_{10} data has been reported in the relevant sections above for 2013 and 2014 – further assessments will be made in future reporting. A photo of the site is shown below as photo 21. The MetOne EBam location is labelled within photo 21. Funding to provide a permanent GPRS ATC (site 36) is still being sought.

Photo 21 – Westway MetOne EBam PM_{10} Monitoring Location

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.

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 20 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 20 – Landore Diesel Sheds and Surrounding Area

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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[38]. 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.

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

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.

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 / Morfa Road proposes several 7(+) story blocks of apartments/student flats. 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.

“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, 1k by 1k NO_2 concentrations (for 2014 based on Background maps base year of 2011) were downloaded from
http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011
and overlain on a GIS background map within Quantum GIS v2.4.0 (Chugiak). .The text file for NO_2 background concentrations for 2014 has been imported into Quantum 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 2014 returns a value of 20.242ug/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 (270500 197500) for 2014 is 19.71ug/m^3. This grid square is located just north of the M4 to the east of junction 44 in the Birchgrove area of Swansea. This grid square lies approximately 350m within the authority's boundary with Neath Port Talbot Borough Council. The main Swansea to London Paddington line runs through this 1k by 1k grid square to the south of the M4 motorway.

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 Swansea Bay Port Health Authority indicate that during 2014 there were a total of 356 vessels visiting the port which equates to 712 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 continuing decrease in movements has been observed during recent years and this has been compounded by the Swansea-Cork ferry ceasing operation from the port during 2011.

5 Industrial Sources

5.1 Industrial Installations

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

Vale, Clydach

Proposals by Vale (see map 15 within section 2.1.15 for location and surrounding area) to develop an energy from waste Pyrolysis Plant at its refinery at Clydach in the Swansea valley may have air quality impacts locally. Whilst Planning Permission has been granted and a permit issued for operation by the now Natural Resources Wales, the project remains on hold at present. Regular updates will be provided in future reporting as to when commencement can be expected.

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 5mg/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 30 authorised petrol filling stations within the authority's area, with fourteen of these having a throughput greater than 2000m^3. Of these fourteen stations, eleven are now fitted with stage II vapour recovery (due to the requirements of the Environmental Permitting (England and Wales) Regulations 2010 (as amended) as all existing stations with a throughput over 3500m^3 from 2011 require stage II vapour recovery), with the remainder being fitted with stage 1 vapour recovery. All new petrol stations with a throughput over 500m3 will require stage II vapour recovery under the above Permitting Regulations 2010. Relevant exposure was examined for each location using Quantum GIS, whereby 10m radiuses 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 and are repeated here for sake of completeness.

One petrol filling (Mumbles Road, Blackpill) station meets the above criteria (throughput, traffic flows and relevant exposure) to have warranted further

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

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

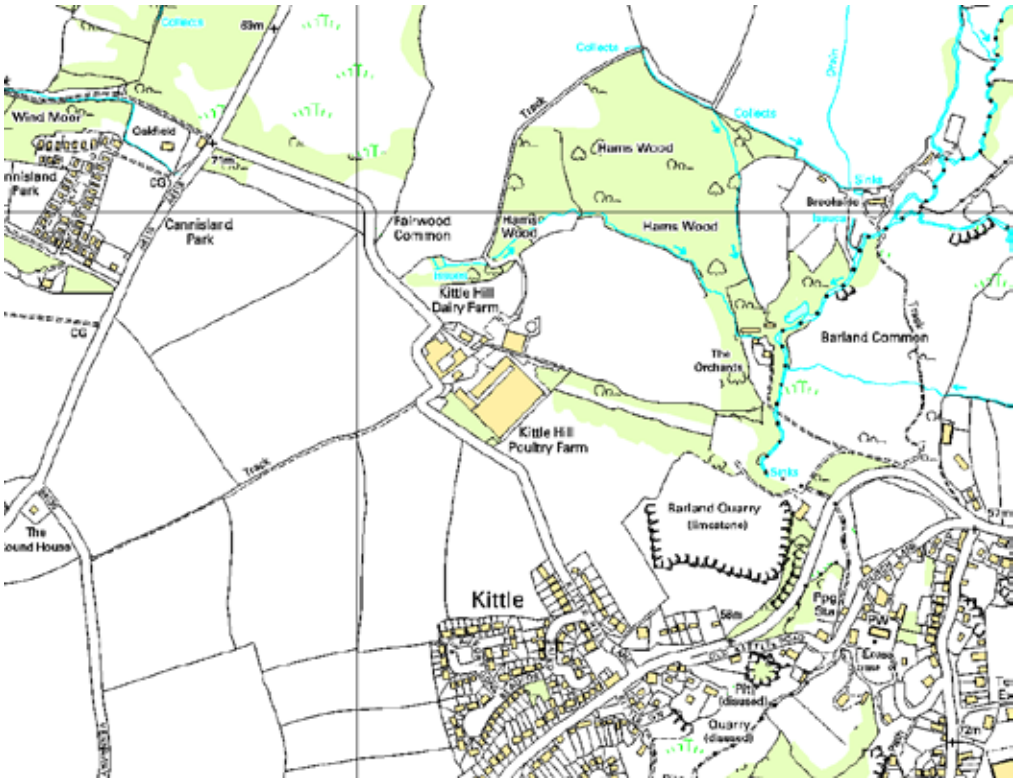
A major food retail output located in Gorseinon has constructed a petrol station during 2014 within the existing rear car park of the existing outlet. The nearest dwelling is located 33.6m away from the nearest pump with a doctor's surgery being located 23m away from the nearest pump. The throughput of this station is not known at present but due to the location of the nearest dwelling, the location falls outside of the scope of assessment. Map 21 below outlines the location and the nearest receptor dwelling.

Map 21 Food outlet Gorseinon – New Petrol Station 2014

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 22 and 23. Information here is updated from previous assessment reports.



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Map 22 – Location of Kittle Hill Poultry Farm, Kittle, Gower, Swansea

Map 23 – Aerial view – Kittle Hill Poultry Farm, Kittle, Gower, Swansea

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Natural Resources Wales granted a PPC permit (EPR/VP3736MR) to permit up to 400,000 laying hens to be housed. However, information to hand indicates that the operators only intend to house 380,000 birds at present. As indicated within map 23 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. Information from Natural Resources Wales indicates a "release" of 6466Kg of PM_{10} from this operation. 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 houses broiler chickens. Map 24 below indicates the proximity of this establishment to local residential properties.

Map 24 – Highfield Poultry farm, Parkmill, Gower.

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Natural Resources Wales granted a PPC permit (EPR/VP3039UR) to permit up to 120,000 broiler chickens to be housed with an approximate actual number of birds actual housed is approximately 114,000. Natural Resources Wales have provided a PM_{10} "release" figure for this operation as 3767kg. 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

6.1.2 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.

The City & County of Swansea confirms that there are no longer any Biomass Combustion – Individual installations meeting the specified criteria within the local authority area

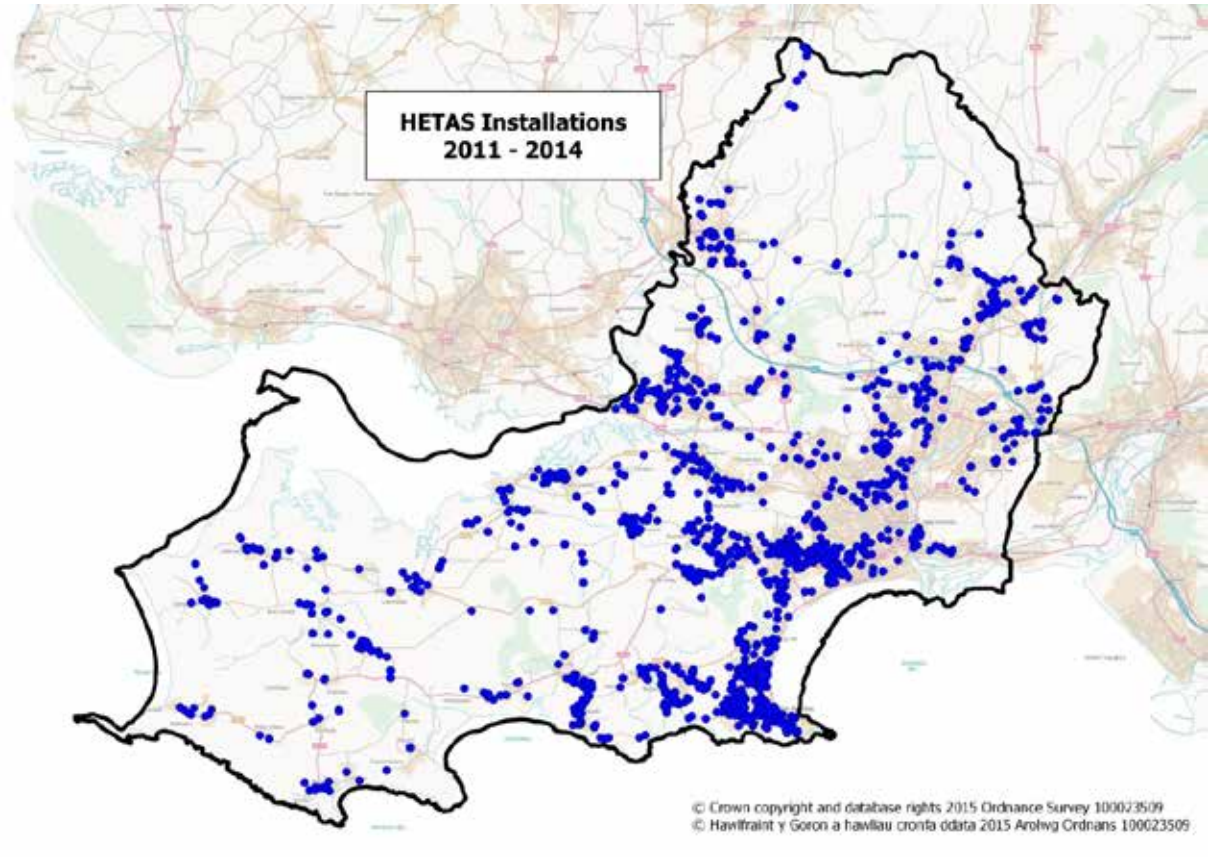
6.2 Biomass Combustion – Combined Impacts

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.

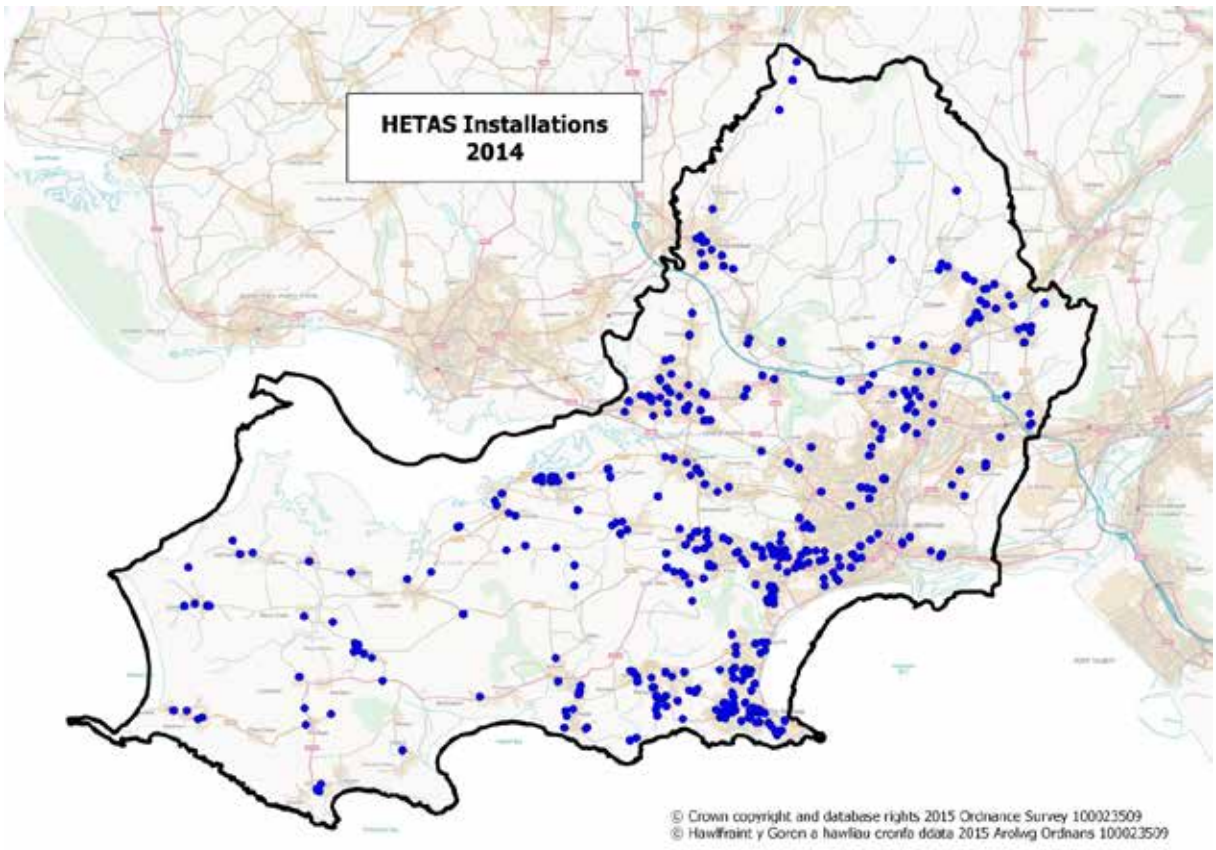
HETAS Ltd approval of appliances consists of assessment of a type test report from a Notified Laboratory to the relevant BSEN supported by the manufacturer's production control, followed by periodic surveillance of the product as appropriate. HETAS Ltd also checks manufacturers Installation and Operating 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 total notifications received under the above scheme, complete with Ordnance Survey easting and northing coordinates to allow plotting within Quantum 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 within map 25 below so that an understanding of the spatial distribution of appliances can be made. In addition, installations notified during 2014 have been plotted separately within map 26. To gain an understanding of the increase in popularity of domestic wood burning / installations, a summary of installations by year is provided within table 40 below. 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 maps 25 and 26 below.



