The Environment Act 1995: Part IV
Local Air Quality Management
Review and Assessment of Air Quality

City & County of Swansea

Progress Report 2008

May 2008

Title	**Air Quality Progress Report 2008**

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Executive Summary

This report contains the latest Progress Report required under the Local Air Quality Management timetable for review and assessment purposes. The report details the latest monitoring works undertaken during the calendar years 2006-2007, outlines future developments that may impact upon air quality and the current progress being made within the Action Plan prepared for the Hafod Air Quality Management Area.

Passive nitrogen dioxide tube monitoring undertaken has indicated continued exceedence of the annual mean objective of 40μg/m^3 within the existing Hafod Air Quality Management Area. Monitoring has also indicated widespread exceedences and also the potential to exceed the annual mean objective outside of the existing Hafod Air Quality Management Area within the Sketty, Llansamlet, Ynystawe, Fforestfach and St Thomas areas. Detailed Assessments within these areas are now underway to establish the likely boundary/extent of the exceedences. The Hafod Air Quality Management Area will then be varied in light of the new information.

The City and County of Swansea participates in the UK Heavy Metals Monitoring Network and has monitoring stations within the Glais, Clydach and Morriston areas monitoring the high level stack discharge from the nickel refinery within Clydach. Monitoring results during 2006-2007 have confirmed the likelihood of exceedence of the 4th Daughter Directive critical threshold monitoring target values. Additional monitoring stations have been established both upwind and downwind of the release point taking the total monitoring locations to four. Two of these stations have been adopted onto the UK Metals Monitoring network.

Swansea has seen an upsurge in re-development works within the city, both on greenfield and brownfield sites - most notably the dock redevelopment at SA1. This development site has undoubtedly been the catalyst for the re-development and regeneration now being witnessed within Swansea. Several other re-development schemes are outlined within this report. More notably, the authority led regeneration proposals for the Tawe Riverside Development Corridor have the potential to impact significantly on conditions both within and outside of the existing Hafod Air Quality Management Area.

As a result of the considerable testing and development works continuing with the Traffic Management Systems and Air Quality Monitoring Feedback modelling project contained within the authorities Action Plan for the existing Hafod Air Quality Management Area, it is envisaged that the system will be proven during 2008. However, further expansion and development of the system will be severely restricted by the budgetary constraints that the authority is subject to. There is no Capital allocation for 2007/2008 or subsequent years for this project and there is also a reduction in the Pollution Control Revenue budget for the financial year 2007/2008**.** This is relevant to both the physical works on the ground planned within the Hafod Air Quality Management Area and the probable expansion necessary to deal with the expanded management areas.

1 The Swansea 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 (June 2000) estimate for the population of Swansea is 230,300. The 2000 Census also indicates that 46,700 (20.3%) of the population were less than 17 years of age with 41,205 (17.9%) of the population being aged 65 or over.

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 Corus Steelworks complex at Port Talbot. Heavy industry has declined steadily within the boundaries of the authority during the last century. This former industrial activity has left its scars – most notably to the Lower Swansea Valley. From the early 1970’s the areas once blighted by slag heaps have undergone extensive remediation and greening. New “light industry” and retail outlets have moved back into the Lower Swansea Valley following the establishment of Enterprise Zone’s and industrial parks. Considerable regeneration is now ongoing within the Swansea area notably the docks re-development and within the city centre/marina area.

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

with the M4 motorway junctions to the north. Local traffic also use these routes as primary routes into the city centre.

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

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

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

The Tawe Riverside Corridor Proposals will, if implemented see, the regeneration of a large section of the lower Swansea Valley from the Quay Parade bridges upto 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 which dealt with the legacy of contamination by clearing derelict sites and undertaking limited remediation with extensive landscaping.

These new developments are outlined within section 6 and are provided for information within this report. A map indicating current air quality monitoring locations can be seen within annexe 2.

2 Statutory Background

Part IV of the Environment Act 1995 required the production of a national strategy for air quality. The same Act places a duty on local authorities to carryout periodic reviews of air quality to determine if they will meet the objectives set out in the National Air Quality Strategy (NAQS). The National Air Quality Strategy was first published in March 1997 with the Air Quality Regulations providing the legal footing for the air quality objective's set out in the NAQS. The NAQS uses health-based standards to control the levels of seven designated air pollutants.

The NAQS has evolved over time and has seen the NAQS revised and republished as "The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air". The revision integrated European air quality standards into UK policy and, eventually legislation for both England and the devolved administrations. In Wales the Air Quality Regulations 1997 have been superseded by the Air Quality (Wales) Regulations

2000 which themselves have been amended with the Air Quality (Amendment) (Wales) Regulations 2002 and came into effect on 31st December 2002.

Air Quality Strategy 2007

The UK Government and the devolved administrations published the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland on the 17th July 2007 (Cmd paper No 7169).

The Strategy:

- sets out a way forward for work and planning on air quality issues
- sets out the air quality standards and objectives to be achieved
- introduces a new policy framework for tackling fine particles
- identifies potential new national policy measures which modelling indicates could give further health benefits and move closer towards meeting the Strategy's objectives

The Air Quality Strategy 2007 in the main retains the existing standards and targets that are already set in regulation. The only notable exception to this is the indicative 2010 objectives for PM_{10} (from the 2000 Strategy and 2003 Addendum) have been replaced by an exposure reduction approach for $PM_{2.5}$ which is still under negotiation with the EU

2.1 Previous Review and Assessment Works

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. Further details on this area of work can be found within section 4.1

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 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 when the technical difficulties being experienced with the equipment are 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 (see section 4.1).

2.2 Summary of LAQM Actions to date

Details on the various stages completed by the authority in the Local Air Quality Management process are given below. Brynlliw Colliery remediation is shown for information purposes due to the delays in the LAQM process that this introduced. The Internet addresses (URL's) that these reports can be downloaded from are given where appropriate.

Report	Date Completed	Internet URL
1st Stage Review	1999	http://www.swansea.gov.uk/index.cfm?articleid=5563
Brynlliw Colliery Remediation	1999-2000	
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

2.3 Guidance

The Department for Environment, Food and Rural Affairs (DEFRA) has issued guidance documents to assist local authorities in conducting their duties under the Environment Act 1995. In accordance with Section 88(2) of the Environment Act 1995, local authorities are required to have regard to this guidance when carrying out any their duties under, or by virtue of Part IV of the Act.

Guidance has been issued in the form of Policy Guidance LAQM.PG (03) and Technical Guidance LAQM.TG (03).

LAQM.PG (03) replaces the second set of policy guidance documents published in March 2000 namely LAQM.G1(00), LAQM.G2(00), LAQM.G3 (00), and LAQM.G4(00).

LAQM.TG (03) replaces the guidance issued previously as LAQM.TG1 (00), TG2 (00), TG3 (00) and TG4 (00). LAQM.TG(03) has undergone further review. An update has been produced in January 2006 resulting in LAQM.TG(03) not being re-published in its entirety. The revisions and updates are provided as a series of FAQ's, supported where necessary by new LAQM tools. The revisions and updates focus upon experiences from the previous rounds of review and assessments and concern the following issues:

- Background pollution maps and future year calculation tools
- Emissions of sulphur dioxide from steam locomotives
- Emissions of sulphur dioxide from shipping
- Emissions of PM_{10} from poultry farms

- Data ratification procedures
- NO_x:NO_2 relationships

The guidance sets out the legislative framework for local air quality management (LAQM). It is seen as an integral part of delivering the Air Quality Objectives set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland published in January 2000 along with the Air Quality Strategy 2007, The Air Quality (Wales) Regulations 2000 and the Air Quality (Wales) (Amendment) Regulations 2002.

Following the first round of review and assessments DEFRA and the Devolved Administrations commissioned a detailed evaluation of first round of reviews and assessments undertaken by local authorities. The main aim was to look at aspects of the LAQM process that worked well and aspects that could usefully be improved upon.

The formulation of the new guidance was the subject of considerable consultation and aims to build on the experiences previous reviews and assessments. Where applicable, all guidance has been considered in the production of this Progress Report.

There were proposals by DEFRA and the Devolved Administrations to issue new/updated LAQM Technical Guidance during 2007 (DEFRA May 2007 - Evaluation of support provided by DEFRA and the Devolved Administrations to Local Authorities for air quality reviews and assessment). However, enquiries to the Review and Assessment Helpdesk have established that this guidance is still in draft form and will not be issued for consultation until the end of April 2008 at the earliest.

2.4 The Air Quality (Wales) Regulations 2000 as amended by the Air Quality(Amendment)(Wales) Regulations 2002

The 2000 and 2002 Regulations provide the statutory basis for the system of Local Air Quality Management (LAQM) and prescribe the standards and objectives to be achieved for those pollutants set in regulation. The Regulations also provide dates by which these standards and objectives are to be achieved. The 2002 Amendment Regulations introduce a second air quality objective for benzene of 5μg/m^3 or less, when expressed as an annual mean, to be achieved by 31st December 2010. The 2002 Amendment Regulations also alter the air quality objective for carbon monoxide (CO), which was to be achieved by 31st December 2003 to a maximum daily running 8 hour mean of 10mg/m^3 or less.

The pollutants set in regulation together with the target dates for compliance are set out in table 1 below. Table 1 also includes the permitted exceedences allowed under the regulations.

Pollutant	Air Quality Objective		Permitted Exceedences	Compliance Date
	Concentration	Measured As		
Benzene	16.25μg/m^3	Running Annual Mean	N/a	31/12/2003
	5μg/m^3	Annual Mean	N/a	31/12/2010
1,3-Butadiene	2.25μg/m^3	Running Annual Mean	N/a	31/12/2003
[1] Carbon Monoxide	10mg/ m^3	Max daily running eight hour mean	N/a	31/12/2003
Lead	0.5μg/m^3	Annual Mean	N/a	31/12/2004
	0.25μg/m^3	Annual Mean	N/a	31/12/2008
[2] Nitrogen Dioxide	200μg/m^3	1 Hour Mean	18	31/12/2005
	40μg/m^3	Annual Mean	N/a	31/12/2005
Particles PM_{10}	50μg/m^3	24 Hour mean	35	31/12/2004
	40μg/m^3	Annual Mean	N/a	31/12/2004

Sulphur Dioxide	350µg/m^3	1 hour Mean	24	31/12/2004
	125µg/m^3	24 Hour Mean	3	31/12/2004
	266µg/m^3	15 Minute mean	35	31/12/2005

Table 1 – Objectives included in the Air Quality (Wales) Regulations 2000 and Air Quality (Wales) (Amendment) Regulations 2002
[1] As amended by the Air Quality (Wales) (Amendment) Regulations 2002
[2] The objectives for nitrogen dioxide are provisional

2.5 UK Objectives not as yet set in Regulation

The particles objectives (PM_{10}) for 2010 announced by the Welsh Assembly Government on the 18th September 2002 were provisional objectives and were not included in Regulation for purposes of LAQM in Wales. These particle objectives are unlikely to be set in regulation given the Air Quality Strategy 2007 retaining the existing objectives. Therefore, the City and County of Swansea are only required to review and assess PM_{10} particles as prescribed in the Air Quality (Wales) Regulations 2000. However, both the guidance and Welsh Assembly Government recommends that local authorities include a provisional assessment of whether or not the particles objectives are likely to be met in their reviews and assessments. The provisional particles PM_{10} objectives are set out below in table 2.

Pollutant	Air Quality Objective		Permitted Exceedences	Compliance Date
	Concentration	Measured As		
Particles PM_{10}	50µg/m^3	24 Hour mean	7	31/12/2010
	20µg/m^3	Annual Mean	N/a	31/12/2010

Table 2 – Provisional Particles PM_{10} Objectives for 2010

The authority has taken limited regard to this advice given the current status of European negotiations and the details contained within the Air Quality Strategy 2007. The situation regarding particles is likely to change further with the

exposure reduction proposals for $PM_{2.5}$ contained within the 2007 Strategy (European obligations still under discussion)

2.6 The Purpose of the Progress Report

Progress Reports have been introduced into the LAQM system following a detailed evaluation of the first round of local authority review and assessment (see 1.3 above). A need was identified to develop a longer-term vision for both LAQM and the review and assessment process. The process was seen as being too start-stop, with some local authorities completing their first round of review and assessment and then doing little or nothing for several years until the next round of reviews commenced. Updating and Screening Assessments are now required at intervals of three years whilst Progress Reports maintain the continuity and are to be produced in the intervening years.

Progress reports should ensure continuity in the LAQM process and should help local authorities:-

- by helping retain a profile for LAQM within the authority, including the retention of staff with a knowledge of air quality issues
- by providing a means for communicating air quality information to members and the public
- by maximising the usefulness and interpretation of the monitoring effort being carried out by the local authority
- by maximising the value of investment in monitoring equipment
- by making the next round of review and assessment that much easier, as there will be a readily available up-to date source of information

- by helping local authorities respond to requests for up-to-date information on air quality
- by providing information to assist in other policy areas, such as transport and land use planning
- by providing a ready source of information on air quality for developers carrying out environmental assessments for new schemes
- by demonstrating progress with implementation of air quality Action Plans and/or air quality strategies
- by providing a timely indication of the need for further measures to improve air quality, rather than delaying until the next full round of review and assessment

There is a separate requirement for those authorities who are implementing air quality Action Plans to prepare annual Progress Reports on the actions completed or those that are still being implemented in the pursuit of compliance with the air quality objectives within the AQMA. As has been mentioned above, this authorities Action Plan for the Hafod AQMA was submitted to the Welsh Assembly Government in December 2004**.**

Within Wales, there is a new requirement that from April 2008 Air Quality Action Plan progress reports are included within Health Challenge Swansea's, Health, Social Care & Well Being Strategy 2008-2011.Guidance on how exactly, the Action Plan Progress could be incorporated into the LHB Health, Social Care & Well Being Strategy was due to have been released by the Welsh Assembly Government during 2007. However, this guidance has not materialised. For the sake of completeness, an update on the progress with the Hafod Air Quality Action Plan is included within this report.

As recommended within the Progress Report Guidance LAQM.PRG (03) details of the progress made to date with the identified actions points listed within the authorities Action Plan are included within this report and can be seen within chapter 7.

This Progress report has been prepared having had regard to the guidance issued under Progress Report Guidance LAQM.PRG (03).

3 New Monitoring Data

3.1 Automatic Real-Time Data within Hafod AQMA

3.1.1 Morfa Groundhog

The Morfa station has been operational since August 2000 and is 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. The station is within the boundary of the Hafod AQMA and has been given a site classification Kerbside (U1)[1].

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 satisfies the majority of the monitoring criteria required by this authority with receptor locations (dwellings) being located within 25m. Due to its location in a fairly open aspect of the lower valley area, this station does not truly reflect the conditions experienced within the narrow congested streets within the Hafod Air Quality Management Area.

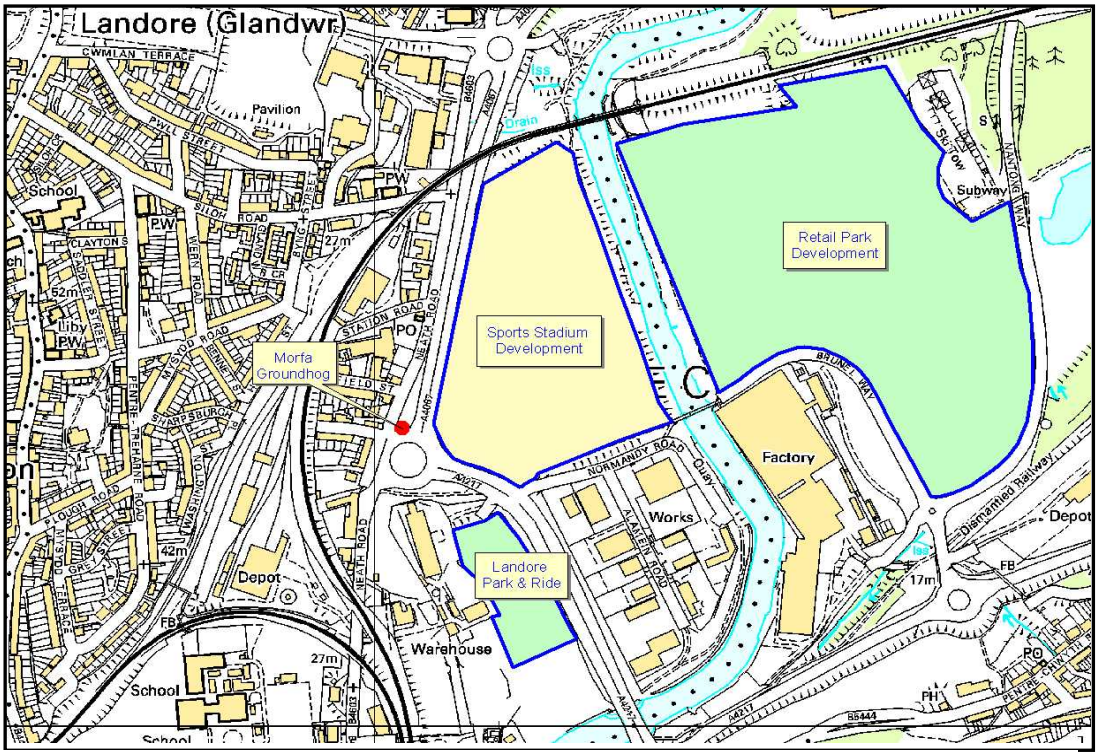
All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring CO, SO_2 and $NO_{x,}$. The R&P TEOM

[1] *Source LAQM.TG(03) Appendix A page A1-42*

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 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.

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data is re-scaled according to the calibration factors obtained on a fortnightly basis. The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. Since the awarding of the contract by the Welsh Assembly Government to AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site is fully audited yearly by AEA Energy & Environment together with the calibration gases stored on site. The L10 cylinders are replaced on a regular basis and are to a certified and traceable standard.

A map showing the location of the Morfa Groundhog station is given below as map 1



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Map 1 Location of Morfa Groundhog station

3.1.2 Results of automatic monitoring 2006 – 2007

3.1.3 Nitrogen Dioxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time NO_x analyser. 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[2]. 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.

[2] LAQM TG(03) Appendix A - Monitoring page A1-37

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

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

Data from 2006 and 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 3. For the sake of completeness, data is also shown from 2004 and 2005. A graph of the 2006-2007 measurements is shown below as chart 1.

Morfa Groundhog											
Annual Mean (40$\mu g/m^3$)				Max 1-hour (200$\mu g/m^3$)				Exceedences of 1-hour std (18 permitted)			
2004	2005	2006	2007	2004	2005	2006	2007	2004	2005	2006	2007
33.5	33.9	38.1	36.1	201.6	169.7	177.6	252.1	1	0	0	2

Table 3 - Nitrogen Dioxide monitoring data - Morfa Groundhog 2004 - 2007

Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

[3] *LAQM.TG(03) Appendix B - Conversion factors page A1-44*

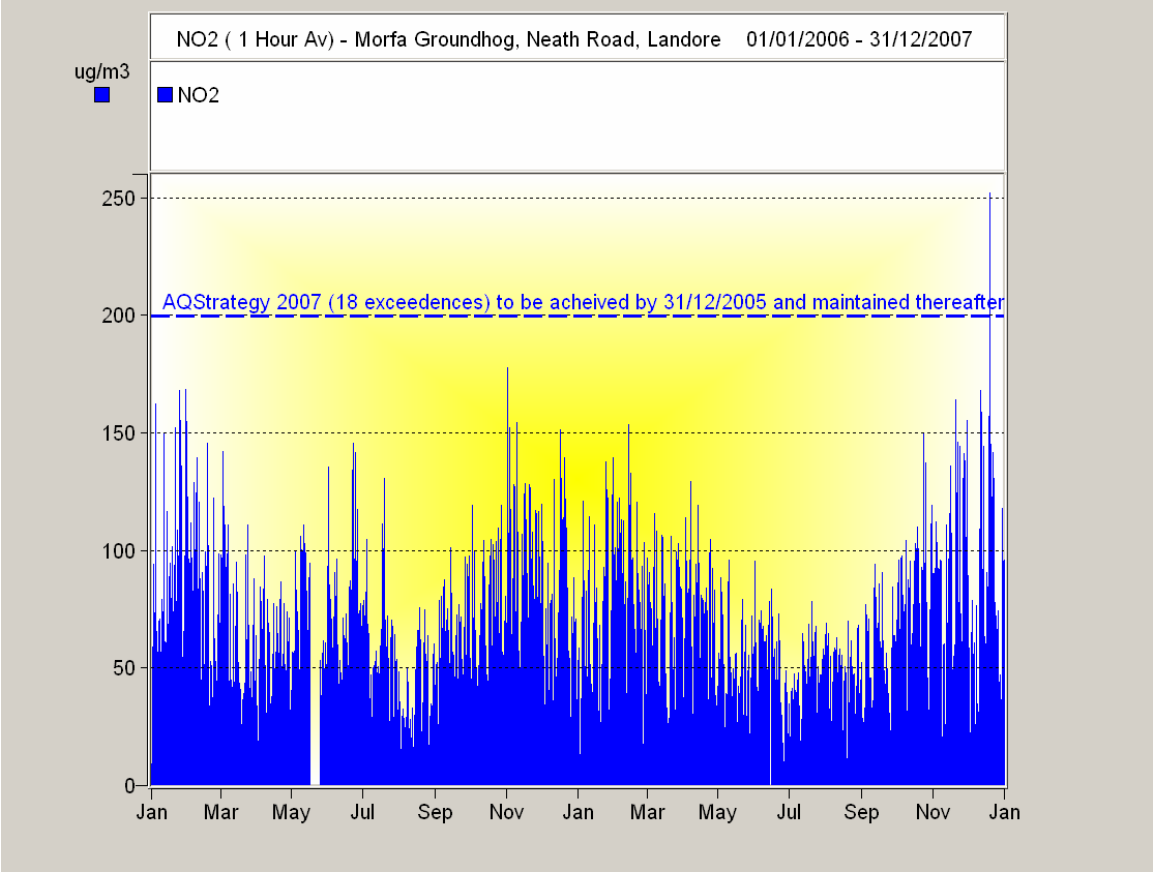


Chart 1 – NO_2 1 hour means 2006-2007 – Morfa Groundhog

The annual NO_2 means for 2006 and 2007 are below the 40µg/m^3 objective for both 2005 and the EU Limit Value in 2010. Hourly NO_2 data capture for 2006 is 95.8 %, and for 2007 is 99.1%. These data capture rates permit the direct compilation of hourly exceedences rather than the use of the 99.8th percentile of hourly means[4].

However, what is most noticeable is the indications of a start in the reversal of the previously identified reduction trend in annual mean NO_2 concentrations both nationally and locally here in Swansea with the NO_2 mean for 2006 being exceptionally close to the EU Limit Value level in 2010. The 2007 annual mean, whilst marginally lower than 2006, does appear to confirm the reversal of the previously identified NO_2 reduction trend. This new upward trend with NO_2

[4] LAQM TG(03) box 6.2 page 6-16 (applies to data outside AQMA – assumption made that this approach is valid within AQMA as well)

concentrations has been observed at numerous other roadside sites throughout the UK. From literature already published on this reversal of the NO_2 reduction trend it is thought likely that oxidation catalysts fitted to newer EURO classification vehicles are emitting greater concentrations of primary NO_2 direct from the exhaust tailpipe.

If this trend continues, then, despite the fact that the Morfa Groundhog is located within a fairly open aspect of the lower Swansea valley area it could result in failure to comply with the EU Limit Value in 2010. It should be restated that the Morfa Groundhog is at present located within the boundary of the Hafod AQMA and should this trend continue, there would be no requirement to either amend the existing AQMA or to extend the boundary.

The January 2006 update of LAQM.TG(03) indicates that the correction factors provided within the original LAQM.TG(03) guidance (box 6.7 and 6.8 page 6-29) to estimate annual mean concentrations in future years should no longer be used. The revised guidance indicates use of the Year Adjustment Calculator v2.2a (from http://www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls). Using 2006 as the base year a projection of 32.99μg/m^3 is obtained for 2010 and using 2007 as the base year a projection of 32.3μg/m^3 is obtained for 2010. These projections remain below the EU Limit value of 40μg/m^3. The Year Adjustment Calculator v2.2a is dated 19th January 2006 and was probably issued prior to the full impact of the increased primary NO_2 emissions being factored into the calculations.

Ideally, monitoring data should be available for at least 5 years before trends in NO_2 concentrations can be meaningfully discussed. Monitoring commenced at this site during August 2000 so over 5 years of monitoring data is available. The annual means from 2001 to 2007 are presented below within table 4 for a brief

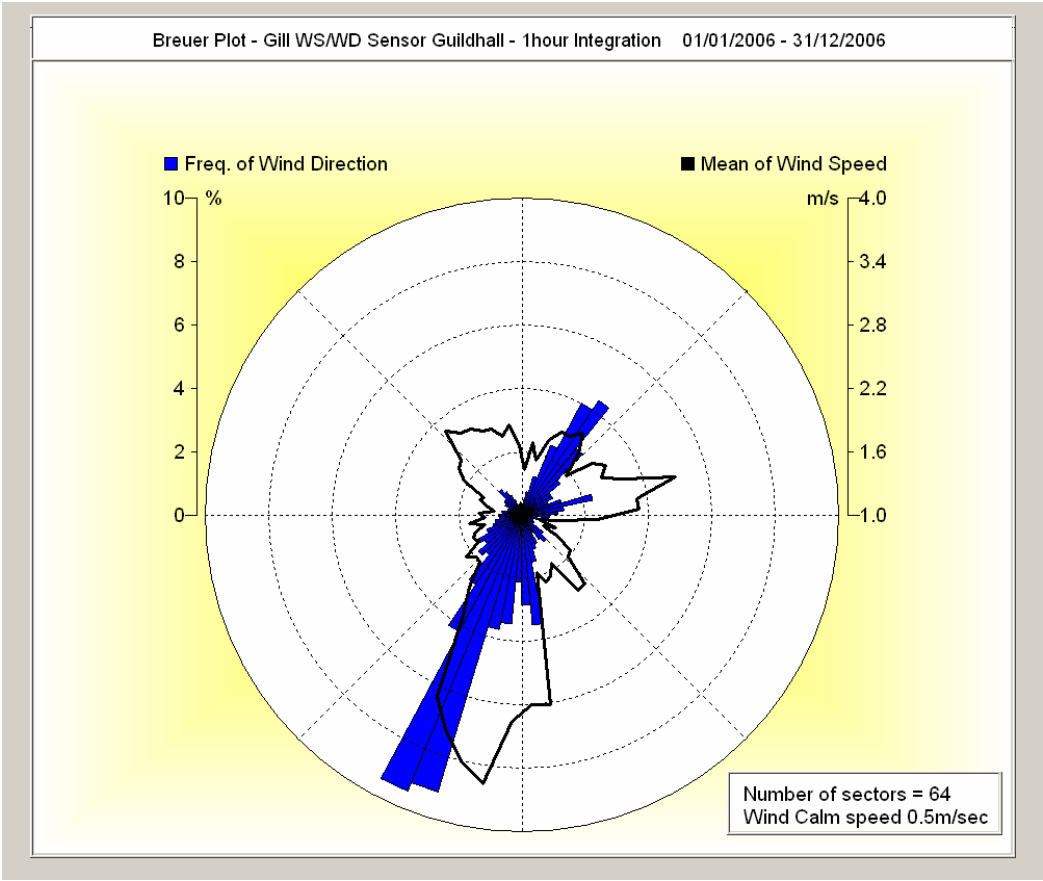
discussion on trends to be made. In addition and as an additional indicator, the maximum hourly concentrations recorded for each year are detailed.