Map 25 - Indicative Biomass Combustion 2011-2014



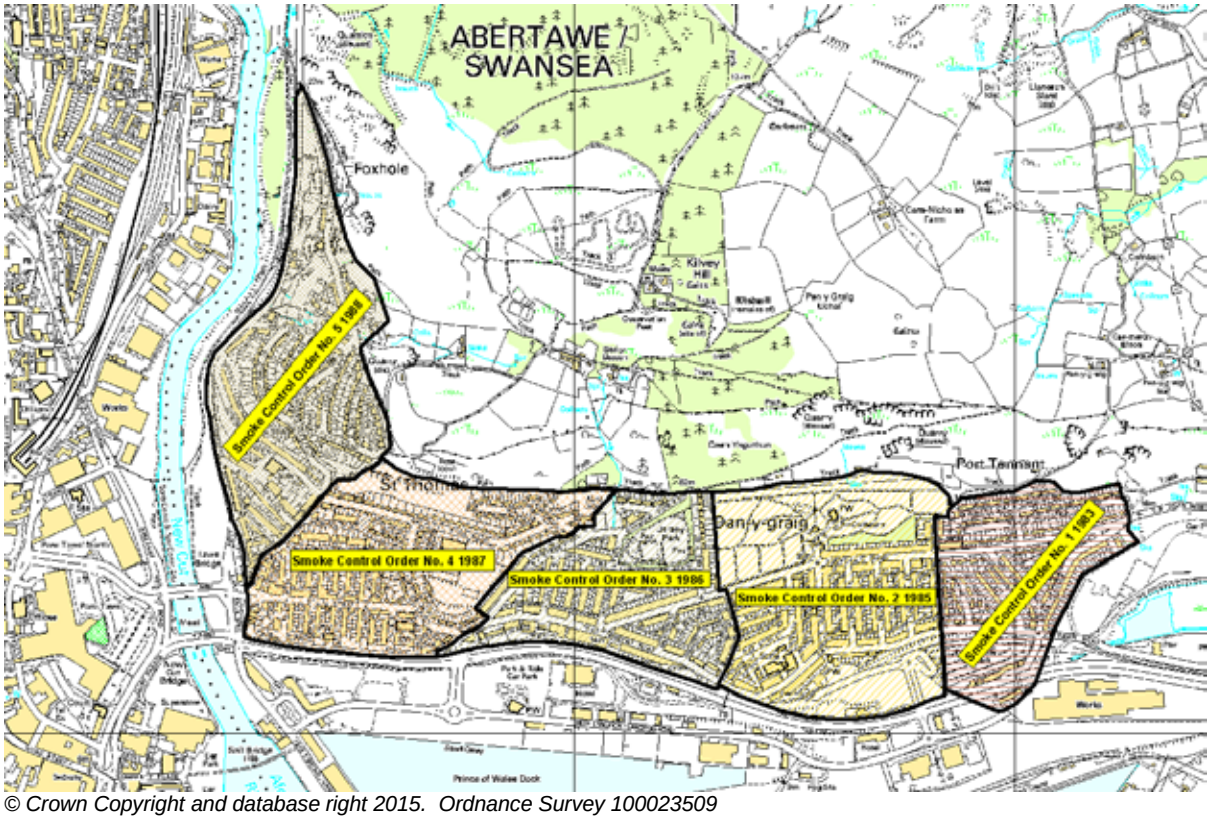
Map 26 - Indicative Biomass Combustion 2014

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 have taken place during 2014 with Building Control to establish a method of appliance identification within the installation notifications that are received by the authority. However, these discussions have not provided a resolution as yet as to how best to improve the recording of the notifications received.

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 27.

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 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.



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Map 27 – 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/Progress Reports submitted.

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

The City & County of Swansea confirms that there are no areas where the burning of Domestic Solid Fuel meets the specified criteria within the local authority area

7 Fugitive or Uncontrolled Sources

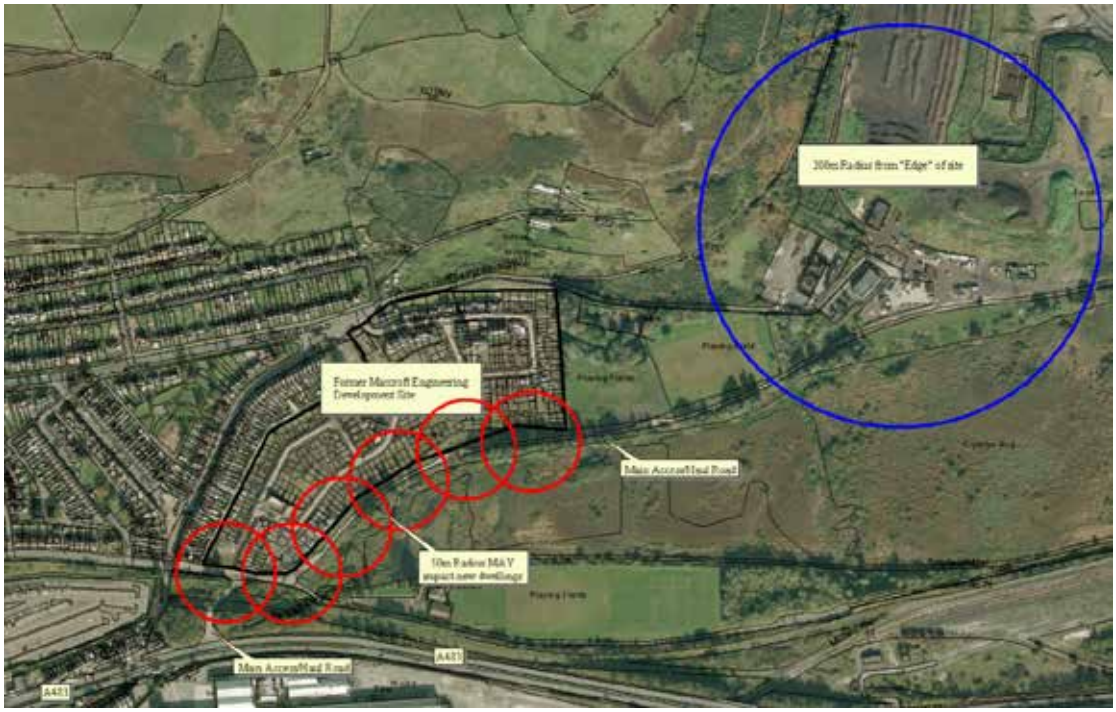
Following the rational mentioned elsewhere within this report, details previously reported are reproduced here again for completeness. Guidance within LAQM.TG(09) box 5.10 Section E page 5-53 indicates an approach to adopt to assess fugitive sources of PM_{10} from a number of sources including quarrying, 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 28mg/m^3, within 400m if the 2004 objective PM_{10} annual mean background concentration taken from background maps is greater than or equal to 26mg/m^3, and within 200m for any background

Based on the 1k by 1k grid squares background PM_{10} maps downloaded for 2014 from http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011, and after indexing the field Total_PM10_14 it can be seen that the maximum 1k by 1k grid square (268500 199500) background concentration is 16.05ug/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 28 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 has been developed over recent years to provide numerous new properties. Development of the site was completed during early 2013 with only a small parcel to the south west section available for any

additional construction. The development can be seen below within the Ordnance Survey MasterMap data as map 28. Obviously, now the development is complete, dozens of new properties fall within the 50m radius (red circles) from the access road. At present, as the maximum background PM_{10} concentrations do not exceed 26ug/m^3 anywhere within the authority's area and, as there are no visible deposits on the road, these locations can be discounted. This view is reinforced by knowledge that no complaints have been received from either the long-term existing residents along Wern Terrace or the new residents surrounding the landfill site.



Map 28 –Tir John Landfill Site, Port Tennant, Swansea

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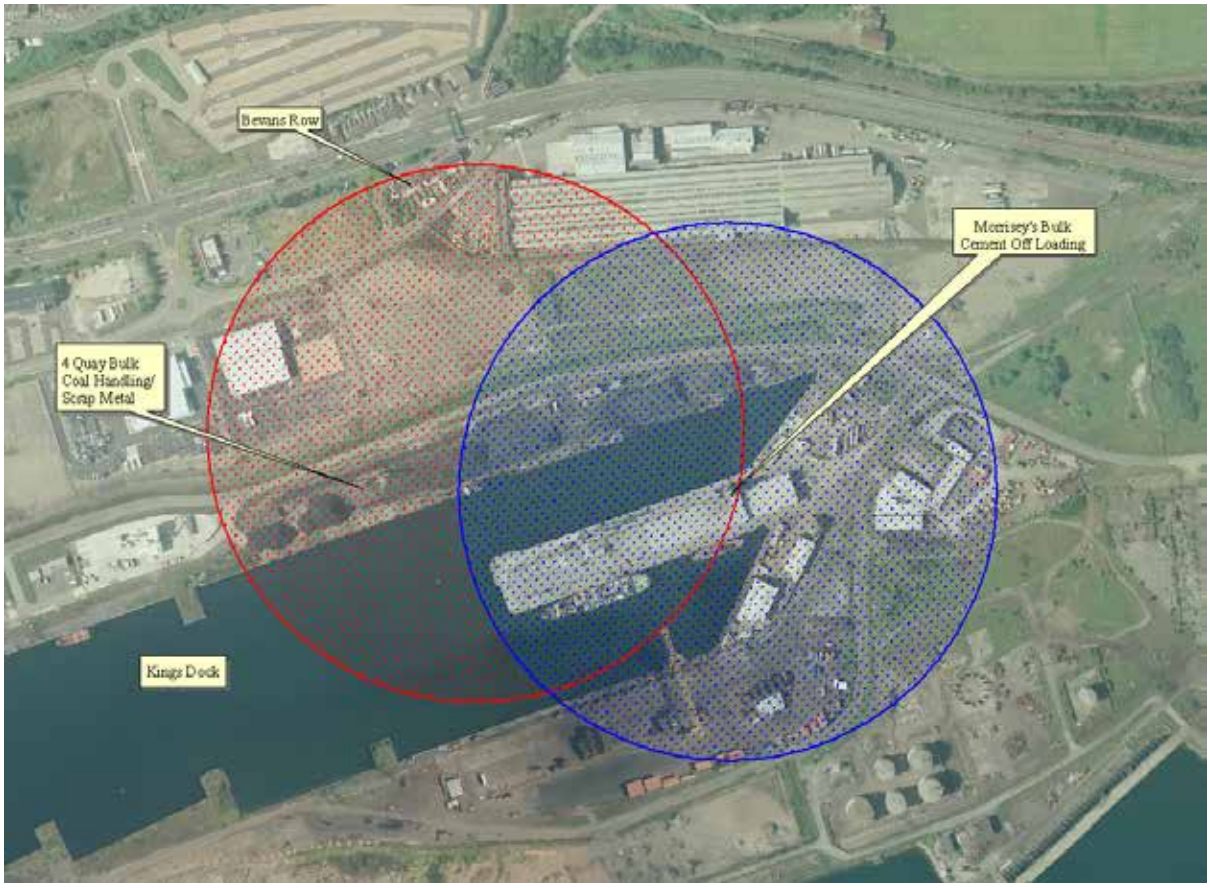
There are no receptor locations within 200m of the main landfill area (blue circle). The Environment Agency (since April 2013 in Wales now known as Natural Resources Wales) refused to issue a permit for the ongoing use of Tir John to the LAWDC – Swansea Waste Disposal Company as a landfill site. The 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 was disbanded and the operations at Tir John have been brought back under the direct control of this 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 29 below identifies both these activities at Kings Dock. 4 Quay handles a bulk coal handling facility on the dock side.



Map 29 – Location of 4 Quay and Morriseys Bulk Cement Kings Dock, Swansea

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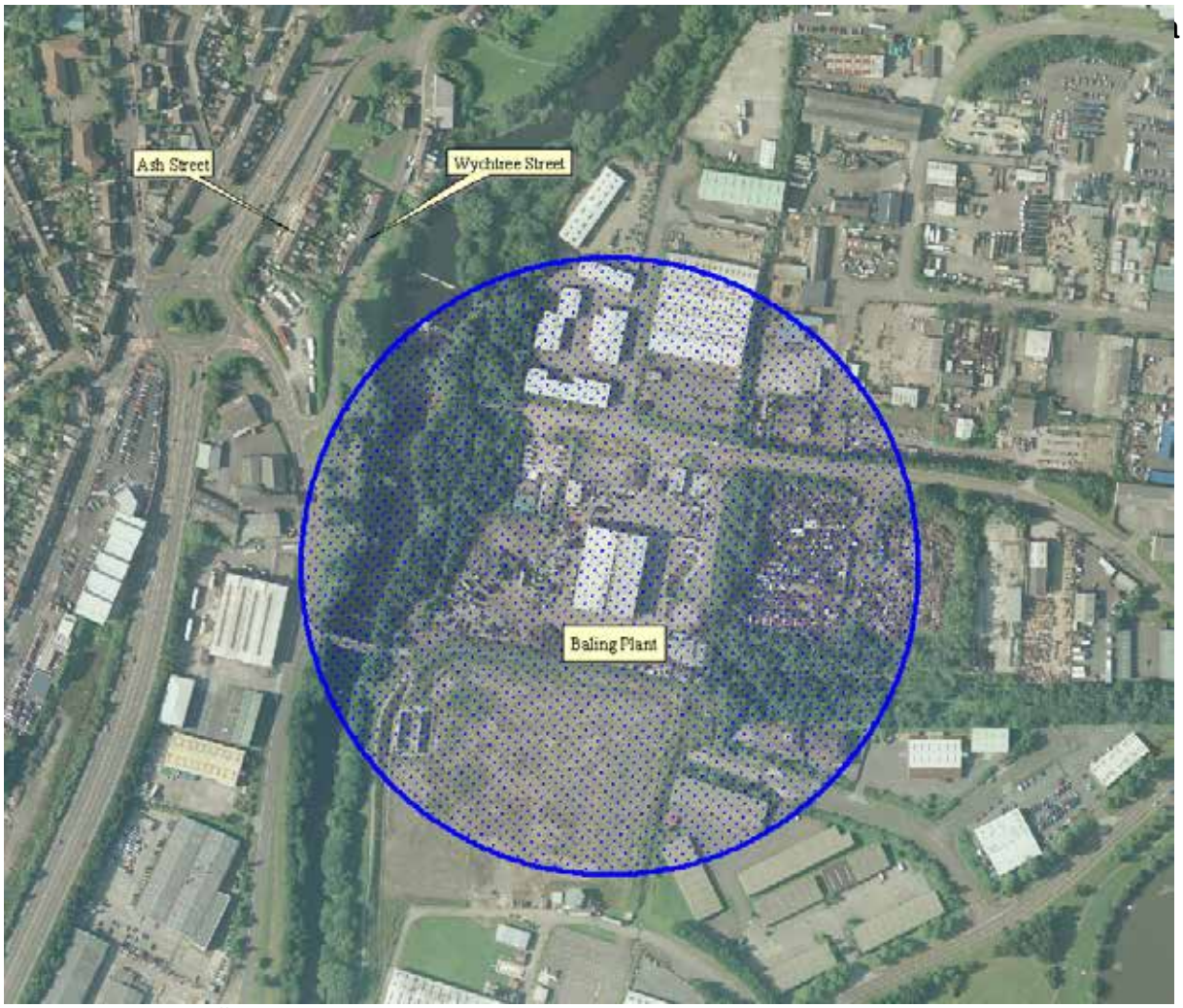
In recent years, stockpiles of scrap metal are also handled on 4 Quay. Receptor locations at Bevans Row, Port Tenant are located within 200m of the bulk coal/metal stockpiles (red circle). Litigation several years ago, resulting from an action from residents of the wider Port Tenant community resulted 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 arisings within Swansea as well as being the main recycling centre within Swansea. Domestic waste in all its forms is transported into the Baling plant pending its bulk transportation to Tir John Landfill site and elsewhere. Map 30 shows the proximity of the facility to the nearest receptor locations.

There have been numerous complaints of odour spanning several years, resulting mainly from the composting activities at the facility, but no substantive dust complaints. Composting activities have now ceased at the facility. 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).



Map 30 – Baling Plant, off Ferryboat Close, Morriston Enterprise Park

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7.4 Operational Opencast Coal Mines or Quarries

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

The City & County Swansea confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

The City & County Swansea confirms that all the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources.**

8. Conclusions and Proposed Actions

Proposals to develop the Tawe Riverside development Corridor may have air quality implications within a wide area of the lower Swansea valley. However, these concerns may be offset by provision of the Morfa Distribution Road and the improvements already being seen around the Quay Parade bridges area. Due to the continued economic downturn it may prove to be many years before the aspirations of the scheme as a whole are realised in full or part. Regular updates will be provided as and when significant developments occur.

The proposals by Vale to develop an energy from waste Pyrolysis Plant at its refinery at Clydach in the Swansea valley may have air quality impacts locally. Whilst Planning Permission has been granted and a permit issued for operation by the now Natural Resources Wales the project is on hold at present again, due to the economic downturn. Regular updates will be provided in future reporting.

Several planning applications have been received that may impact upon local air quality notably the Swansea Bay Tidal Lagoon development and the Liberty Stadium expansion.