Morfa	Annual Mean (40µg/m^3)							
	2001	2002	2003	2004	2005	2006	2007	2010
	38.63	34.13	36.6	33.5	33.9	38.1	36.1	32.3
	Maximum Hourly Concentration (200µg/m^3)							
	191.5	124.9	155.1	201.6	169.7	177.6	252.1	

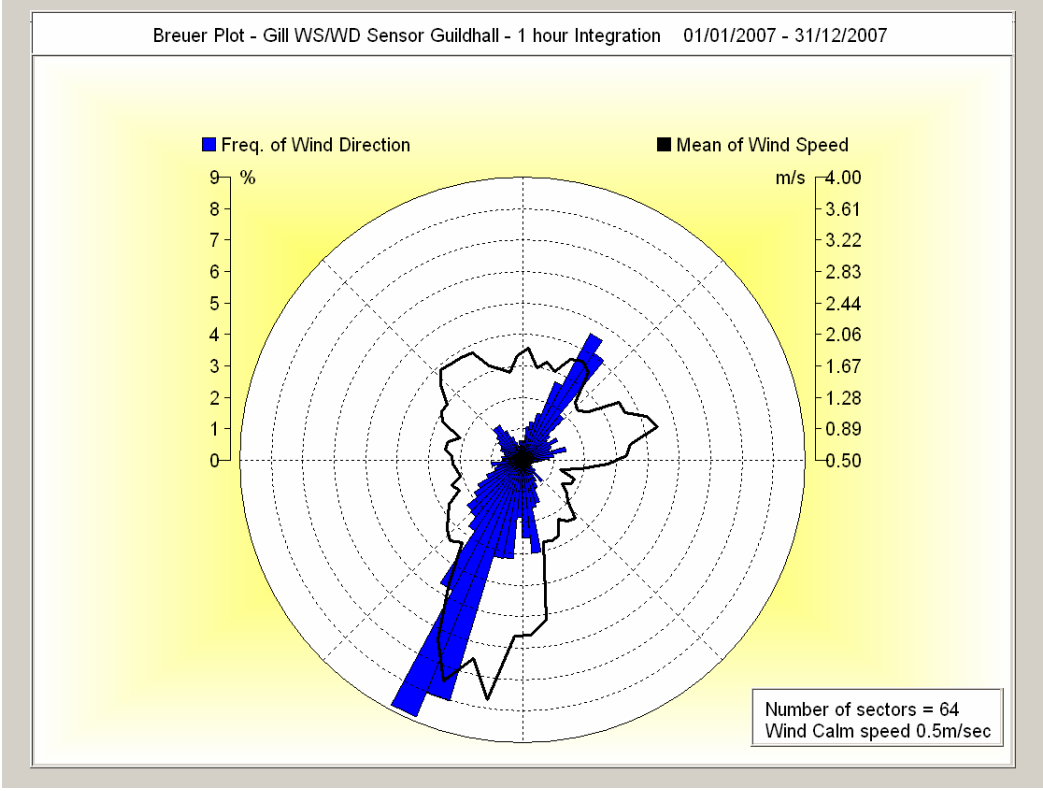
Table 4 - Morfa Groundhog NO_2 monitoring results 2001 - 2006

The data presented within table 4 suggests that a gradual decline in NO_2 concentrations had started to be observed from 2001 levels. The exceptions to this are the annual mean result from 2003 and more recently for 2006 and 2007. However, it has been observed not only here in Swansea [5] but also nationally [6] that meteorological conditions experienced during 2003 were atypical of previous years. The slight elevation of the NO_2 annual mean during 2003 can in all probability be attributed to "abnormal" meteorological conditions within the lower Swansea valley. There are no indications from the meteorological data recorded during 2006 to indicate that there were any prolonged periods of atypical weather. Breuer plots 1and 2 below show a domination of the period by the expected prevailing south westerly fetch together with periods of north-easterlies – a source not traditionally associated with elevated levels in Swansea. Breuer Plot 2 for 2007 is broadly similar to those conditions seen within 2006 with a slightly lower annual mean but which saw two exceedences of the 1 hour objective during December 2007.

[5] *City & County of Swansea Updating and Screening Assessment - July 2004 page* 64
[6] *Met Office - Air Quality Wales - Welsh Air Quality Forum Bulletin Issue 5 September 2003*



Breuer Plot 1 – Swansea Meteorological Conditions 2006



Breuer Plot 2 – Swansea Meteorological Conditions 2007

The meteorological station located on the fringes of Swansea Bay foreshore at the Guildhall has been used to generate the above Breuer plots as the 9m mast located at the Morfa Groundhog site is experiencing significant shielding to winds from a northern section between approximately 320º to 30º which is thought to be due to a section of trees. The largest of these trees have recently been felled in an attempt to improve the situation but it's unlikely that a free field of measurement can be obtained and then maintained.

During the morning of the 19th December 2007, two exceedences of the 1-hour objective were observed both at the Morfa site and at other real-time stations operated by the authority (mentioned later within each relevant station). These breaches appear to have occurred during a period of cool, calm stable meteorological conditions leading up to and during the early morning peak traffic flows – "traditional" conditions for producing high NO_2 readings. A time-series graph representing the period 18th – 20th December 2007 is shown below.

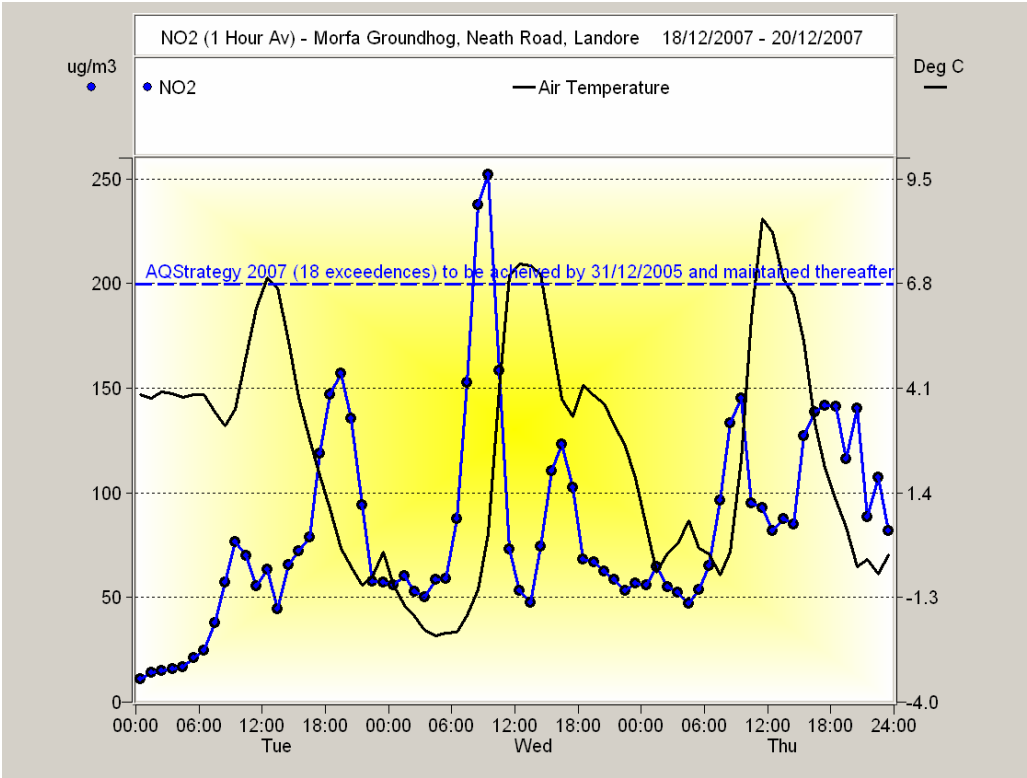
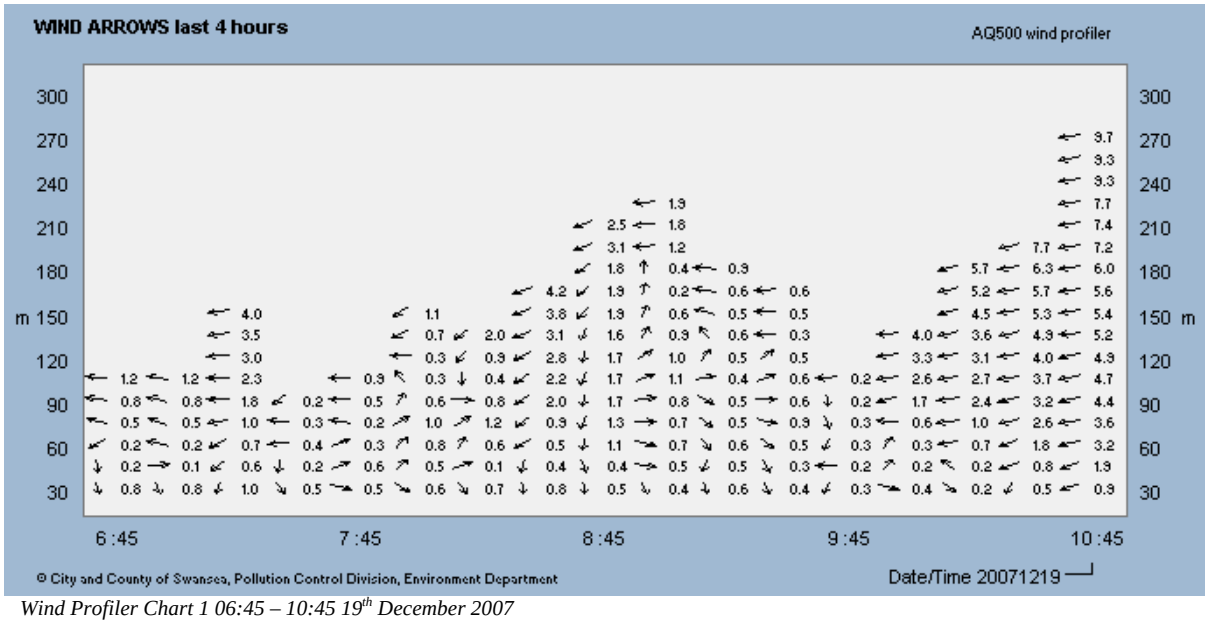


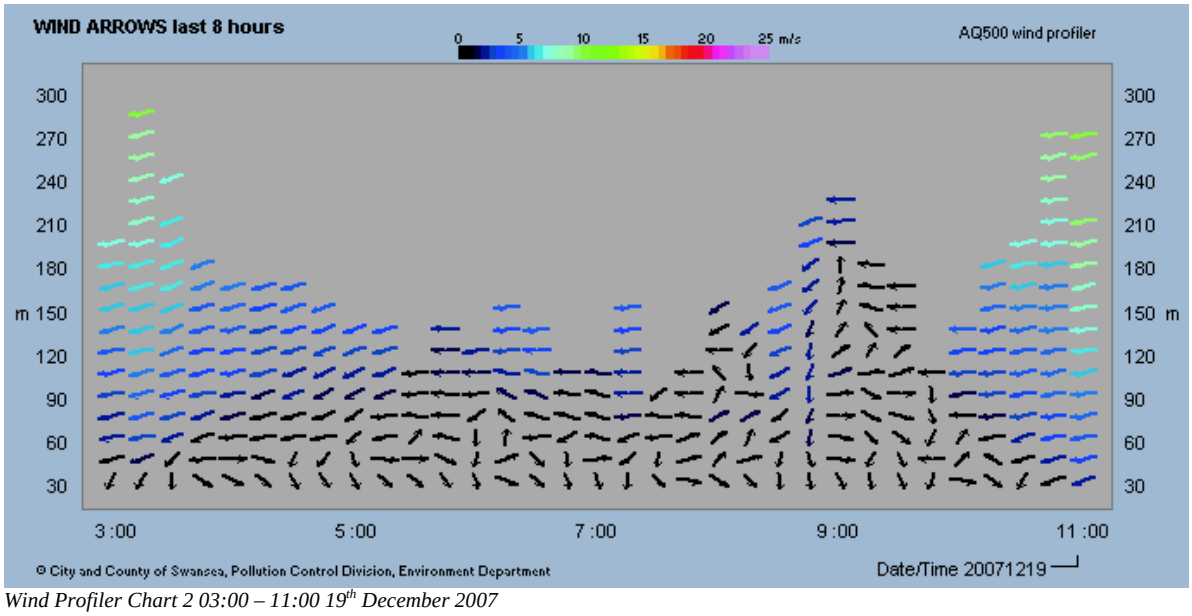
Chart 2 – NO_2 and Ambient Air Temperature levels Morfa Groundhog 18th – 20th December 2007

The authority has installed a 30m Meteorological Mast approximately 200m away for the site within Cwm Level Park. Unfortunately, testing was underway during this period and meteorological data from this source is not currently available. However, the authority have also located an AQ500 Wind Profiler (SODAR) on the valley floor approximately 250m to the south east of the site located within the Morfa Territorial Army Centre (opposite Landore Park and Ride). This profiler measures wind speed and direction every 15m (from its start/base level of 30m) up to its maximum range of 300m. Summary charts of meteorological conditions within the Lower Swansea Valley are therefore available for this period. The authority is working on the importation and availability of this SODAR data for use with its dispersion modelling.

Ambient air temperature data available for the station shows that the temperature had been slowly falling since approximately midday the day before reaching -2.2 at 06:00 on the morning of the 19th December coinciding with the start of the "episode". See also Met Charts 2 and 3 within section 3.2.1 below for the Hafod DOAS which provide additional meteorological information for the period 11th – 20th December 2007.

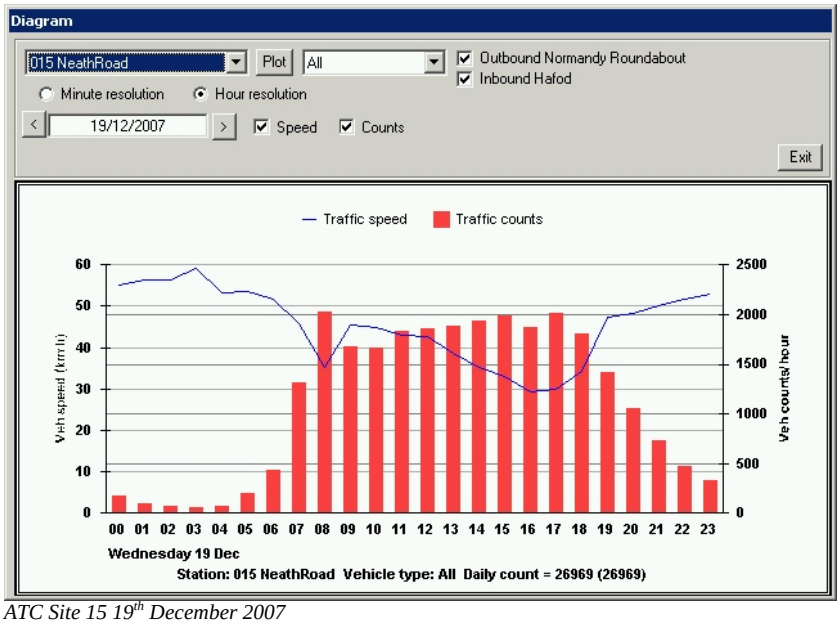


Wind Profiler Chart 1 06:45 – 10:45 19th December 2007

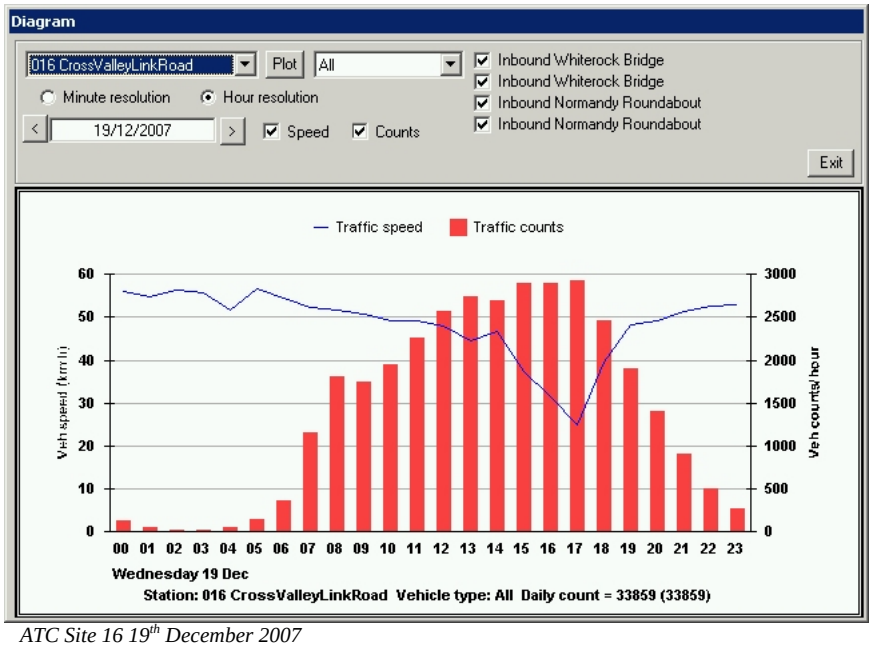


Wind Profiler Chart 2 03:00 – 11:00 19th December 2007

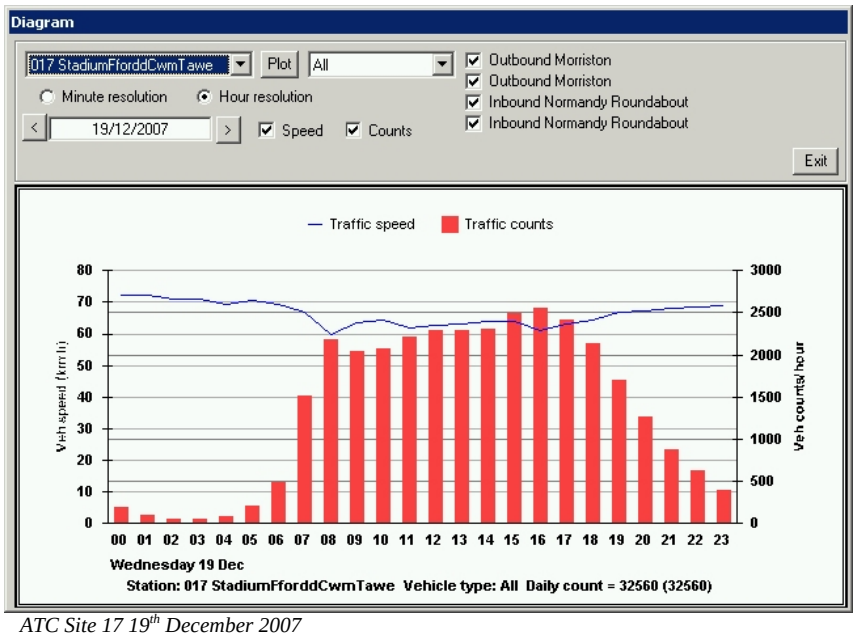
The authority operates 3 GPRS Automatic Traffic Counters within a 200m radius of the Morfa monitoring station. Site 15 Neath Road is located to the south west; site 16 is located opposite the Landore Park & Ride site with site 17 located outside the Liberty Stadium on the Ffordd Cwm Tawe dual carriageway. Indications of the local traffic flow are presented below:



ATC Site 15 19th December 2007



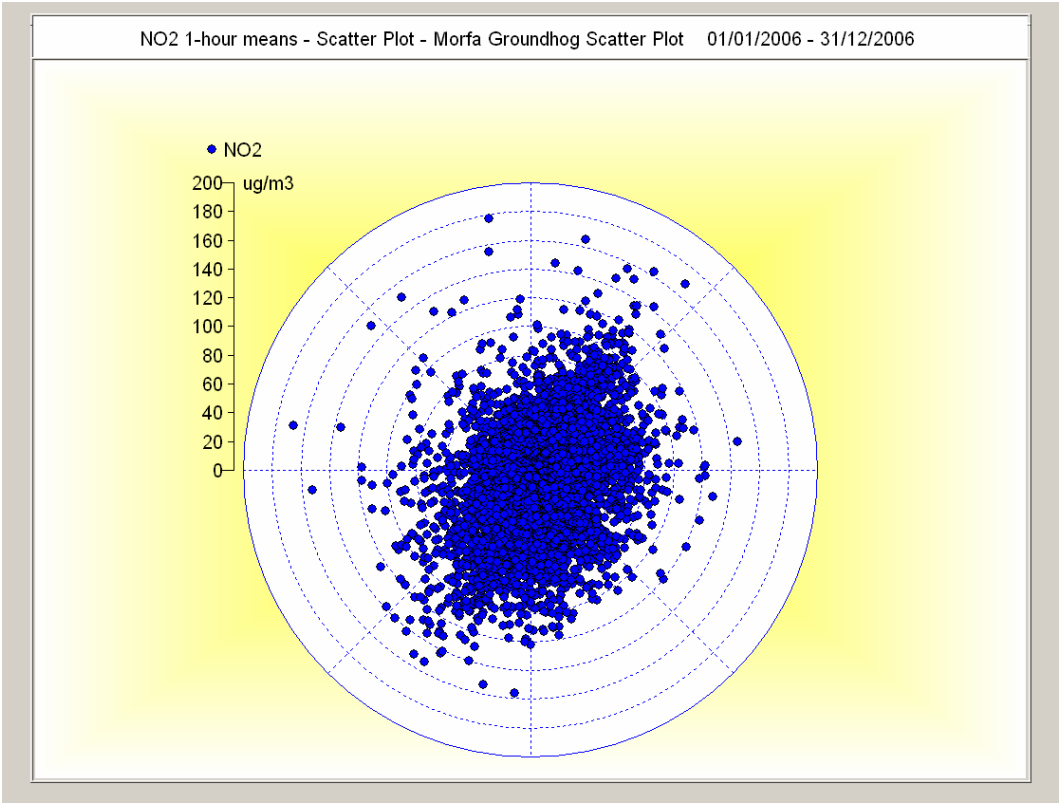
ATC Site 16 19th December 2007



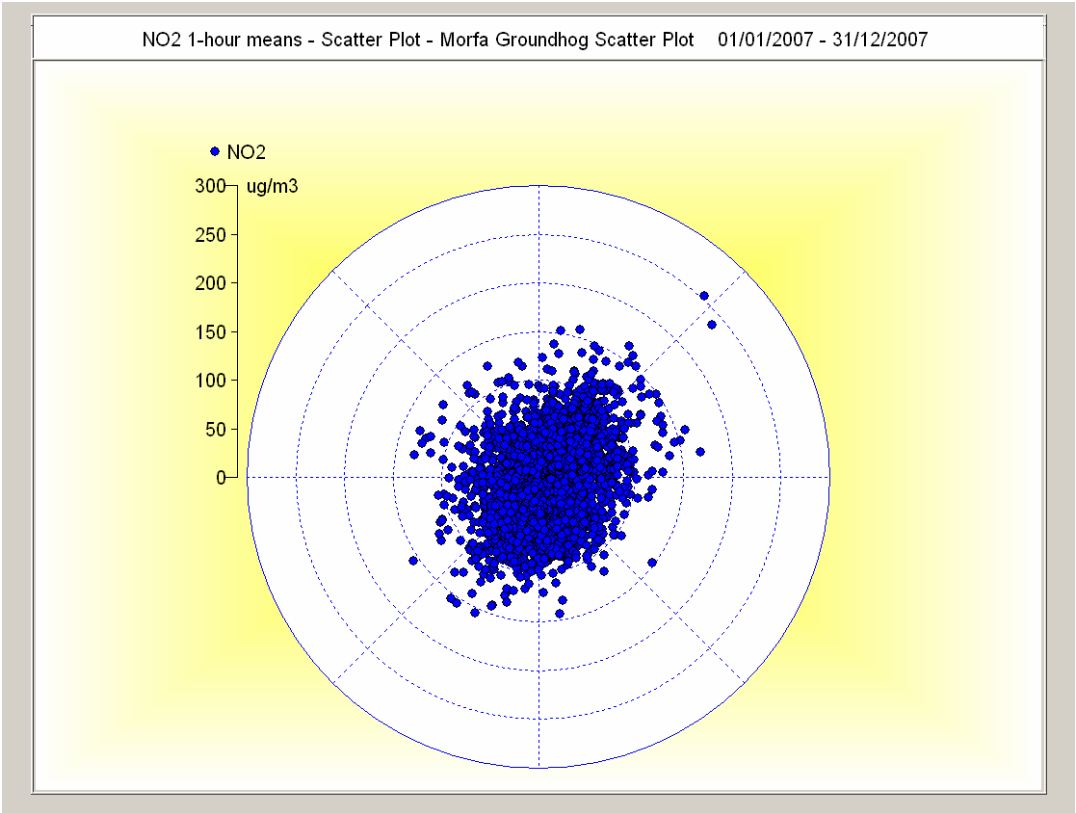
ATC Site 17 19th December 2007

All ATC sites show the expected am peak flows during the period of inversion formation. The inversion dispersed late morning leading to decreasing NO_2 concentrations whilst traffic volumes remained high.