8.1 Conclusions from New Monitoring Data

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 2014. However, real-time open path monitoring along Neath Road, Hafod (Hafod DOAS) continues to show exceedence of the annual mean objective. The number of exceedences of the hourly NO_2 objective however continues to reduce against the permitted 18 exceedences from 16 during 2011, 6 during 2013 to 1 during 2014. 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. During 2012 and through to 2013 marginal compliance was observed but

during 2014 full compliance has been observed. This would tie into the results post 2011 obtained for site 35 (Delhi Street) which is within 75m of the DOAS path and is another indication of the probable success of the gyratory now operational at Quay Parade bridges.

Annual mean NO_2 future year projections made for 2015 to 2025 using the updated LAQM.TG(09) June 2014 adjustment factors indicate continued full compliance with both objectives at suitable receptor locations at the Swansea AURN, Morriston Groundhog sites and St.Thomas DOAS. However, using the updated LAQM.TG(09) June 2014 adjustment factors at the Hafod DOAS site indicates that the Hafod DOAS will not see (marginal) compliance with the annual mean objective until 2019. The newly established monitoring location at Station Court, High Street is currently given cause for concern in that exceedence of the annual mean objective may well be seen during 2020. However, no firm conclusions can be made with the limited dataset available at present.

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.

Monitoring from outside of the existing Swansea AQMA 2010 has identified areas that are failing the annual mean objective. Numerous locations within the city centre are failing the annual mean objective. However, monitoring during 2014 has once again indicated that exceedences of the 1-hour objective have not been seen around the café type environments along the Kingsway, Orchard Street and Dillwyn Street areas. Extensive new passive NO_2 monitoring sites have been established during January 2015 along Dyfatty Street, Orchard Street, High Street, Castle Street, The Kingsway and Westway to inform the planning process.

Continued monitoring along Newton Road within the Mumbles area has shown a continuing and improving picture with once again only the two sites closest to the junction with Mumbles Road now showing during 2014 an exceedence of the annual mean objective. These sites are free of the complications caused by a canopy over commercial premises where there are flats at first floor level above the canopy structure on one side of Newton Road. The situation along Newton Road is exacerbated by tourism traffic during the summer months. Table 14 indicates the annual means for sites 206-216 during 2010-2014 along Newton Road. A continued decline in annual mean concentrations can be seen with the likelihood that this trend will continue. The authority does not propose, given the continued downward trend in annual mean concentrations to declare an AQMA along Newton Road. Monitoring will continue for the foreseeable future to verify the trend in concentrations and to assess the added impact of the proposed Traffic Regulation Order prohibiting parking by delivery vehicles during peak times along Newton Road. During 2014, it can be argued that sites 206 and 209 are only marginally above the annual mean objective level.

Areas previously experiencing exceedences of the annual mean objective within the St Thomas area now continue to indicate full compliance. Site 35 within the St Thomas area (Delhi Street) indicated exceedence of the annual mean objective during 2011 but monitoring during 2012 -2014 has now shown full compliance. This maybe due to the improvements made with the gyratory system around the Quay Parade bridge area. Site 291 (Vale of Neath Road) on the outbound A483 towards the M4 has shown exceedence of the annual mean objective during 2012 and 2013 but monitoring during 2014 has now indicated compliance with the annual mean objective. Transportation colleagues have altered the phasing of the signal controlled junction of the A483 with the SA1 junction. This area may become critical should the Swansea Bay Tidal Lagoon Development obtain approval as this junction will see an increase in HGV traffic resulting from materials delivery to the project site. At present it is thought that the rock required to form the lagoon structure will be delivered via sea routes but there is a possibility that significant HGV traffic will be seen at the SA1 junction area should this sea delivery method not prove possible.

Annual mean NO_2 future year projections using the latest June 2014 adjustment factors now indicate that compliance with the annual mean objective will be seen at all bar one site (site 59 Neath Road) in 2019. Full compliance with the annual mean objective is predicted to be seen at all sites during 2020.

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.

Particulate Matter PM_{10}

No exceedences of the annual mean objective were seen at any of the monitoring stations during 2014. Similarly, no breach of the 35 permitted exceedences of the 24 hour objective was seen, nor, where data capture was below 90% did the 90^{th} percentile (given in brackets after the number of exceedences in table 18) exceed $50ug/m^3$.

Benzene

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

Ozone

Compliance with the 8-hour mean UK objective (not set in regulation) has been seen during 2014 at the Morriston Groundhog, St Thomas DOAS and Cwm Level Park monitoring stations. However, 12 exceedences of the 8-hour ozone mean target were seen at the Hafod DOAS site against the permitted 10. Whilst ozone is considered a

national rather than local problem it will continue to be measured for the foreseeable future.

Heavy Metals Monitoring

Significant changes have occurred to the heavy metals monitoring network within Swansea during 2013 and the early part of 2014. Due to recurring issues with the equipment deployed at the Glais School site and the imposed budget constrictions the authority is operating under, monitoring ceased at Glais School on the 1st April 2013. In addition, monitoring at YGG Gellionnen ceased in January 2014 due to the costs of the heavy metals analysis. Future heavy metals monitoring will now only be undertaken from 2014 onwards at the two UK network funded sites located at Coed Gwilym Cemetery and Morriston Groundhog.

Monitoring results during 2014 have shown **nickel** concentrations to be below the 4th Daughter Directive annual mean target value following improved abatement at the primary release point. Newly identified release points within the Pontardawe area of Neath Port Talbot Borough Council have the potential to influence measured nickel concentrations within the Swansea area given certain 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

Proposals to develop the Tawe Riverside development Corridor may have air quality implications within a wide area of the lower Swansea valley. However, these concerns may be offset by provision of the Morfa Distribution Road and the improvements already being seen around the Quay Parade bridges area. Due to the continued economic downturn it may prove to be many years before the aspirations of the scheme as a whole are realised in full or part. Regular updates will be provided as and when significant developments occur.

The proposals by Vale to develop an energy from waste Pyrolysis Plant at its refinery at Clydach in the Swansea valley may have air quality impacts locally. Whilst Planning Permission has been granted and a permit issued for operation by the now Natural Resources Wales the project is on hold at present again, due to the economic downturn. Regular updates will be provided in future reporting.

Several planning applications have been received that may impact upon local air quality notably the Swansea Bay Tidal Lagoon development and the Liberty Stadium expansion.

The proposals to introduce additional dwellings within the city centre with the intention of increasing footfall and hence trade will have implications in respect of air quality. The authority is in the early stages of a wide ranging review of development proposals for the city centre. This review will also examine the existing road network and linkages within the city centre and surrounding area. There are likely to be major changes both in respect of ease of access and addressing safety concerns (there have recently been concerns regarding the road infrastructure put in place for the Metro service following several recent pedestrian incidents) which will ultimately result in extensive alterations to the road network serving the city centre. At present there are no outcomes from the review as to what form these highway alterations will take. Therefore, it is not proposed to declare an AQMA for the city centre until the review outcomes are known. Extensive new passive NO_2 monitoring sites have been established during January 2015 along Dyfatty Street, Orchard Street, High Street, Castle Street, The Kingsway and Westway to inform the planning process.

8.3 Proposed Actions

Due to the reductions in nitrogen dioxide annual mean concentrations being witnessed year on year, along Newton road, Mumbles, it is not proposed to declare an AQMA at present. The authority will work towards the introduction of a Traffic Regulation Order along Newton Road prohibiting delivery vehicles delivering goods during busy periods of the day to restrict congestion along Newton Road. In view of the reductions in annual mean concentrations being measured, concentrations at first floor level above the canopy to flats will not be investigated further.

Due to the wide ranging implications of the City Centre review and likely highway alterations, it is not proposed to declare an AQMA within the city centre until the outcomes and recommendations of the review are known. The review is so wide ranging that the source i.e. the highway network, may be removed from where there are currently receptor locations. Discussions will continue on how best the desired provision of housing within the city centre can be achieved within the overall development proposals both in terms of the air quality implications and also exposure to noise for those residents.

No alterations to the existing Swansea AQMA 2010 are proposed.

The authority will update the information within this report together with the outcomes of the city centre review within its Progress Report 2016.

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. City & County of Swansea Updating and Screening Assessment 2012
x. City & County of Swansea Progress Report 2013
xi. City & County of Swansea Progress Report 2014
xii. Technical Guidance LAQM.TG(09) and subsequent updates
xiii. Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138)
xiv. Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298)
xv. 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

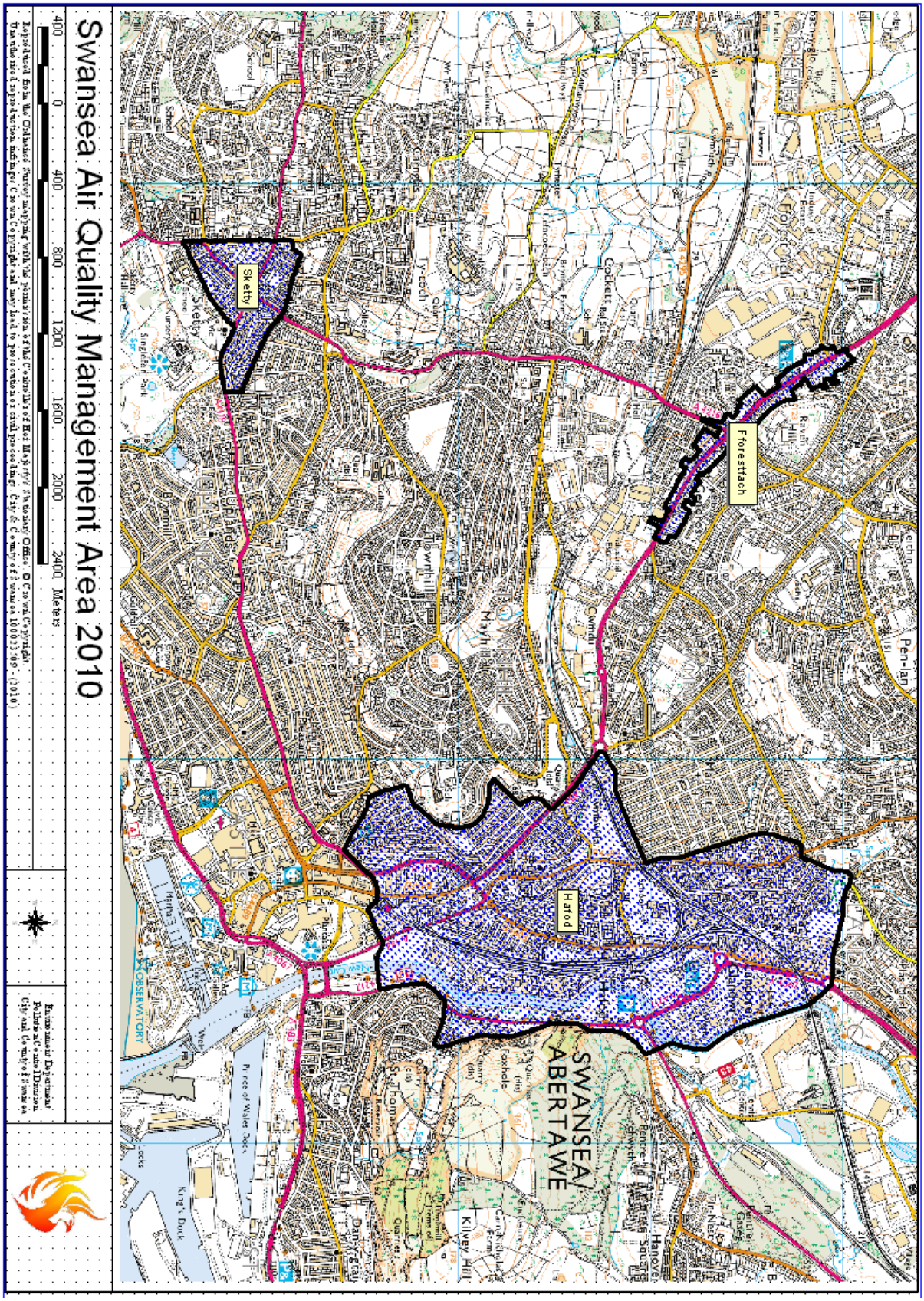
Appendix 1

Hafod AQMA

Hafod Air Quality Management Area
400 0 400 800 1200 Meters
Pollution Control Division.
Environment Department
City & County of Swansea.
SWANSEA/ABERTAWE
Hafod
Landore
Glandwr
Cwmbwrla
Manselton
Mayhill
Townhill
Gendros
Kilvey Hill
St Thomas
Foxhole
Pentre-chwyth
Hanover Square
Bon-y-maen
Dan-y-graig

Appendix 2

Swansea AQMA 2010


Swansea Air Quality Management Area 2010
Sketty
Ffforestfach
Hafod
SWANSEA / ABERTAWE
Pen-lan
Mayh
Cwmdu
Kilvey Hill
Hanover
St Thomas
Foxhole
Danygraig
Port of Wales Dock
King's Dock
OBSERVATORY
Marina
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 Measured Value	HSL Calculations (Pre-Sendout) Sample A Calculated Spiked Value	Harwell Analysis Tubes A Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score	HSL Calculations (Pre-Sendout) Sample B Measured Value	HSL Calculations (Pre-Sendout) Sample B Calculated Spiked Value	Harwell Analysis Tubes B Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score
2011	115	Sept-Dec																		
	114	Jul-Aug																		
	113	Apr-Jun			1.524	1.532	1.478	1.471	1.475	0.005	0.30%	-0.5	2.292	2.304	2.296	2.254	2.275	0.030	1.30%	-0.1
	112	Jan-Mar			2.07	2.10	2.103	1.090	2.097	0.010	0.50%	0	0.93	0.94	0.952	0.953	0.953	0.027	0.10%	0.2
	111	Sept-Dec			1.85	1.84	1.821	1.821	1.821	0.000	0	0.1	1.57	1.54	1.512	1.482	1.497	0.022	1.50%	-0.4
2010	110	Jul-Aug			1.00	0.99	0.972	0.987	0.980	0.011	1.1	0	2.47	2.37	2.367	2.394	2.381	0.020	0.80%	0.1
	109	Apr-Jun			1.06	1.03	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			1.91	1.92	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
	107	Oct-Dec			2.04	2.03	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	1.44	1.42	1.880	1.429	1.655	0.319	19.3%	2.1
2009	106*	Jul-Sept			1.84	1.84	1.880	1.880	1.880	0.000	0.0%		1.44	1.42	1.439	1.429	1.434	0.007	0.5%	
	105	Apr-Jun			1.69	1.68	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			2.01	2.02	2.017	2.047	2.032	0.022	1.1%	0.0	1.19	1.22	1.269	1.230	1.252	0.024	1.9%	0.2
	103	Sept-Dec			1.22	1.22	1.242	1.234	1.238	0.006	0.5%	0.1	0.95	0.94	0.957	0.951	0.954	0.005	0.5%	0.1
	102	Jun-Aug			1.38	1.37	1.470	1.472	1.471	0.043	2.9%	0.5	2.30	2.28	2.435	2.386	2.411	0.035	1.5%	0.4
2008	101	Apr-Jun			0.94	0.92	0.974	0.991	0.983	0.013	1.3%	0.5	1.93	1.86	1.947	1.958	1.953	0.008	0.4%	0.4
	100	Jan-Mar			1.37	1.36	1.395	1.384	1.390	0.008	0.6%	0.2	1.45	1.47	1.511	1.516	1.514	0.004	0.3%	0.2
	99	Oct-Nov			2.16	2.15	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
2007	98	Jul-Sept			1.85	1.83	1.877	1.854	1.866	0.013	0.7%	0.2	1.20	1.19	1.229	1.223	1.226	0.005	0.4%	0.2
	97	Apr-Jun			0.87	0.89	0.920	0.918	0.919	0.002	0.2%	0.2	1.59	1.58	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[41] 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	08/01/2014	05/02/2014	36.4	46.7	44.3	42	5.4	13	13.4	38.7	99.4	Good	Good
2	05/02/2014	11/03/2014	34.4	34.2		34	0.1	0	1.3	29.5	96.6	Good	Good
3	11/03/2014	02/04/2014	43	36	36.8	39	3.8	10	9.5	38.2	99.8	Good	Good
4	02/04/2014	01/05/2014	39.4	37.8	38.4	39	0.8	2	2.0	34.5	99.7	Good	Good
5	01/05/2014	28/05/2014	30.2	30.2	31.2	31	0.6	2	1.4	27	99.6	Good	Good
6	28/05/2014	02/07/2014	19.7	22.9	26	23	3.2	14	7.8	25	99.7	Good	Good
7	02/07/2014	30/07/2014	24.2	25.7	22.3	24	1.7	7	4.2	19	99.4	Good	Good
8	30/07/2014	03/09/2014	21	23.1	24.6	23	1.8	8	4.5	19	95.7	Good	Good
9	03/09/2014	02/10/2014	35.5	44.5	40.4	40	4.5	11	11.2	40	99.5	Good	Good
10	02/10/2014	05/11/2014	30.5	30.2	34.9	32	2.6	8	6.5	28	99.7	Good	Good
11	05/11/2014	04/12/2014	54.6	59.8	53.6	56	3.3	6	8.3	43.3	99.7	Good	Good
12	04/12/2014	14/01/2015	34.4	39.4	38	37	2.6	7	6.4	31.8	98.3	Good	Good
13													
											Overall survey -->	Good precision	Good Overall