Scatter Plot 1 for 2006 and Scatter Plot 2 for 2007 below indicate the spread of NO_2 data.



Scatter Plot 1 – NO_2 1-hour means Morfa Groundhog 2006



Scatter Plot 2 – NO_2 1 hour means Morfa Groundhog 2007

Whilst there is evidence of elevated levels during 2006 from the north-east sector, these are mirrored in other directions and are not thought to significantly account for the increase in annual mean concentration during 2006. The two exceedences can easily be seen within Scatter Plot 2 for 2007- the remaining data is tightly grouped and shows no dominant direction/source which would tend to point to local sources dominanting.

Again, meteorological data from the Guildhall station has been used within scatter plots 1 and 2 above. Whilst it is accepted that this is not ideal due to the complex topographical induced meteorological features of the lower Swansea valley it represents the best local indicative meteorological data currently available. This situation will change shortly when the additional data streams are capable of being integrated into the systems under development.

It is now possible that a reversal in this downward trend is starting to be observed with a pronounced elevation in the annual mean concentration for 2006 with the mean concentration for 2007 following close behind. As mentioned above, this, at present, is thought most likely to be attributable to the newer EURO classification vehicles directly emitting increased concentrations of primary NO_2. Whilst the upward “trend” has only been observed during the last year or so, if the reasons for the sudden increase in concentrations are verified then, this would have implications for future years and compliance with EU objectives within other areas of Swansea not previously thought to be at risk of failing. Indeed, this reversal trend may already have started to be observed more widely in Swansea within the non continuous nitrogen dioxide passive tube monitoring data as can be seen within section 4.

Previous review and assessment works have projected forward to the key dates

of 2005 and 2010. The various projections and source are indicated below in table 5.

LAQM Report	Base year data	Annual Mean in Base Year	Projection for 2005 μg/m^3	Projection for 2010 μg/m^3
Stage 4 Review	2001	38.63	34.6	
Stage 4 review	2002	34.13	32	
USA 2004	2003	36.6	30.33	
Progress Report 2004	2004	33.5	32.66	26.87
USA 2006	2005	33.9		28.52
Progress Report 2007	2006	38.1		32.95
Progress Report 2008	2007	36.1		32.3

Table 5 – Morfa Groundhog Previous Projections 2005 and 2010

The data ranged from underestimating the 2005 annual mean by -10.5% (2003 base data) to an overestimate of 2% (from the 2001 base data). The 2001 base data produced the closest estimate. 2002 base data produced an underestimate of -5.6% and 2003 base data an underestimate of -3.6%.

It must be noted that the method for projecting forward these predictions and the tools developed to enable this forward look have evolved over time i.e. the latest Year Adjustment Calculator (2006) uses 2004 as its base year.

3.1.4 Particulate Matter PM_{10}

The particles objectives (PM_{10}) for 2010 announced by the Welsh Assembly Government on the 18th September 2002 were provisional objectives and were not included in Regulation for purposes of LAQM in Wales. These particle objectives are unlikely to be set in regulation given the Air Quality Strategy 2007 retaining the existing objectives within The Air Quality (Wales) Regulations 2000 as amended by the Air Quality (Amendment)(Wales)

Regulations 2002. Therefore, the City and County of Swansea are only required to review and assess PM_{10} particles as prescribed in the existing regulations.

The situation regarding particles is likely to change further with the exposure reduction proposals for $PM_{2.5}$ contained within the 2007 Strategy (European obligations still under discussion).

3.1.4.1 Rupprecht & Patashnick Co., Inc. TEOM

A Rupprecht & Patashnick Co., Inc. TEOM measured particulate Matter PM_{10} at the Morfa Groundhog site until the 18th October 2006 at 11am. On this date, the existing R&P TEOM system was removed from site pending an upgrade to the Thermo Inc FDMS PM_{10} system. The Thermo FDMS system was installed on the 28th November 2006, (see 3.1.4.2 below) providing equivalency with the EU reference gravimetric method. In hindsight, it may have been prudent to delay the upgrade until January 2007 and obtain a full year of measurement with the existing R & P TEOM PM_{10} system.

The logged 15-minute means from the R & P Co. Inc TEOM 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[7]. 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 daily 24-hour means and the annual mean. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the hourly means were specified to be present[8].

[7] *LAQM.TG(03) Monitoring A1-37*
[8] *LAQM.TG(03) Monitoring A1-38*

All results are presented in µg/m^3 and have been corrected with the interim default correction factor of 1.3 to estimate gravimetric concentration. For ease of comparison, results from the previous years (2004 and 2005) are shown alongside the results for 2006 within table 6 below. A chart representing the 24-hour daily means from 2006 is given below as chart 3 and a Breuer Plot representing the scatter of the 24-hour means during 2006 as Scatter Plot 3

Morfa Groundhog PM_{10} (TEOM)	Annual Mean (40µg/m^3)			24-hour Exceedences (50µg/m^3) (35 permitted)		
	2004	2005	2006	2004	2005	2006
	29.17	27.13	29.27 *	28	8	17 *

Table 6 PM_{10} (TEOM) Monitoring Results 2004-2006 Morfa Groundhog

** Data capture for 2006 75.89% due to upgrade to Thermo FDMS unit 18th October 2006*

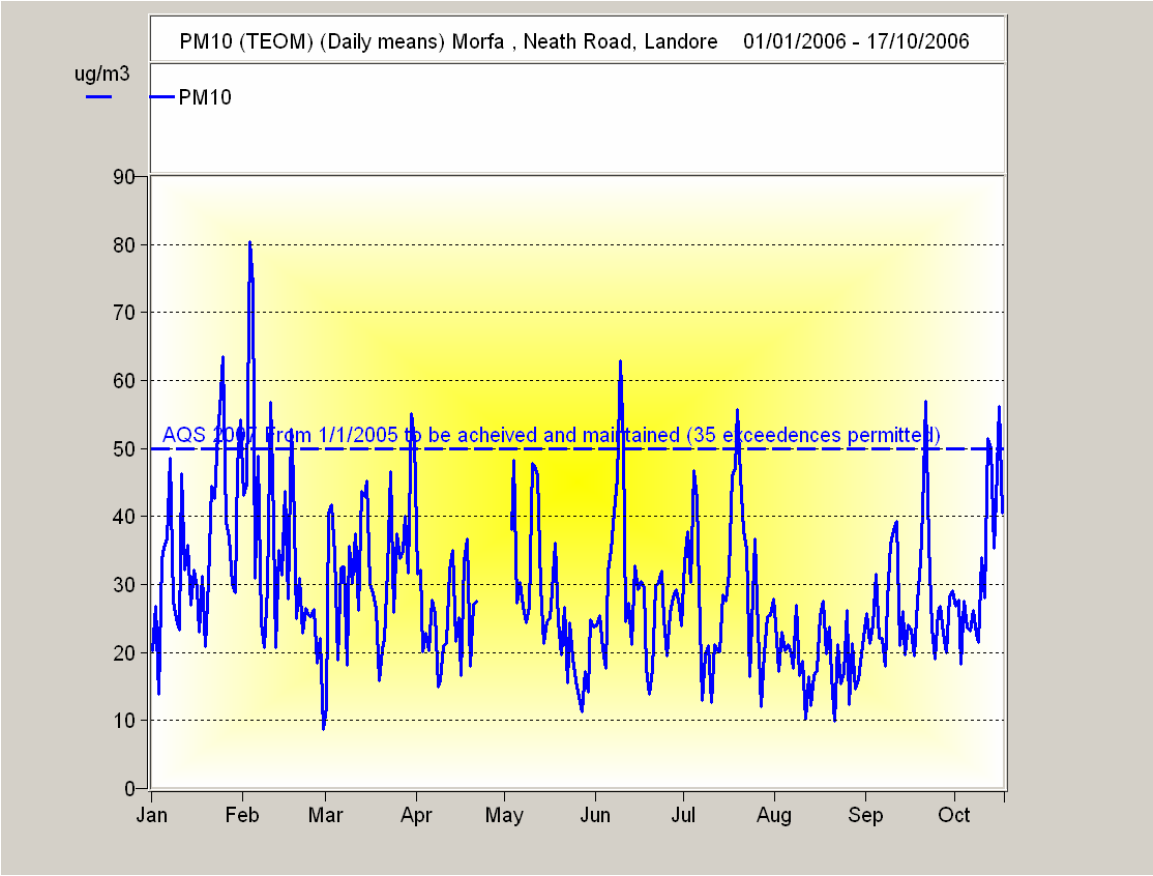
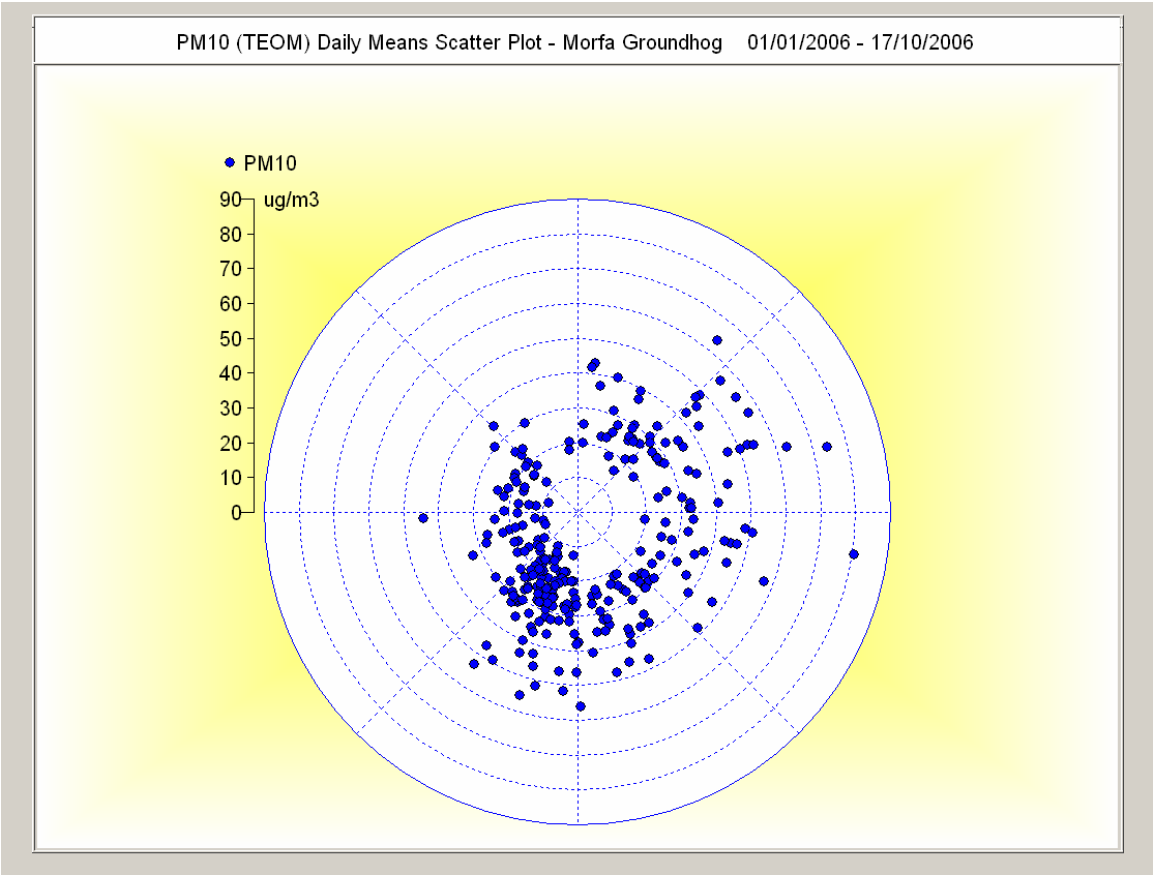


Chart 3 24 Hour PM_{10} (TEOM) Means Morfa Groundhog 2006



Breuer Scatter Plot 3 24 Hour PM_{10} (TEOM) Means Morfa Groundhog 2006

From table 6, it is evident that the data (TEOM) is showing compliance with the existing objectives during 2005 and 2006 both in respect of the annual mean concentrations and permitted number of exceedences. The results for 2006 do not represent a full year of measurements with only 75% data capture due to the upgrade of the R & P TEOM commencing 18th October 2006.

The scatter indicates no dominating direction during 2006 but hints at the more elevated levels during 2006 to be from a south-easterly and north-easterly direction.

In previous analyses undertaken of PM_{10}, elevated levels of PM_{10} emanating from a south-easterly direction has been associated with the heavy industry located in Port Talbot: notably, the Corus steel plant

Again, meteorological data from the Guildhall station has been used within scatter plot 3 above. Whilst it is accepted that this is not ideal due to the complex topographical induced meteorological features of the lower Swansea valley it represents the best local indicative meteorological data currently available.

Whilst the number of exceedences did not breach the objective (accepting the limitations of the dataset mentioned above) during 2006 at least double the amount of daily exceedences compared to 2005 were recorded. What is unsure at the moment is if this increase in exceedences can be attributed to periods of south-easterly winds and influence of heavy industry, or, if it is another indication of the effect of the newer EURO classification vehicles locally.

The maximum daily mean for 2006 was 80.37μg/m^3 recorded on the 3rd February 2006.

Data capture for 2006 was 75.89%. Direct compilation of 24-hour exceedences rather than the use of the 90th percentile of 24-hour means is therefore not permitted.[9] The 90th percentile for 2006 is 46.13

3.1.4.2 Thermo Inc FDMS PM_{10}

The Thermo FDMS system was installed on the 28th November 2006, providing equivalency with the EU reference gravimetric method – section 5.5.3[10]

[9] LAQM.TG(03) Box 8.4 page 8-22
[10] DEFRA and devolved administrations report UK Equivalence Program for Monitoring of Particulate Matter dated 5th June 2006 at http://www.airquality.co.uk/archive/reports/cat05/0606130952_UKPMEquivalence.pdf

The dataset collected from the FDMS system is not directly comparable to the historical R&P TEOM dataset even given that the use of the advised interim default correction factor was advised to estimate the EU reference gravimetric method. This correction factor has been called into dispute by various studies at diverse locations throughout the UK each deriving differing correction factors.

The data collected for 2006 from the FDMS unit amounts to a mere month at best and is reported here merely for information purposes. Additionally, brief operational issues that have been identified are outlined here for information as the operation of the FDMS units differs substantially from that of the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[11]. 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 provides hourly integration data and has been configured as per DEFRA's FDMS parameter protocol. The RS232 port on the FDMS control unit allows the collection of up to 8 parameters via telemetry. The parameters collected from the FDMS units are : Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. However, the FDMS unit will not directly produce a PM_{10} mass concentration. The PM_{10} mass concentration is obtained via post processing of

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

the volatile and non volatile mass parameters by creating a calculated channel within the database to subtract volatile mass from the non volatile mass.

AEA Energy and Environment has produced a new LSO operating procedure for the FDMS units. One of the more problematic issues with use of the FDMS units that this authority has found is the routine changing of both the purge filter (within the chiller unit) and the “normal” tapered element filter within the sensor unit. The chiller unit is held at approximately 4°C - upon removal of the filter housing, condensation can be seen on the filter holder. It is this authorities experience that should the new 47mm Pallflex TX40 MFAB filter be installed without ensuring the filter holder is dry then this can (and most certainly does) produce very noisy/spiky data. Correct orientation of the 47mm Pallflex TX40 MFAB filter within the filter holder is critical as incorrect orientation will result in poor quality data being returned. The 47mm filter and tapered element sensor unit filter should always be exchanged at the same time. Whilst the TEOM units did take up to 1-2 hours to stabilise after the sensor unit filter exchange and status code 4 OK being reached, the FDMS units can, and do, take even longer to stabilise. Should the site suffer a power failure or air conditioning failure then it is recommended that 3 hours data post resolution of either condition should be deleted from the dataset.

Data collected from the FDMS units has an integration period of 1-hour. PM_{10} mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Opsis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to

calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present[12].

Chart 4 below shows the FDMS dataset from commencement on the 28th November 2006 to 31st December 2007. Between the start of measurements using the FDMS method, until the end of 2006, there were two exceedences of the 24 hour mean objective – both occurring between 20th -21st December 2006.

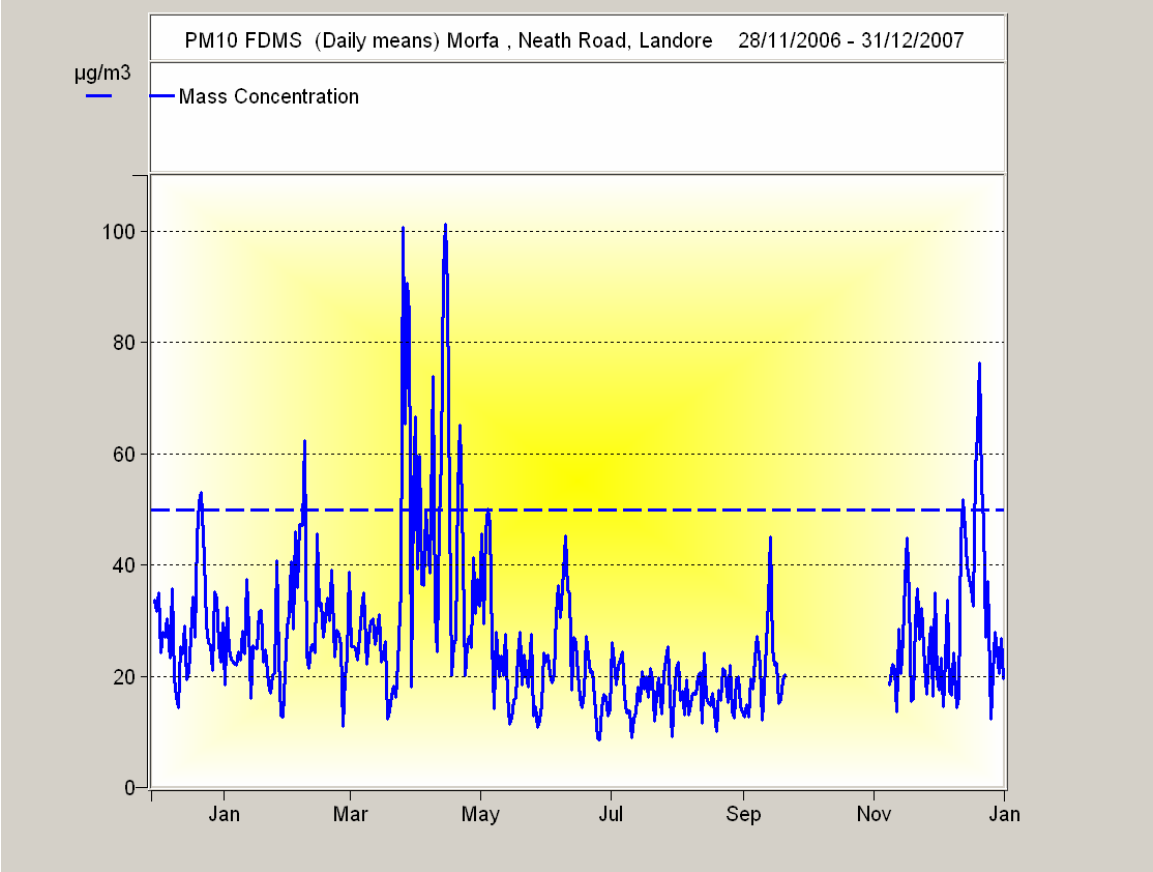


Chart 4 Morfa FDMS PM_{10} 24-hour means 28th November 2006 – 31st December 2007

The annual mean for 2007 is 27µg/m^3. Data capture for 2007 is 86.8% (see 90th Percentile table 7). The data capture rate was reduced due to the failure a circuit board within the FDMS chiller unit between the 21st September and 7th November 2007. Table 7 below summarises the monitoring activities for 2007.

[12] *LAQM.TG(03) Monitoring A1-38*

Morfa Groundhog PM_{10} (FDMS) 2007	Annual Mean ($40\mu g/m^3$)	Max Daily Mean ($\mu g/m^3$)	Max 1-hour mean ($\mu g/m^3$)	24-hour Exceedences ($50\mu g/m^3$) (35 permitted)
	27	101.2	165.5	22*
Date of Max	-	14th April 2007	25th March 2007	
90th Percentile	45.6			

Table 7 Morfa FDMS PM_{10} 2007

** For information only as data capture 86.8%*

The vast majority of the 22 daily exceedences can be seen in Chart 4 as occurring between 24th March 2007 and 22nd April 2007. Some of these exceedences were part of much wider trans boundary episodes and were observed at numerous monitoring stations within Wales and the UK. The back trajectory calculations that have been undertaken indicate two episodes, firstly a Saharan dust episode and then an episode that has been attributed to the Ukrainian forest fires. AEA Energy and Environment together with the UK Met Office have analysed these episodes and the full report[13] can be found at:
http://www.airquality.co.uk/archive/reports/cat12/0802071455_AQF_Partepi0307-final_final.pdf

The conclusions from the report into these episodes are reproduced below[13]:

- Air sourced from the Ukraine and western Russia and often passing over northern Europe contained a cloud of particulates for at least 7 days, between approximately 25th March and 2nd April.

- Dust from sandstorms in North Africa and Jordan/Syria, leading up to the event, may have contributed to the particulates reaching the UK during the episode, especially during the early stages, as shown by both satellite imagery and modelling studies.

[13] UK Air Quality Forecasting : A UK Particulate Episode from 24th March to 2nd April 2007

- The satellite imagery captured clearly shows smoke issuing from the vicinity of the Ukraine with easterly transport of the particulates.

- FDMS data indicate that the air reaching the UK during the mid and late stages of the episode is likely to have contained secondary particulates formed from emissions across continental Europe.

- The particulate laden air is therefore thought to have been the result of long range transport from fires in Russia and the Ukraine, combined with a contribution of European secondary PM_{10} pollution and also dust from sandstorms in the region of North Africa.

It is likely therefore, given the conclusions above, that the exceedences seen within Swansea post 2nd April 2007 were from "local sources" as the

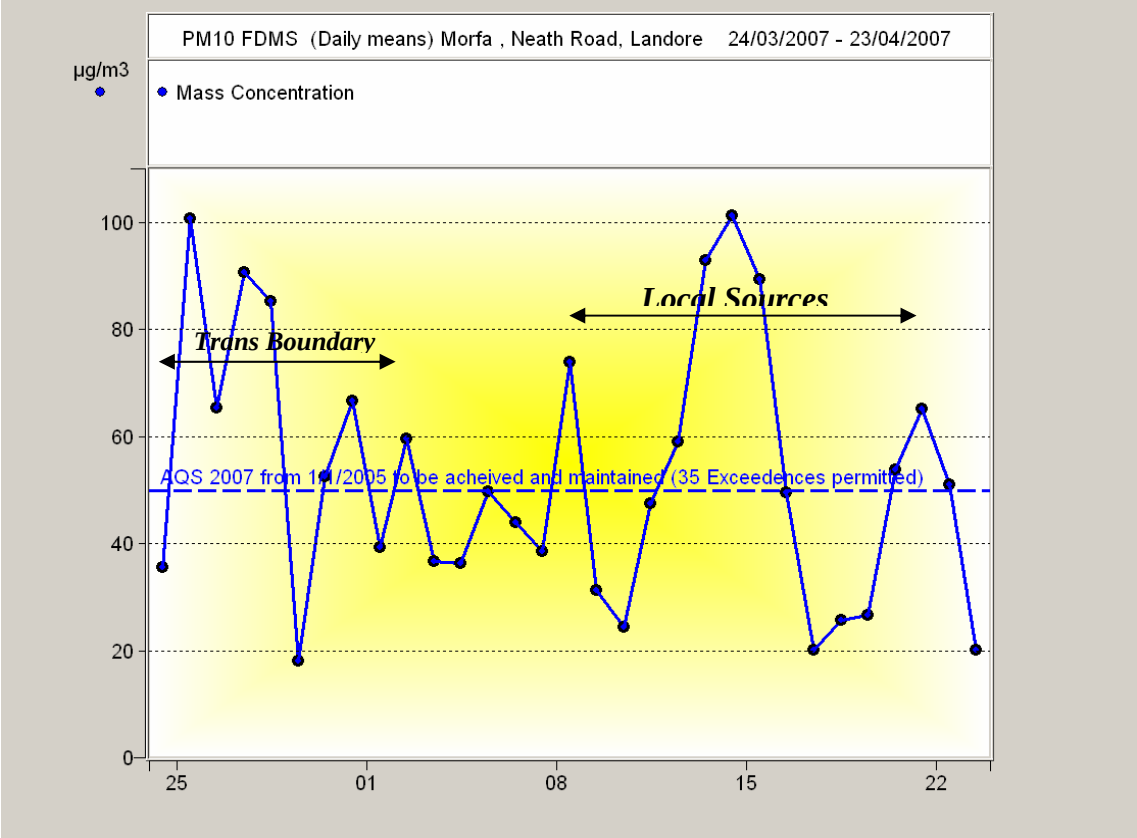
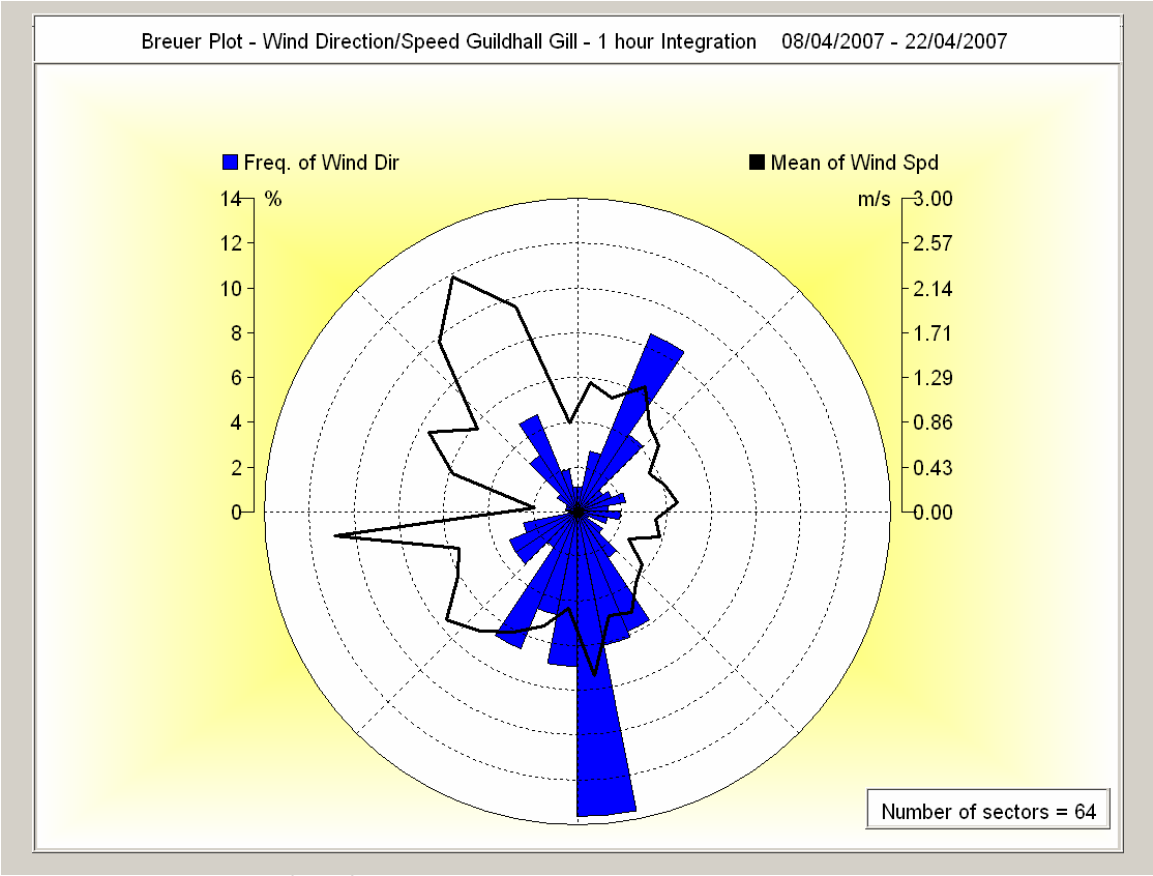