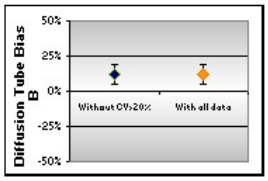
It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Swansea AURN
Precision	12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.89 (0.84 - 0.95)
Bias B	12% (5% - 19%)
Diffusion Tubes Mean:	35 μgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	31 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	31 (29 - 33) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.89 (0.84 - 0.95)
Bias B	12% (5% - 19%)
Diffusion Tubes Mean:	35 μgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	31 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	31 (29 - 33) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Bias correction factor – Swansea AURN 2014

The derived bias correction factor of 0.89 (0.84-0.95) has been calculated with all diffusion tube data periods having a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor using 12 periods of data of 12% (5% - 19%)

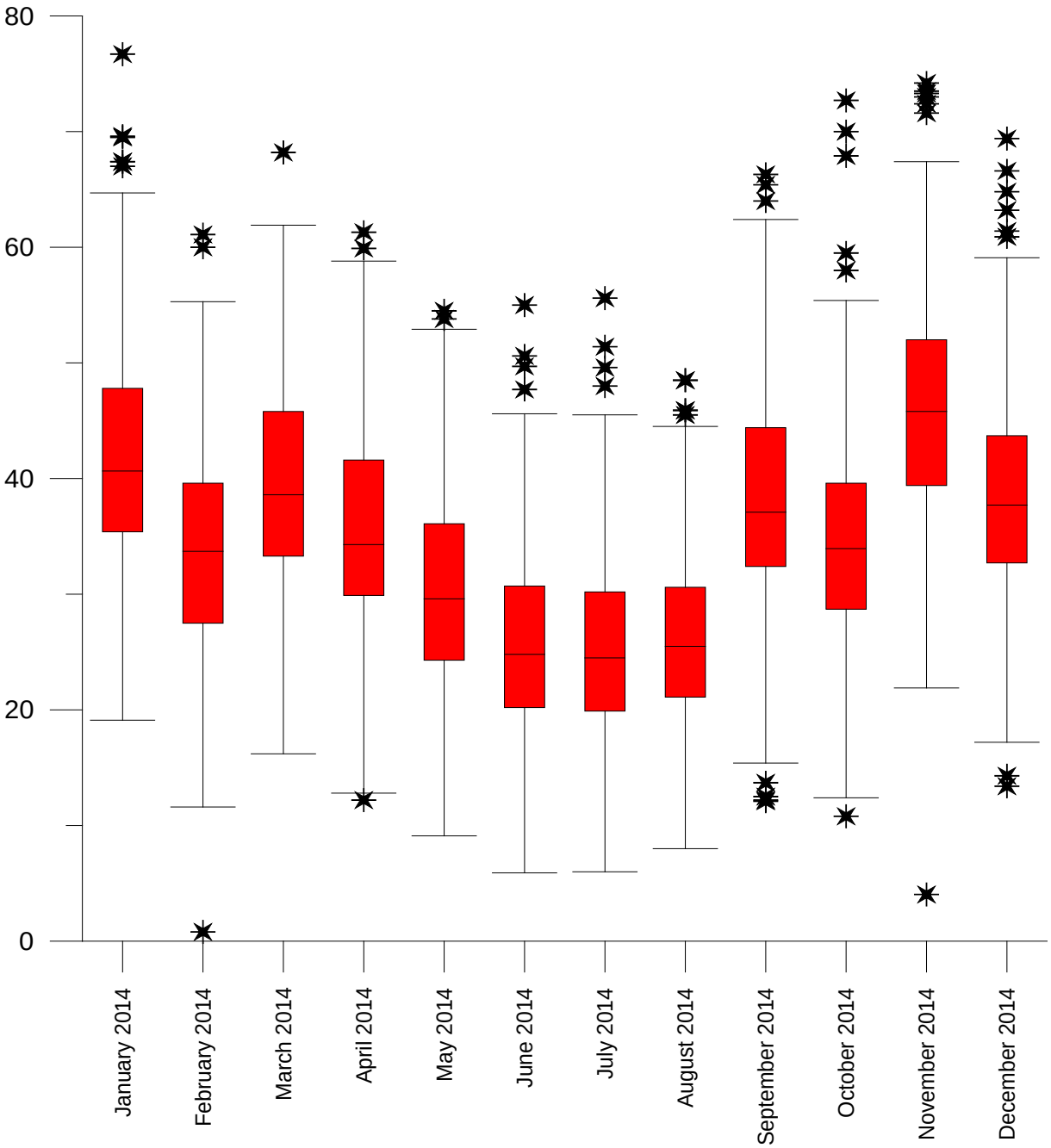
[41] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

Appendix 5

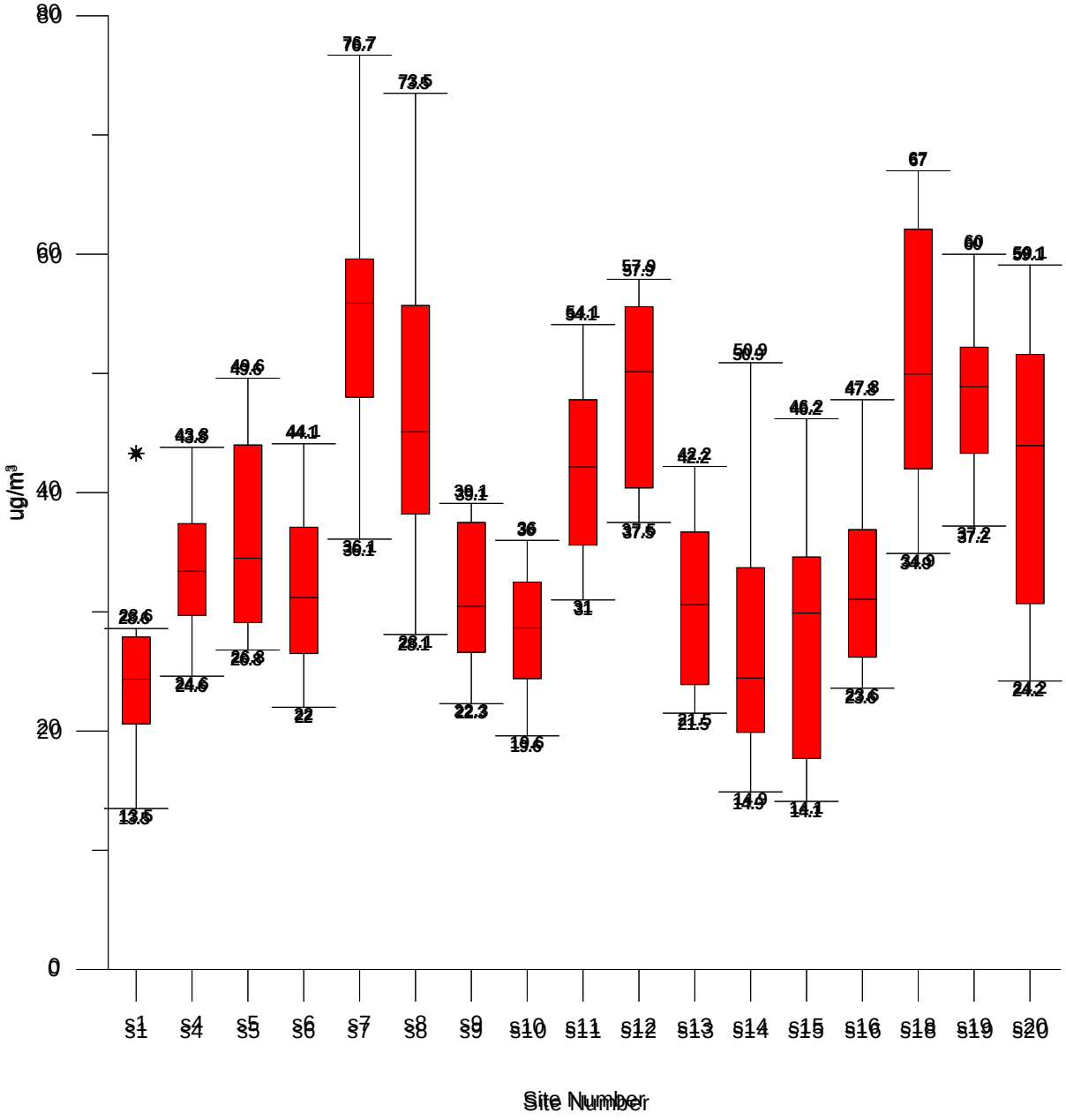
Box-Whisker Plots 2014

Nitrogen Dioxide Passive Diffusion Tube Data (RAW - uncorrected)

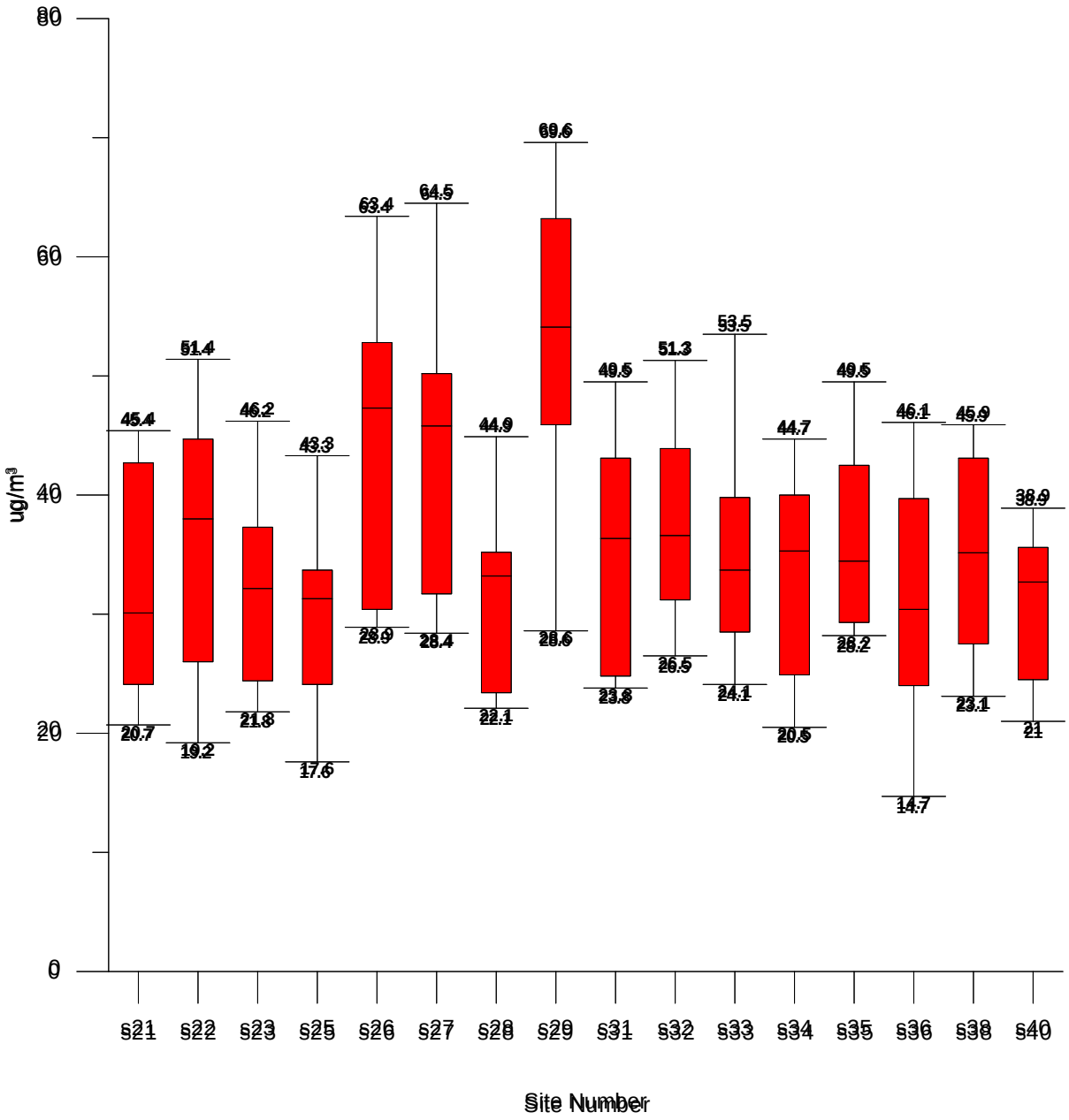
Box-Whisker Plot - All Sites by Month
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data - All Active Sites