Chart 5 Morfa Groundhog FDMS Mass Concentration 24th March 2007 - 23rd April 2007

exceedences were also seen at the Morriston Groundhog FDMS unit. Chart 5 above focuses in on the period 24th March 2007-23rd April 2007 at Morfa. There were several days post 2nd April where concentrations remained below the daily objective before the mass concentrations started to rise again. Breuer Plot 3 shows the prevalent wind direction to be southerly with the mean wind speed from that direction being very low <1m/sec. The Gill WindSonic[14] deployed at the Guildhall monitoring station has a wind speed resolution of 0.01m/sec enabling these low recorded wind speeds to be reliable.

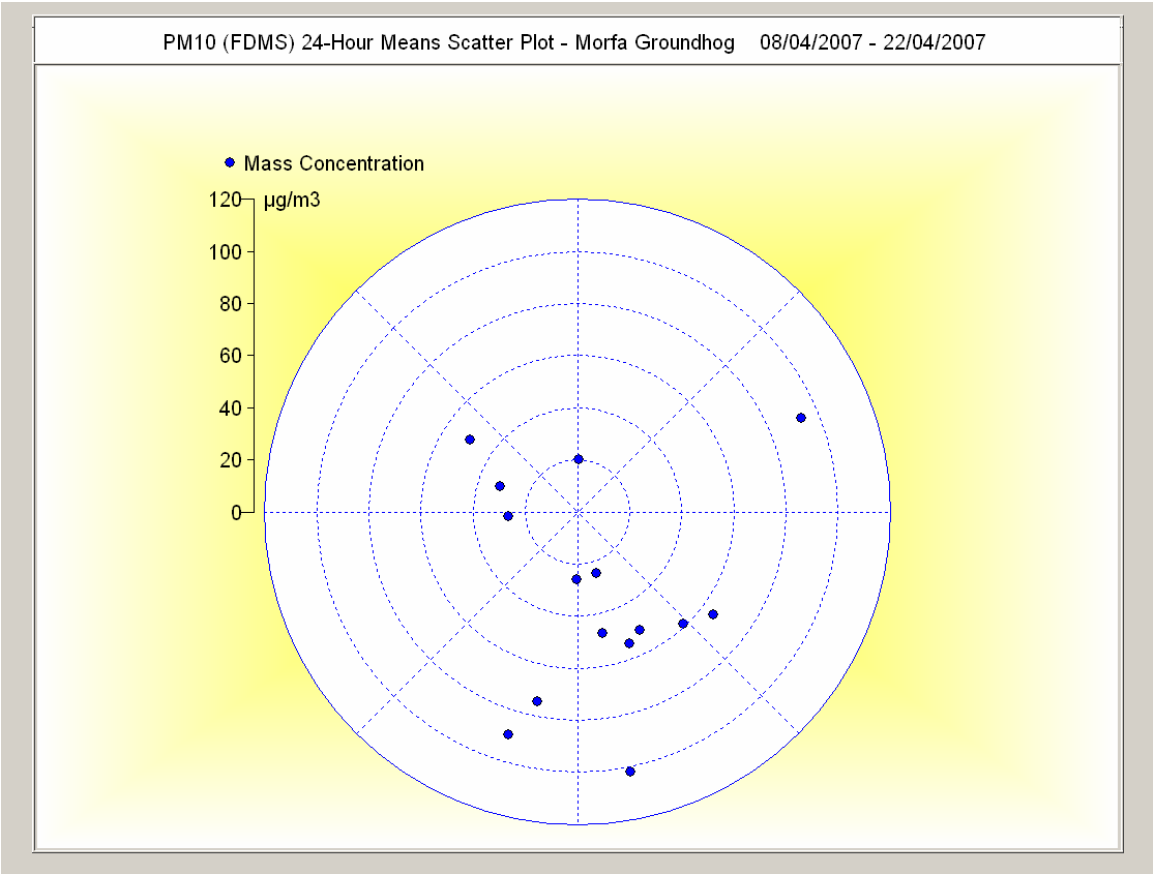


Breuer Plot 3 – Wind Direction 8th – 22nd April 2007

Breuer Scatter Plot 4 below indicates the spread of the data during the period 8th April – 22nd April 2007. As expected, the highest daily means are mainly indicated as emanating from the prevailing wind direction of the period. All

[14] http://www.gill.co.uk/data/datasheets/WindSonicWebDatasheet.pdf

wind speeds during this period from the prevailing direction are generally below 1m/sec.

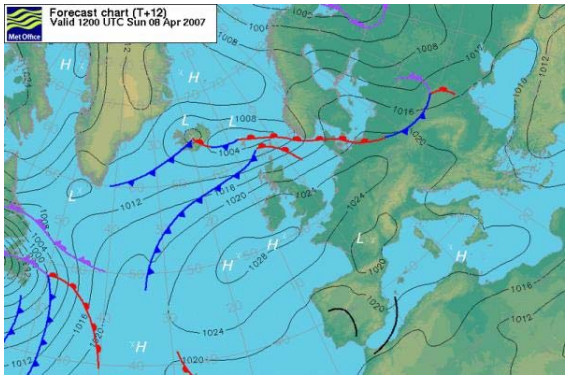


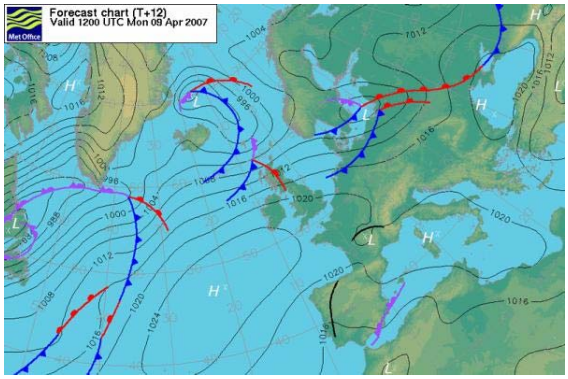
Breuer Scatter Plot 4 – Morfa FDMS PM_{10} Mass Concentrations 8th – 22nd April 2007

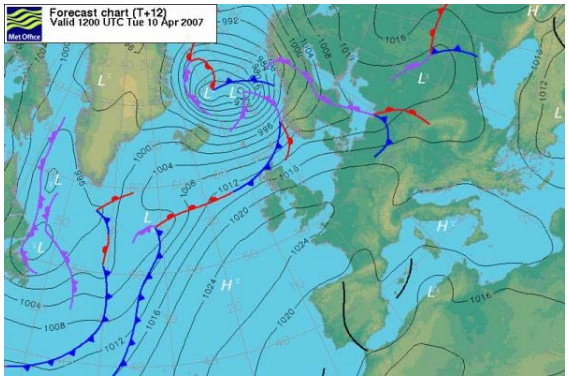
Examination of historic meteorology charts point to the period being dominated by high pressure systems. Met chart 1 below shows surface pressure charts during the period 8th – 22nd April 2007.

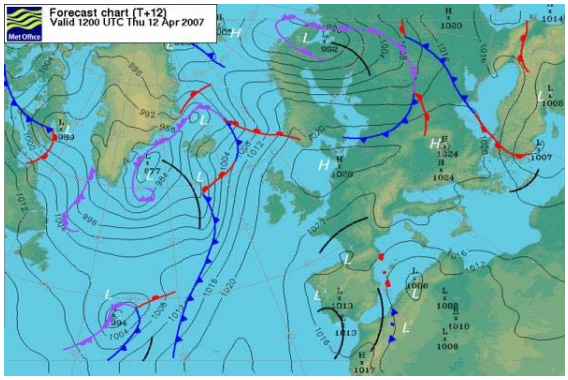
Surprisingly, this has been sourced from www.birdlist.co.uk which includes an on-line catalogue of daily 2007 surface pressure charts at http://www.birdlist.co.uk/charts/birdmigration2007.htm as issued by the UK Met Office - this information was not found when a search of the UK Met Office website was undertaken.

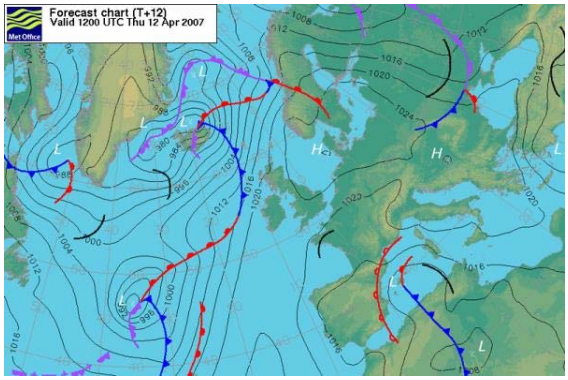
Surface Pressure Charts for the period 8th April – 22nd April 2007 can be found at http://www.birdlist.co.uk/charts/apr07week3.htm#8thapr http://www.birdlist.co.uk/charts/apr07week3.htm#15thapr and at http://www.birdlist.co.uk/charts/apr07week3.htm#22ndapr