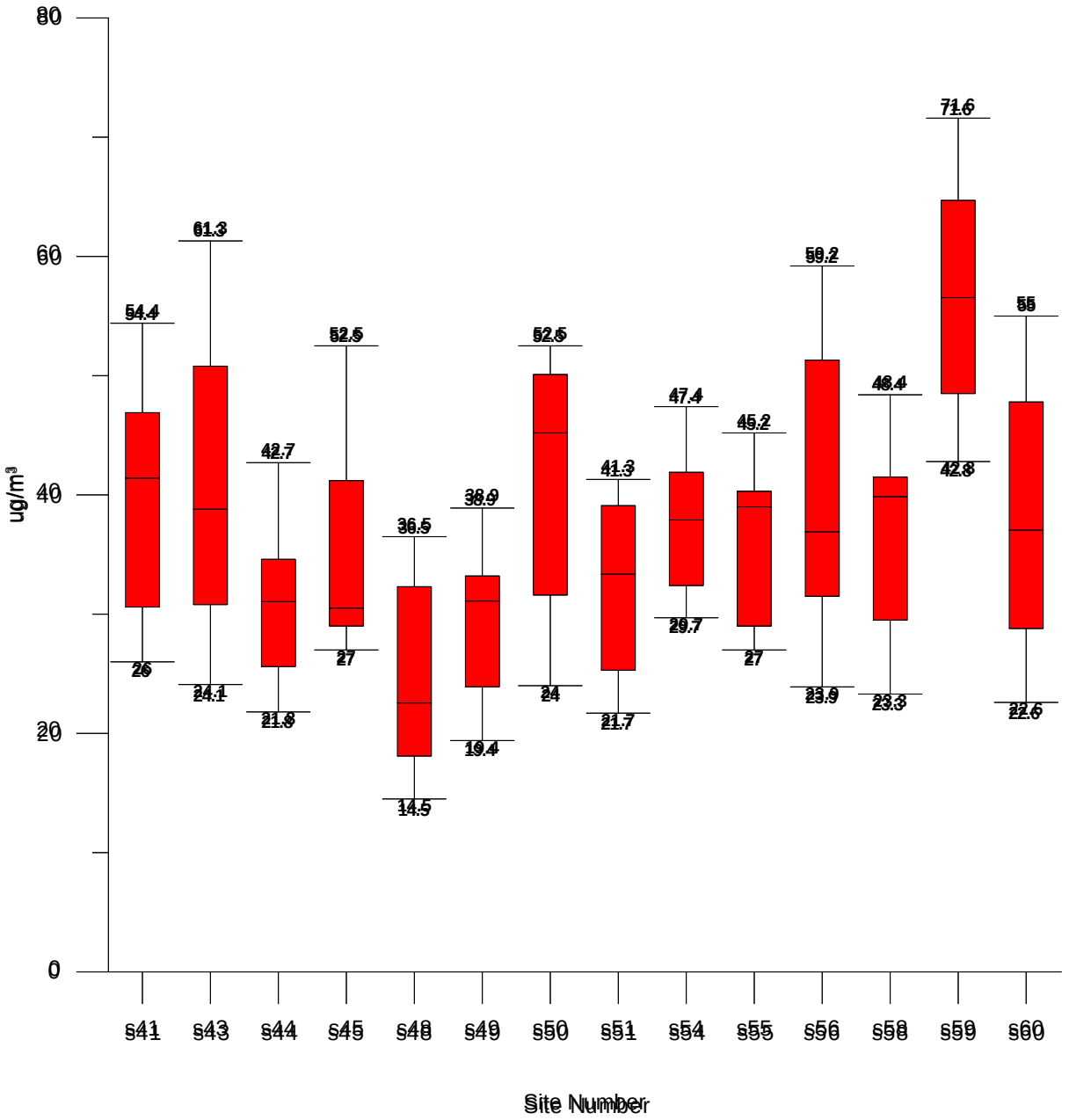
Box-Whisker Plot - Sites 1-20
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



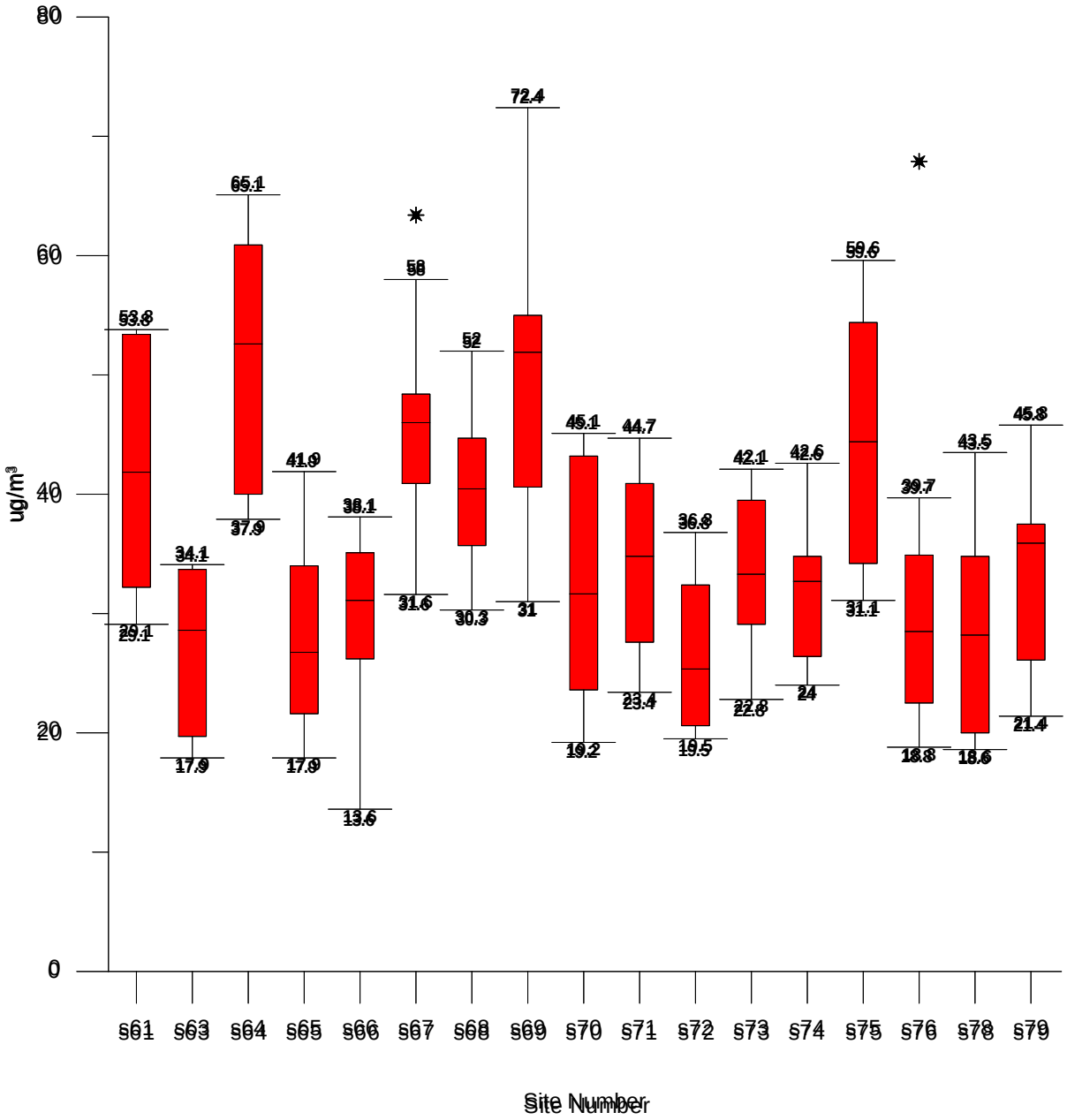
Box-Whisker Plot - Sites 21-40
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



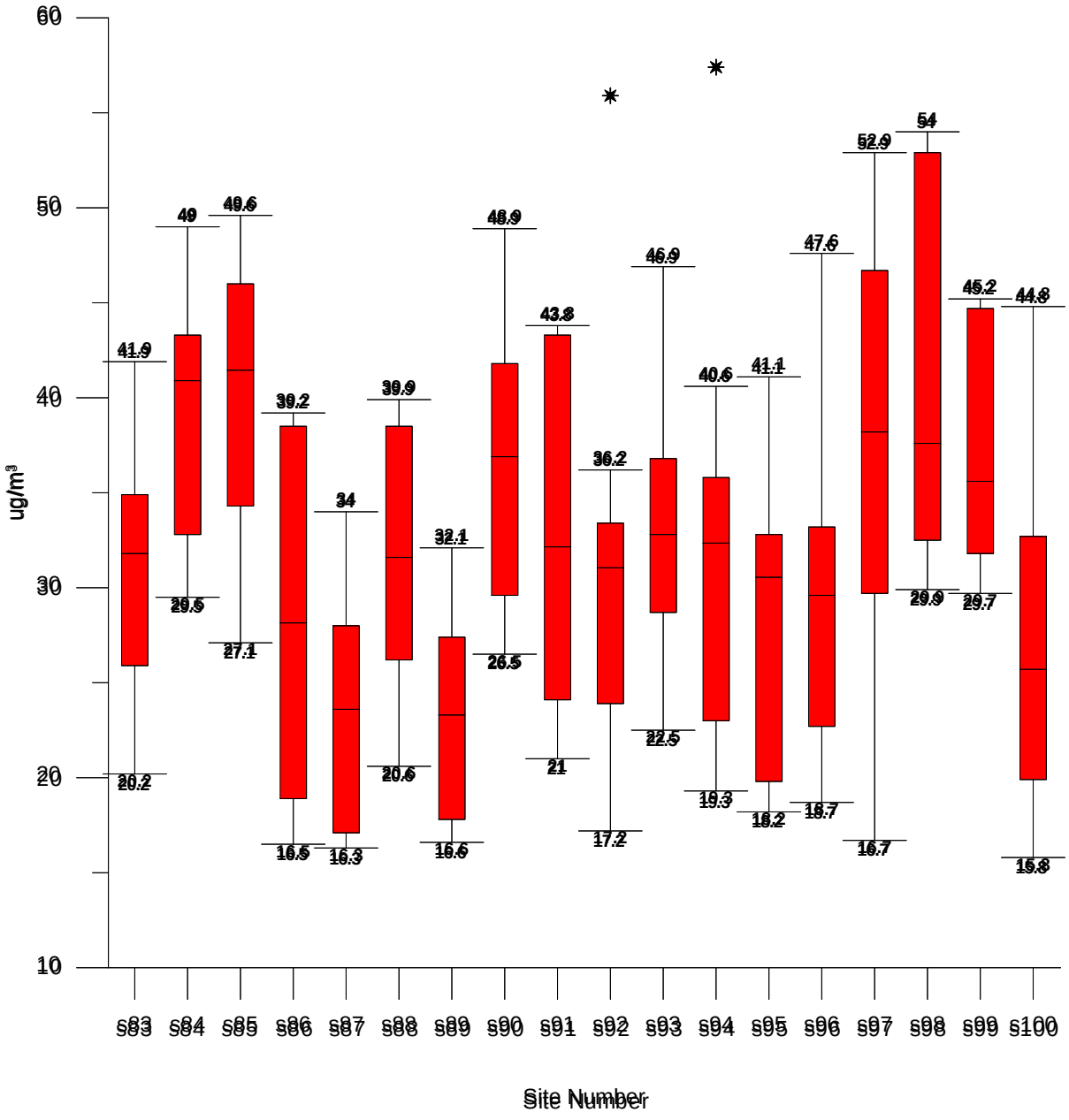
Box-Whisker Plot - Sites 41-60
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



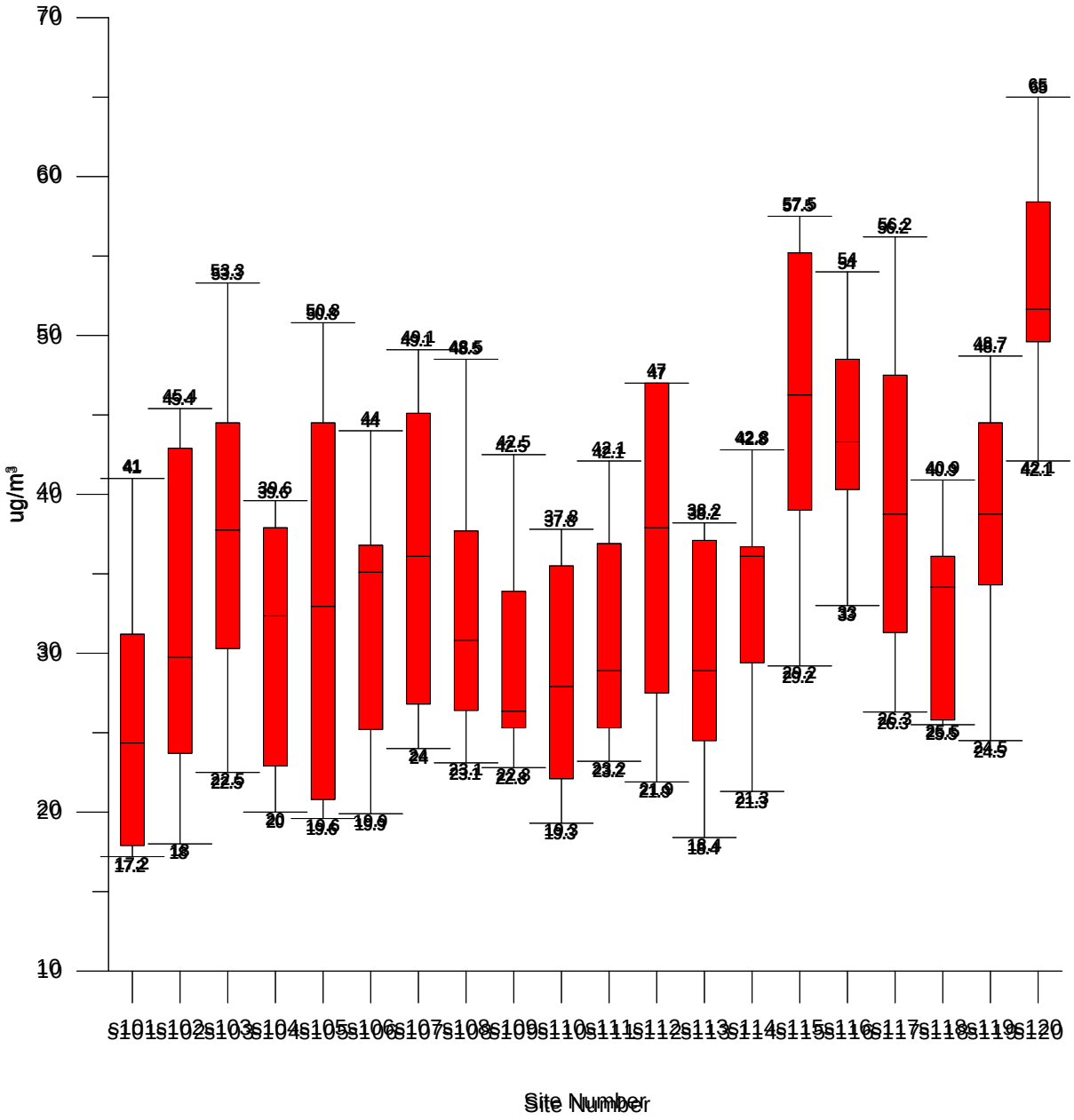
Box-Whisker Plot - Sites 61-80
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



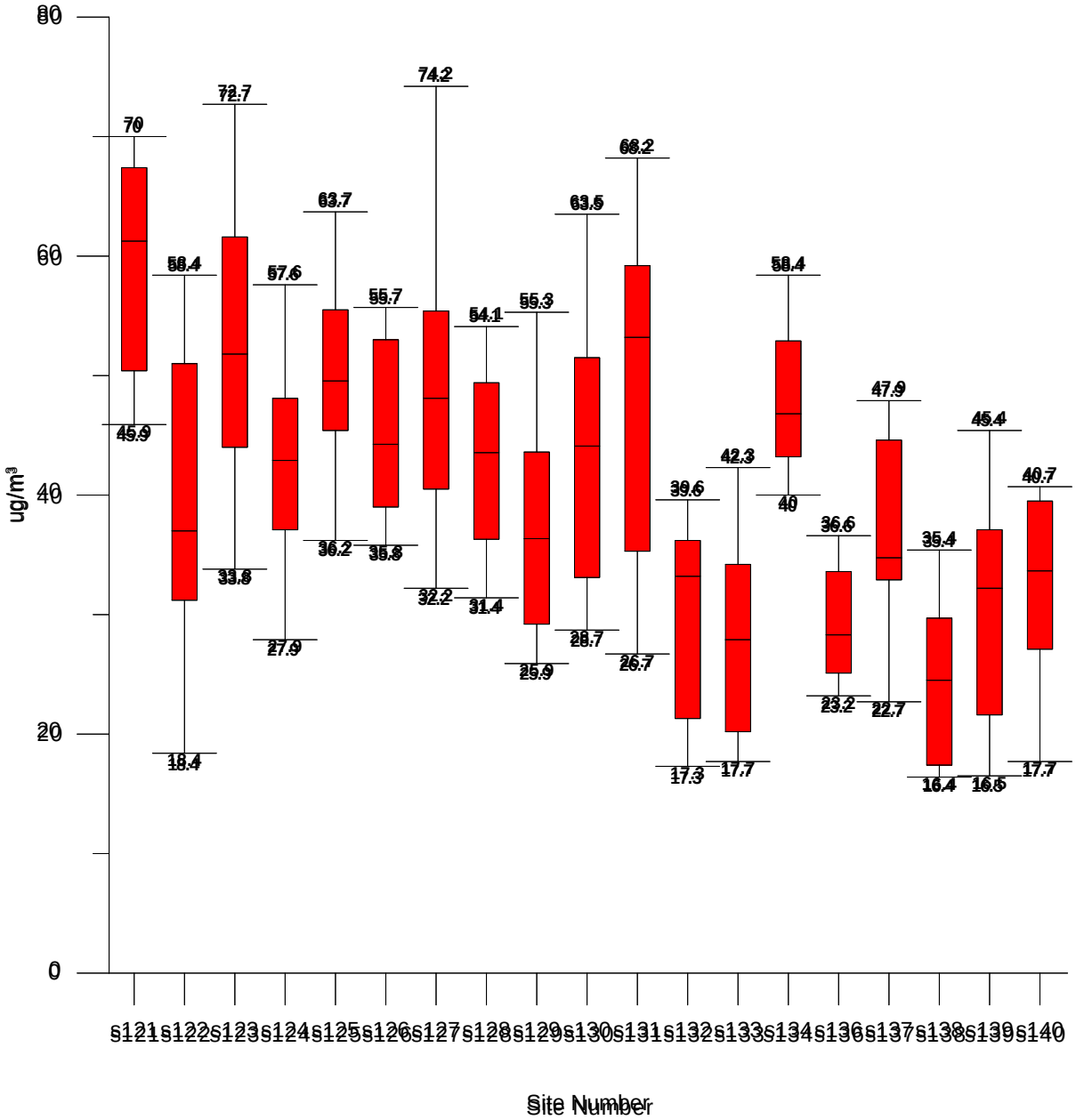
Box-Whisker Plot - Sites 83-100
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



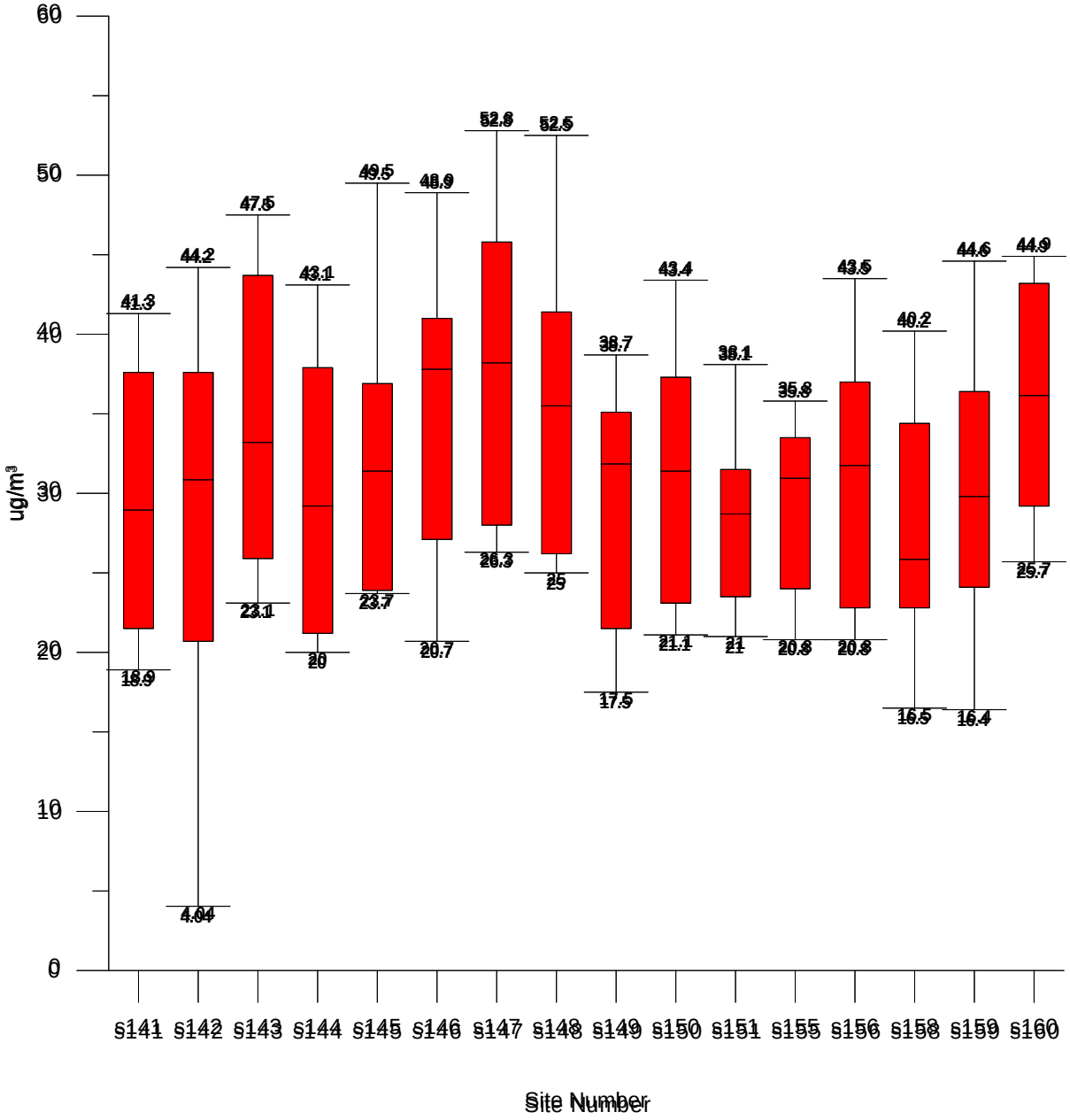
Box-Whisker Plot - Sites 101-120
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



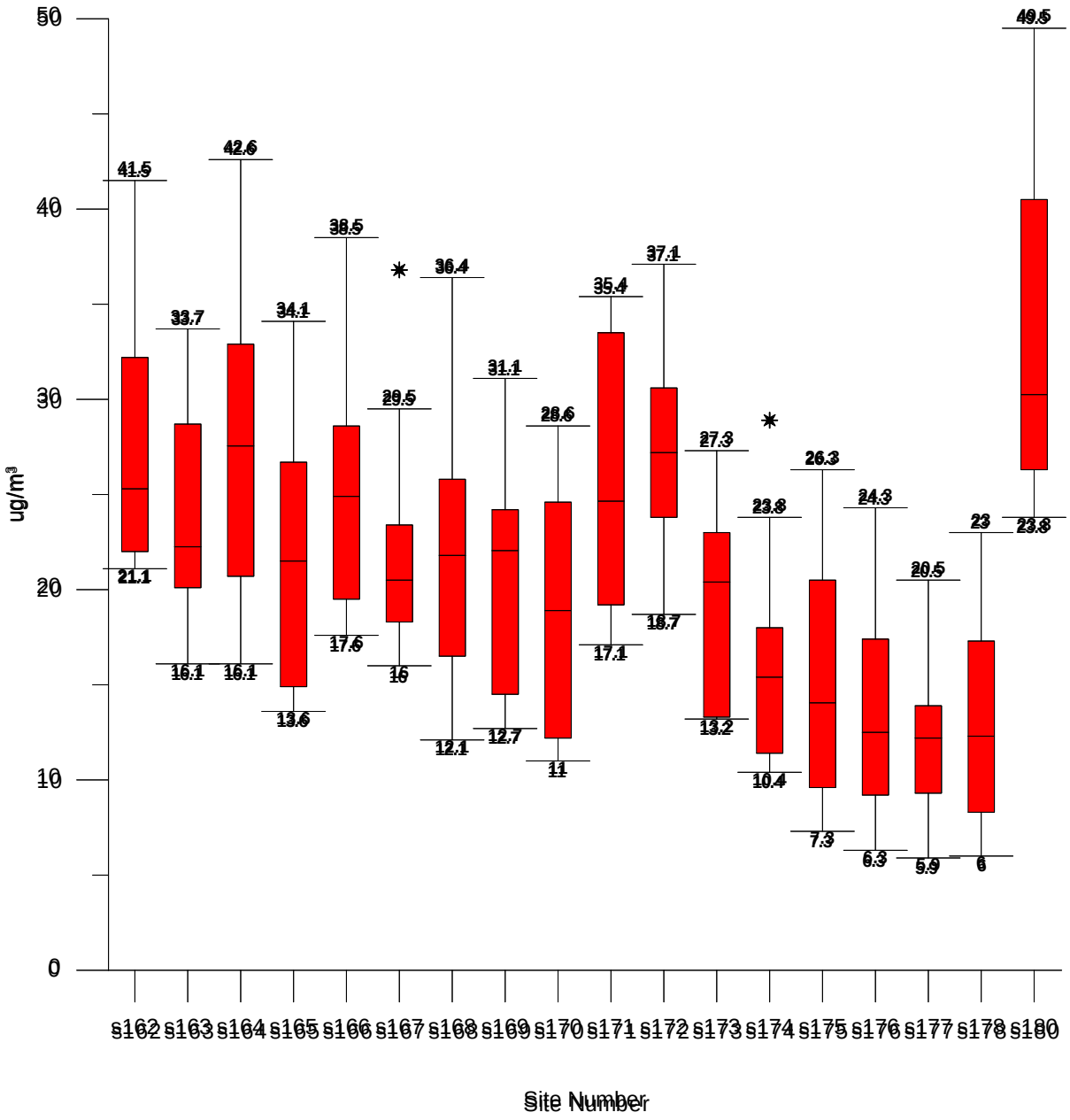
Box-Whisker Plot - Sites 121-140
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



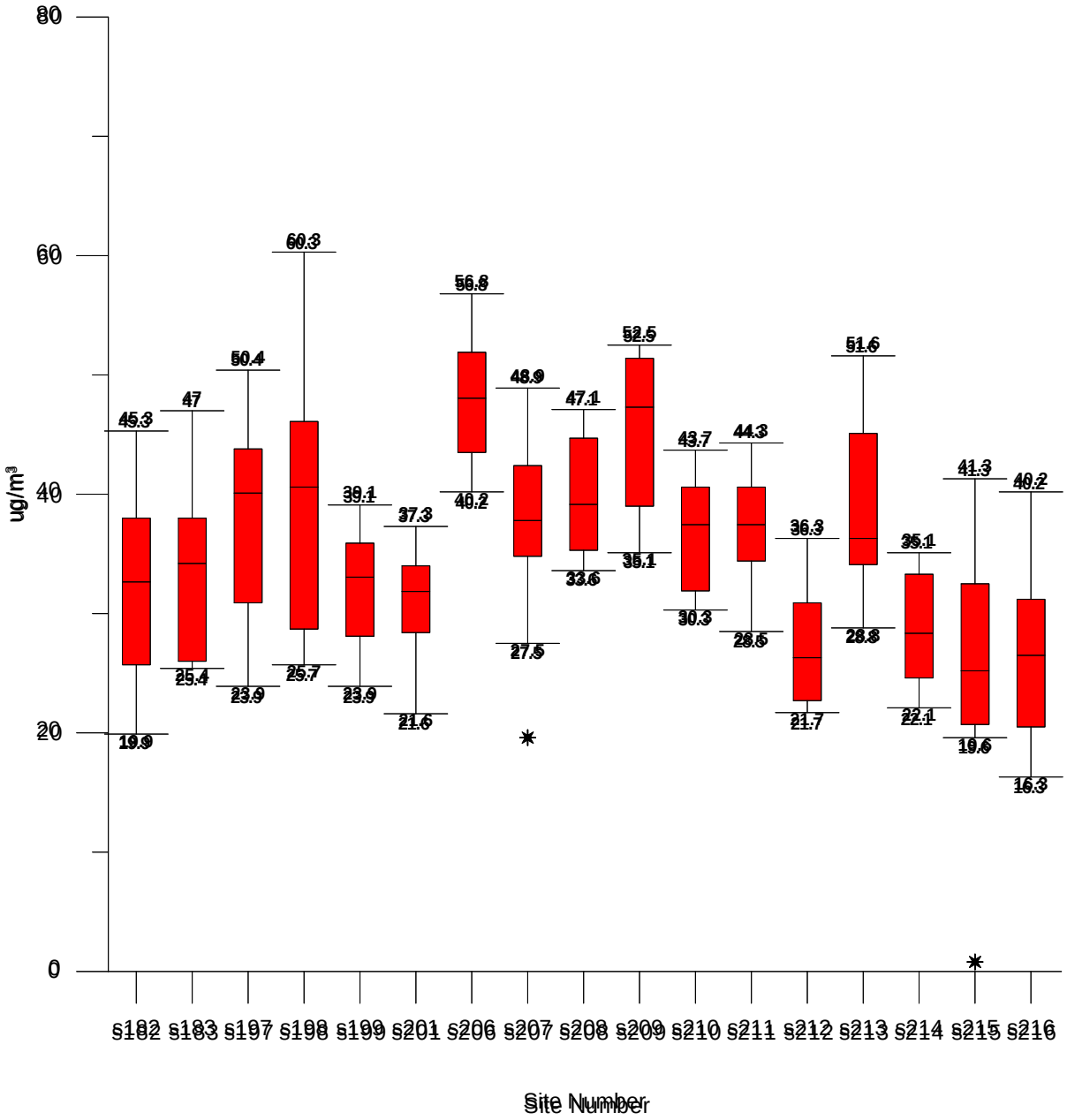
Box-Whisker Plot - Sites 141-160
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



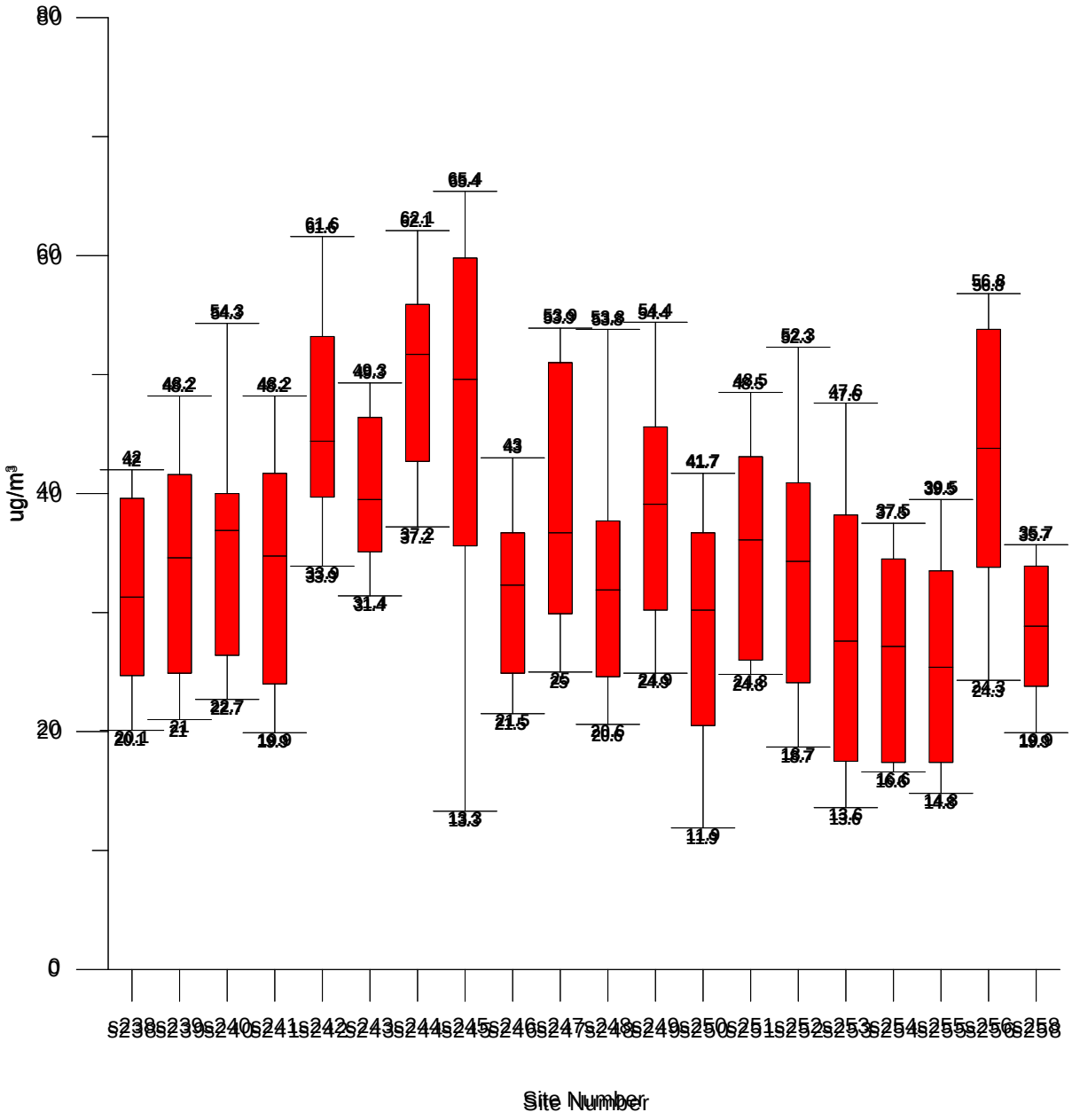
Box-Whisker Plot - Sites 162-180
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



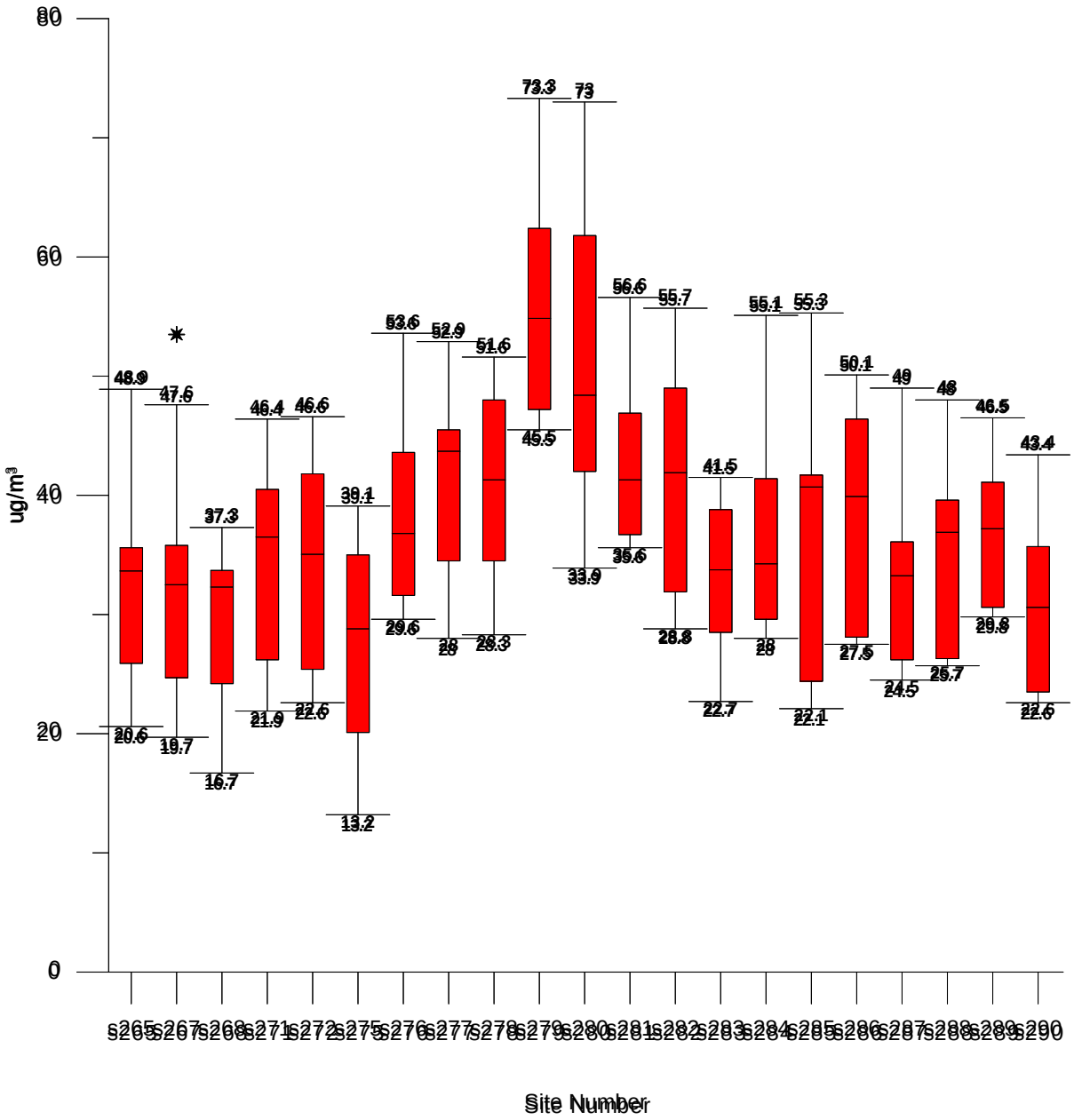
Box-Whisker Plot - Sites 182-216
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



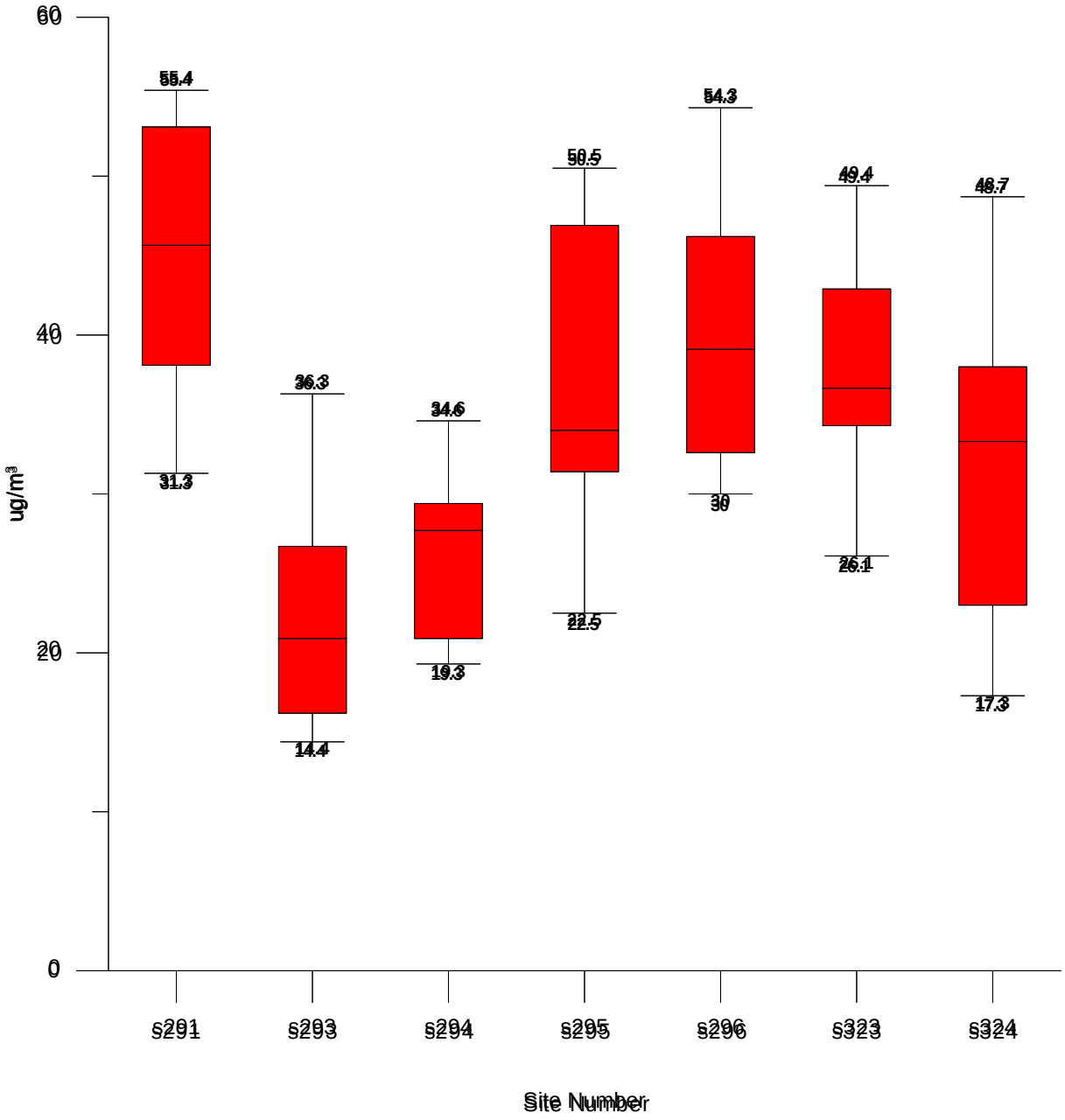
Box-Whisker Plot - Sites 238-258
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



Box-Whisker Plot - Sites 265-290
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



Box-Whisker Plot - Sites 291-324
Passive NO_2 Diffusion Tube Results - 2014
Raw (Uncorrected for Bias) Data



Appendix 6

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

Heather Price[1], Robert Arthur[3], Keith Sexton[2], Clive Gregory[3], Bastiaan Hoogendoorn[3], Ian Matthews[3], Tim Jones [1], Kelly BéruBé[2]

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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

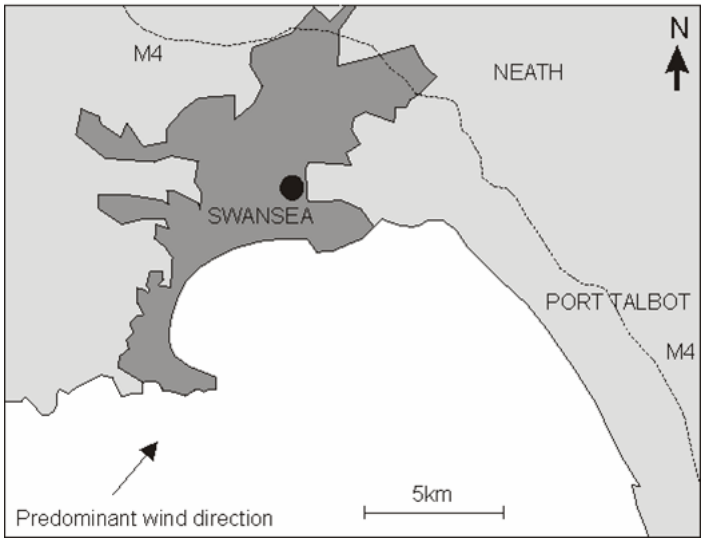

Figure 1. Location map showing the Neath Road, Swansea sampling site (black circle) in relation to surrounding feature

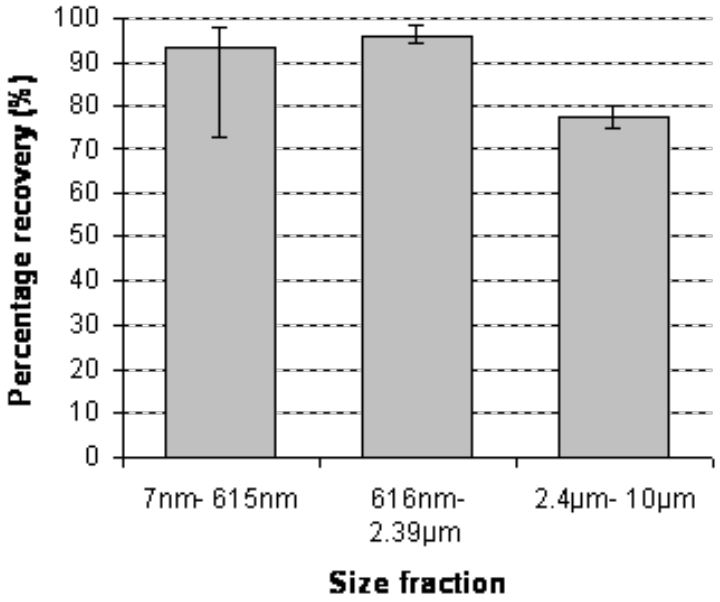

Figure 2. Particle mass extraction efficiency for the three analysed size fractions (30nm- 615nm, 616nm- 2.39µm, 2.4µm- 10µm). Error bars indicate the range of recovery efficiencies measure

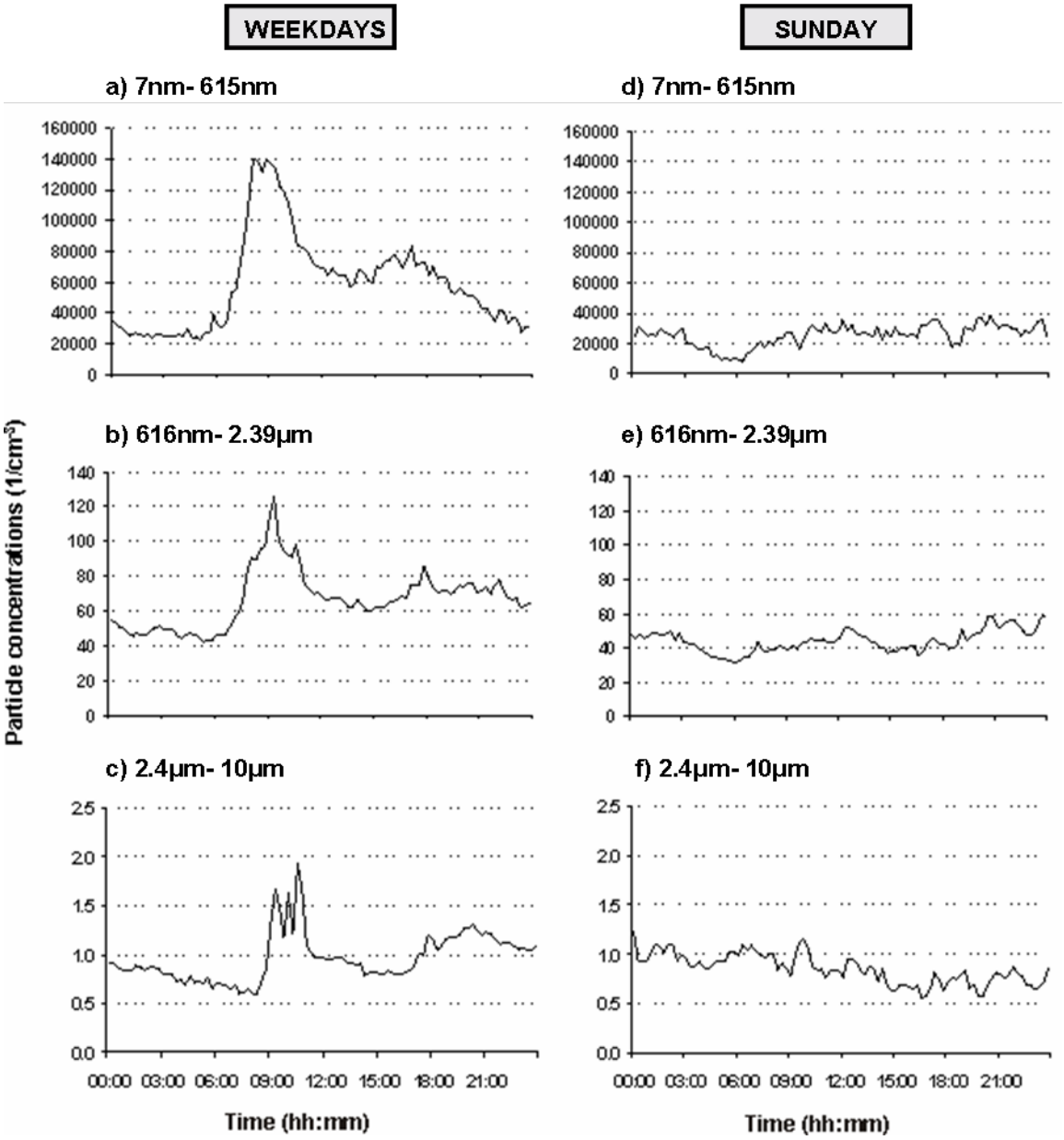

Figure 3. Average daily particle concentration profile in Neath Road traffic corridor for (1) weekdays and (2) Sundays in three size fractions (a) 7nm- 615nm, (b) 616nm- 2.39µm, (c) 2.4µm- 10µm

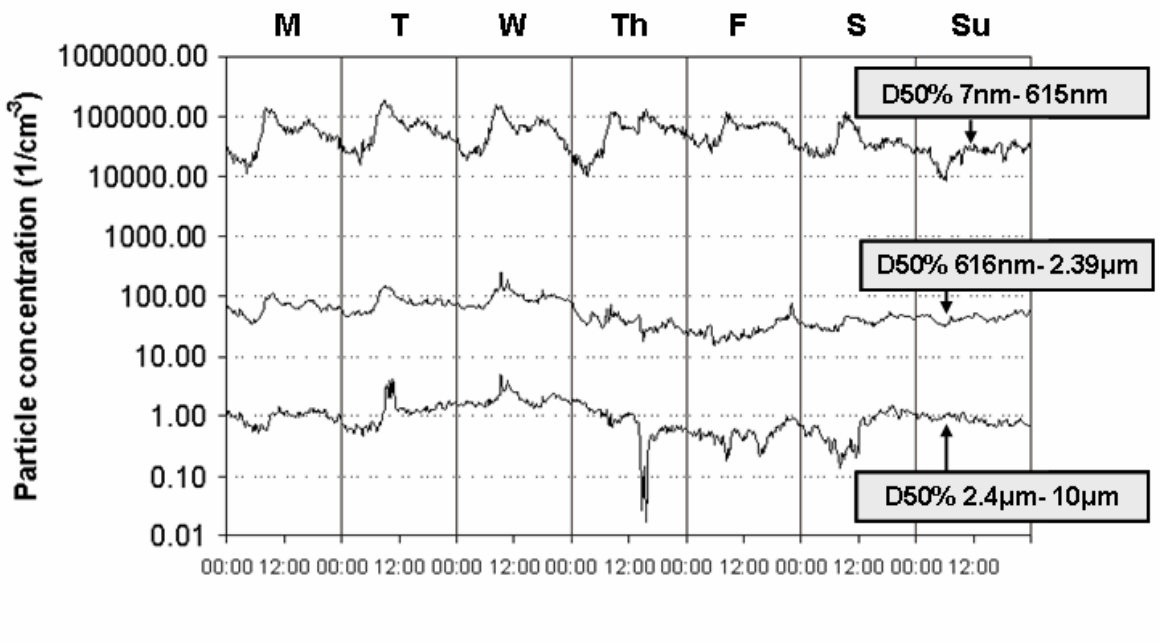

Figure 4. Average weekly particle concentration profile for Neath Road, Swansea

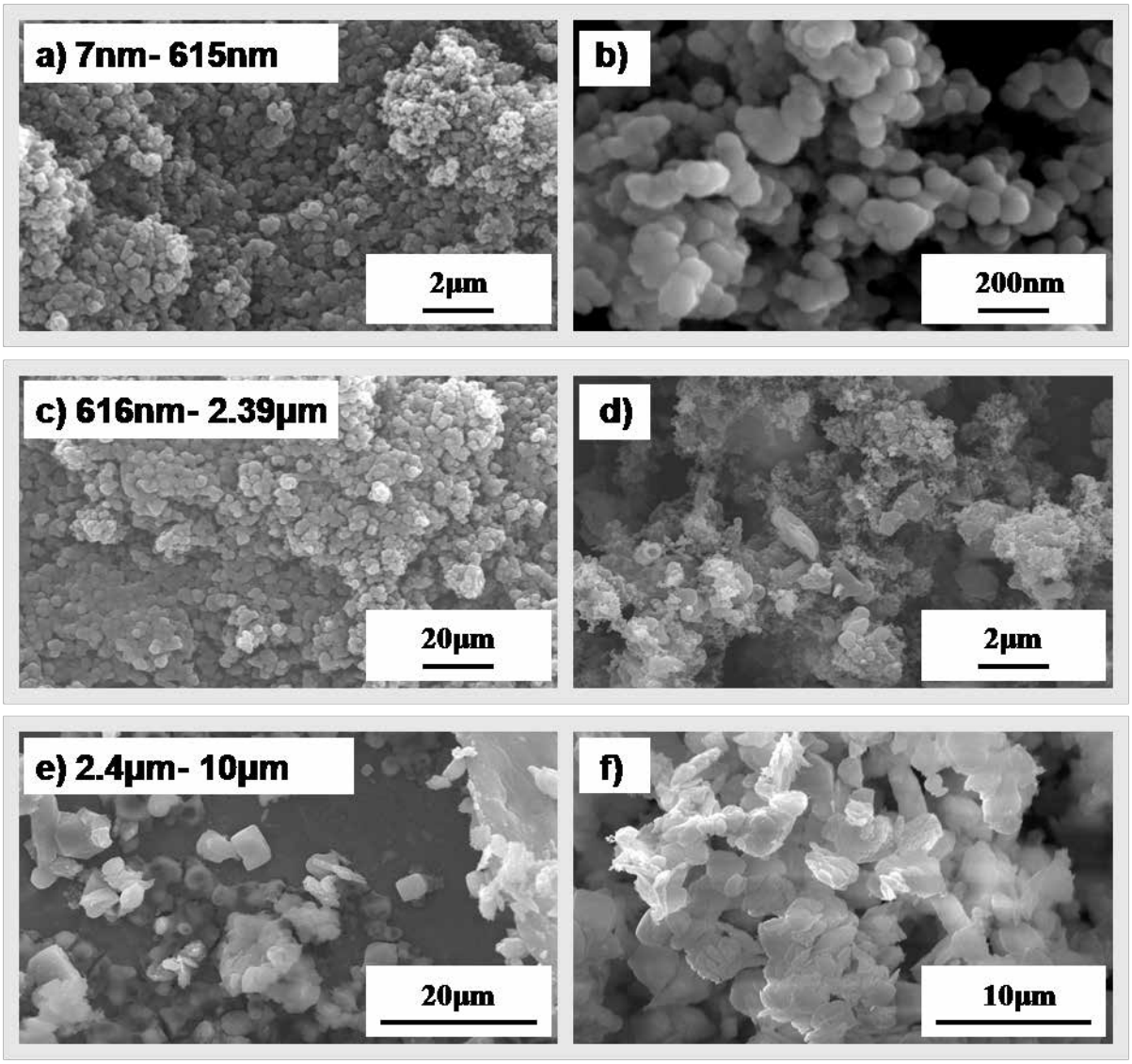

Figure 5. FE-SEM images of particles in the three measured size fractions collected in Neath Road, Swansea

(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

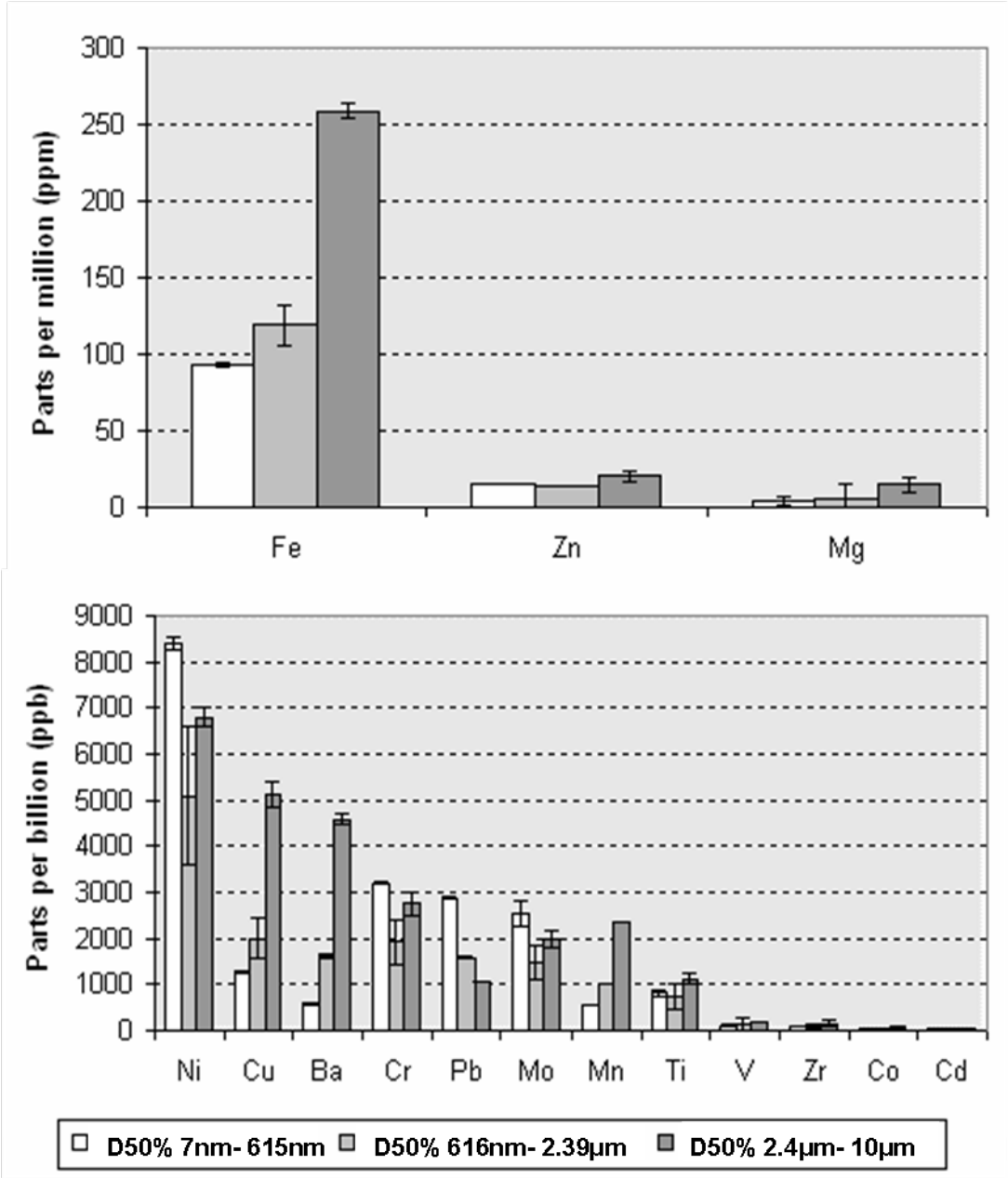

Figure 6. ICP-MS elemental analysis of the three analysed size fractions
Bars represent the three different analysed size fractions (white= D50% 30nm- 615nm; light grey= D50% 616nm- 2.39µm; dark grey= D50% 2.4µm- 10µm), top graph showing elements in parts per million (ppm) concentrations and bottom graph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

Acknowledgements

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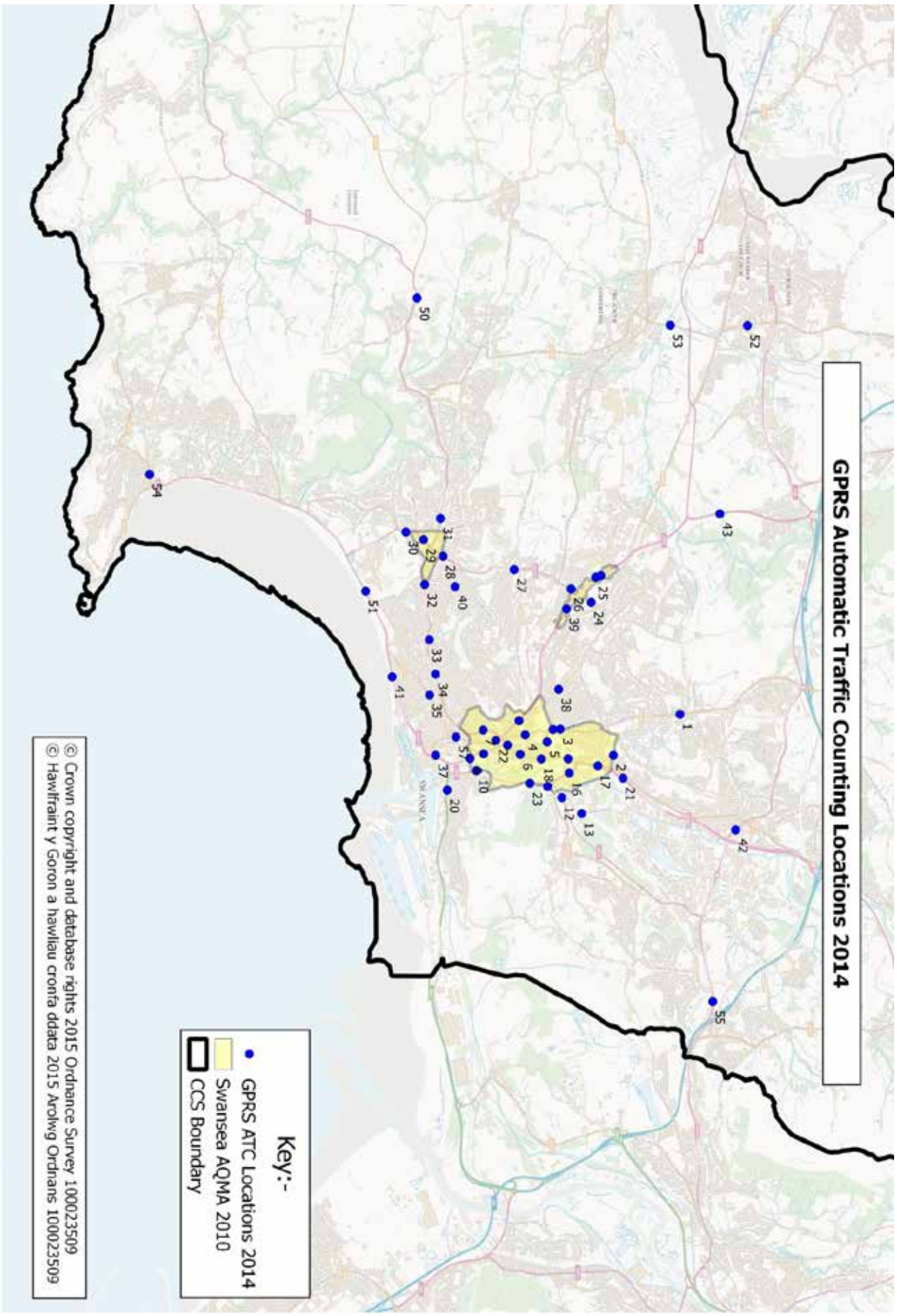
Annexe 7

Location of GPRS Automatic Traffic Counters 2014


GPRS Automatic Traffic Counting Locations 2014
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GPRS ATC Locations 2014
Swansea AQMA 2010
CCS Boundary
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