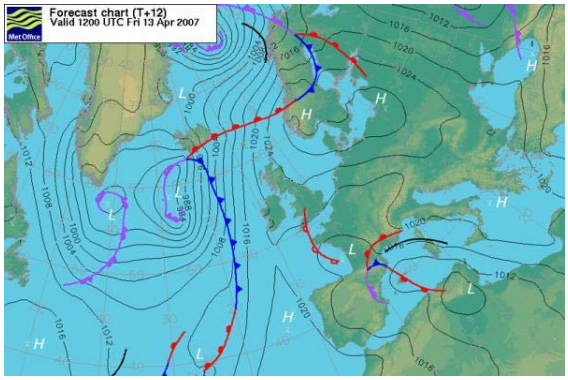


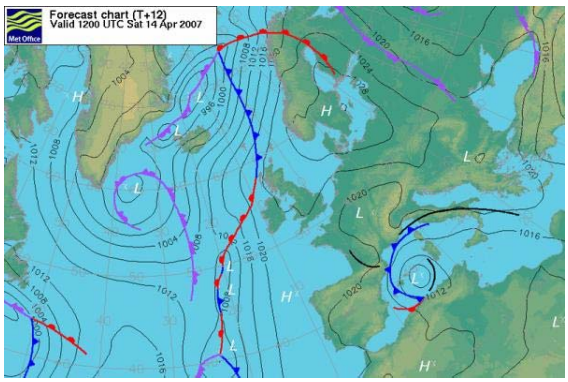


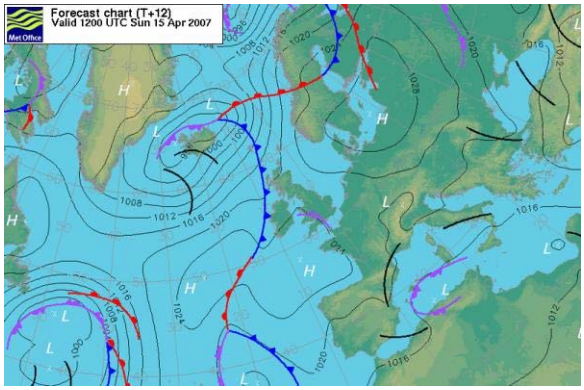


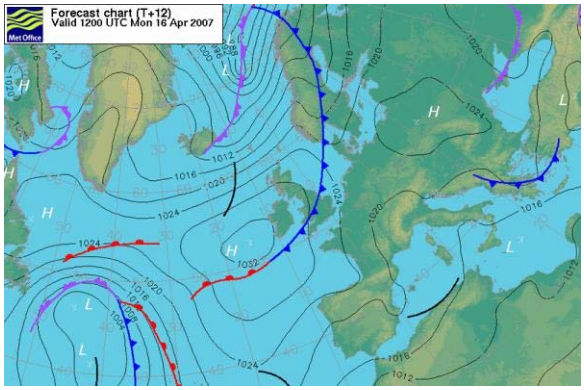


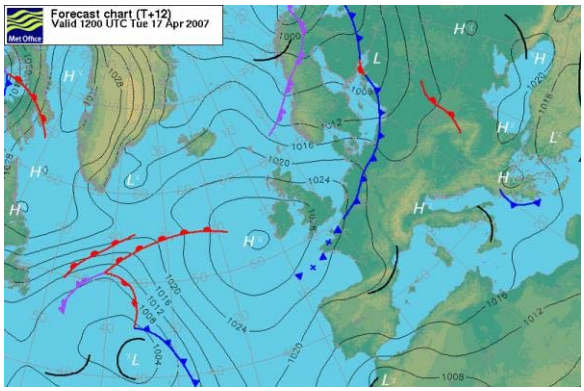


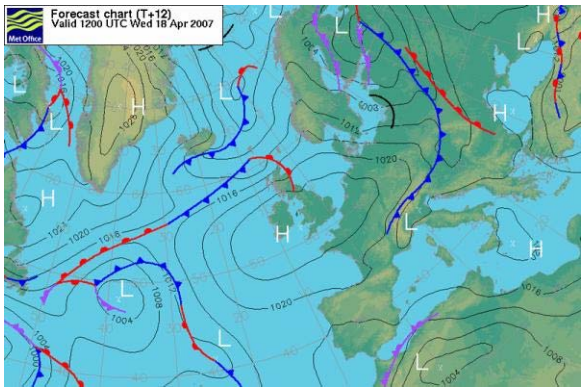


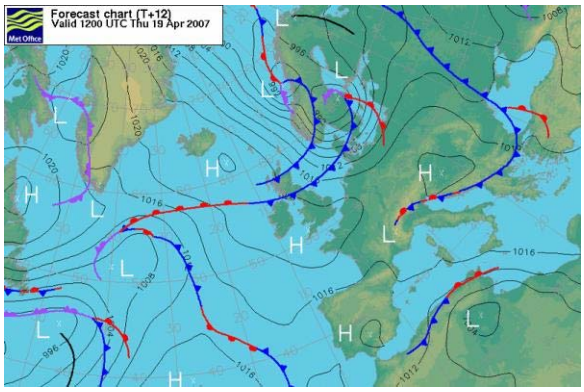


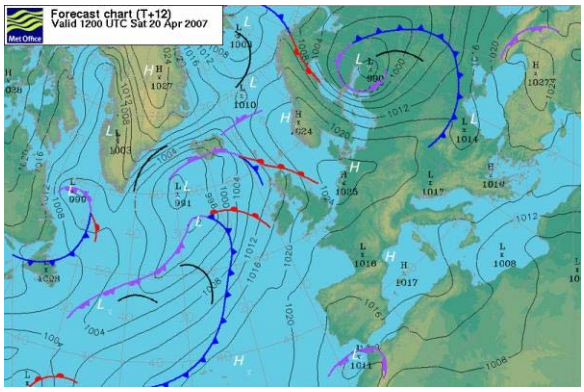


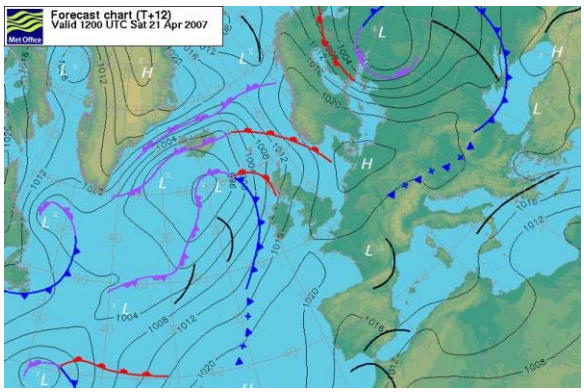


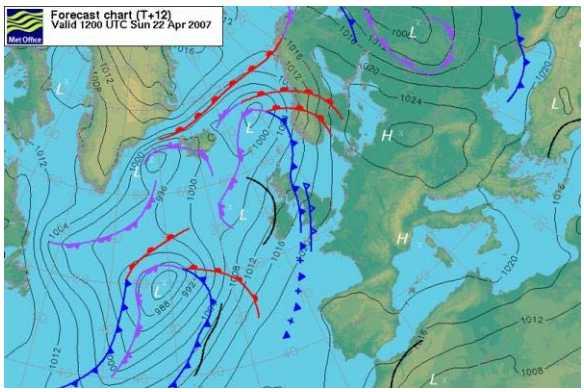












Met Chart 1 Surface pressure Charts 8th – 22nd April 2007

The cold front that passed through the UK on the 16th April, whilst producing no measurable rainfall, produced a reduction in PM_{10} concentrations. High pressure rebuilt from the south-west during the 17th and became established over the UK. PM_{10} concentrations again rose above the 24hour mean objective within Swansea between the 18th – 21st April, before concentrations dropped off following the introduction of cold fronts across the UK on the 22nd April 2007. Rainfall totals measured in Swansea between the 22nd and 24th April totalled 21mm seemingly producing considerable wash out of the remaining particulate matter.

3.1.5 Carbon Monoxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time CO analyser. 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. 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 running eight hour means.

The running 8-hour mean for a particular hour, is the mean of the hourly average concentrations for that hour and the preceding 7 hours. The average period is stepped forward by one hour for each value, so running mean values are given for the periods 00:00 – 07:59, 01:00 – 08:59 etc. There are, therefore, 24 possible 8-hour means in a day (calculated from hourly data). In order for a running average to be valid, 75% data capture is required i.e. 6 hourly averages

out of every 8 must be valid. The maximum daily running 8-hour mean is the maximum 8-hour running mean measured on any one day. [15]

All results are presented in mg/m^3 by multiplying the logged result in ppm by the conversion factor of 1.16 [16] to produce results expressed in mg/m^3. For ease of comparison with results from the previous year, the results obtained from 2003 -2006 are shown within table 8 below. The date for compliance with the Air Quality (Amendment)(Wales) Regulations 2002 objective standard was the 31st December 2003. The EU objective of a maximum daily 8-hour running mean of 10mg/ m^3 with a compliance date of 2005 has also been achieved.

Year	Max 8-hour running mean
2003	3.17 mg/m^3
2004	4.19 mg/m^3
2005	2.92 mg/m^3
2006	3.08 mg/m^3
2007	2.41 mg/m^3

Table8 CO 8-hour means maximum concentrations 2003 - 2007

Data capture for 2007 is above the 90% data capture rate mentioned within LAQM(TG)03[17]. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

A chart representing the 8-hour running means during 2007 is given below as chart 6.

[15] *Source LAQM.TG(03) – Monitoring – Calculation of exceedence statistics, paragraph A1.104 page A1-37.*
[16] *Technical Guidance LAQM.TG(03)Appendix B - Conversion factors page A1-44*
[17] *Technical Guidance LAQM.TG(03) box 2.2 Monitoring. Page 2-5*

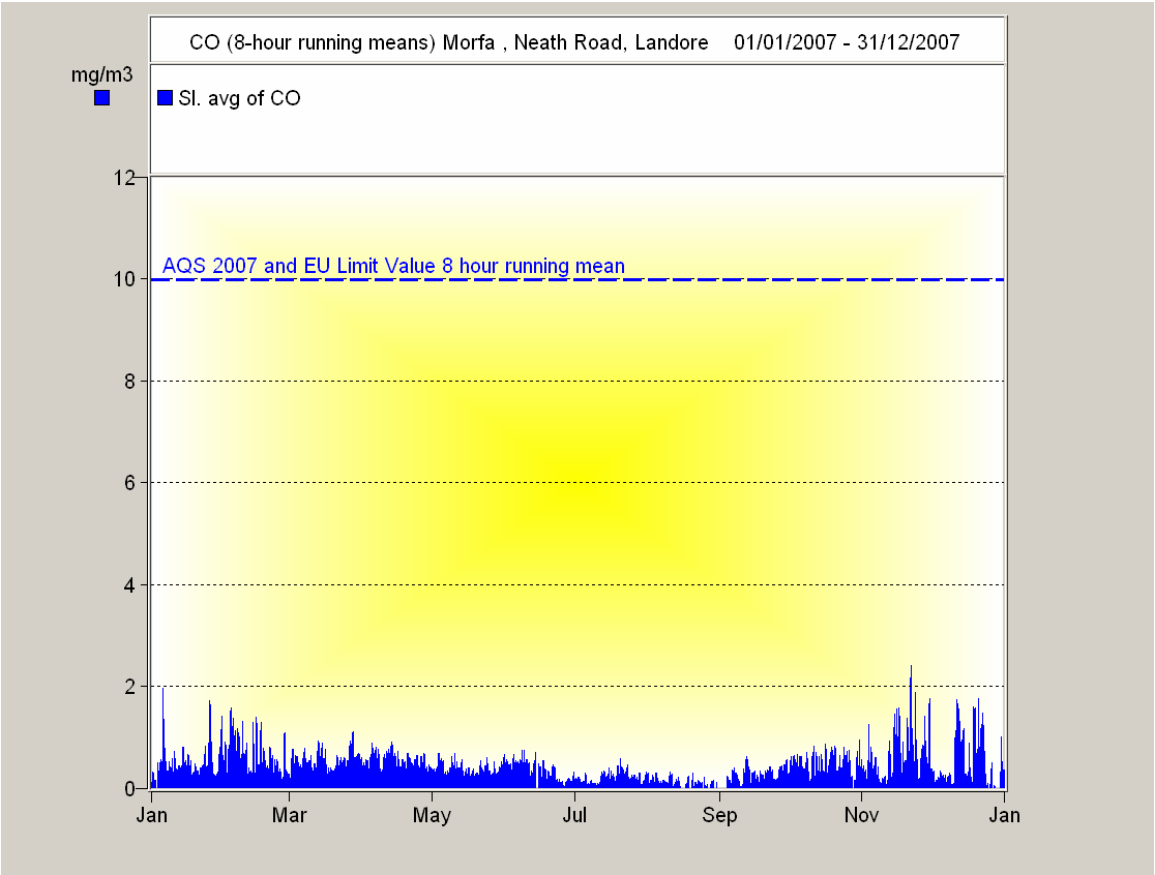


Chart 6 Morfa Groundhog 8 hour running means 2007

There appears no discernible trend with the overall dataset (2000-2007) at present except to say:

- Concentrations have remained below the objective level of a maximum daily 8-hour running mean of 10mg/ m^3 recorded at this site since it was established in 2000.
- 2007 saw the lowest maximum 8 hour running mean since monitoring commenced at this site.

3.1.6 Sulphur Dioxide

An Advanced Pollution Instrumentation (API) real-time SO_2 analyser measures $S0_2$ at the Morfa Groundhog site. 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. 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 daily 24-hour means. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the hourly means were specified to be present[18].

Ratified datasets have been downloaded from the Welsh Air Quality Forum at http://www.welshairquality.co.uk/data_and_statistics.php for both the 15 minute integration and 1 hour averaging periods.

All data is ratified by AEA Energy and Environment under the contract by the Welsh Assembly Government to run the Welsh Air Quality Forum. There is one point to note that during June 2006 there were additional exceedences (2) within the ratified dataset than previously reported for 2006. These exceedences occurred on the 29th June 2006 – the episode was observed at other monitoring stations in Swansea (St.Thomas and the Swansea AURN) but was not evident within the raw logger data held by the authority for the Morfa Groundhog. Data was present for this time period but not at the concentrations reported within the ratified Welsh Air Quality Forum dataset. As AEA Energy and Environment at that time collected data from the site by remote telemetry, the lack of, or otherwise of this data may be down to telemetry errors by the authorities data

[18] *LAQM.TG(03) Monitoring A1-38*

collection system. Enquiries are being made with AEA Energy and Environment to ascertain why the radical differences exist between the datasets.

Data from 2006 and 2007 has been analysed for each of the objectives set within existing regulation and the Air Quality Strategy 2007. Results are presented below within table 9. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

Morfa Groundhog	Max 15-Min Mean μg/m^3 (266μg/m^3)	Max 1-hour Mean μg/m^3 (350μg/m^3)	Max 24-Hour Mean μg/m^3 (125μg/m^3)
2006	447	221	26.3
Exceedences	3	0	0
Date of Max	29/06/2006	29/06/2006	01/07/2006
Time of Max	10:00	10:00	-
2007	101	72	18.3
Date of Max	01/6/2007	01/6/2007	14/12/2007
Time of Max	12:45	13:00	-
2007 Percentiles	15 Minute	1 Hour	24-Hour
99.9th Percentile	44.9	-	-
99.7th Percentile	-	35.03	-
99th Percentile	-	-	14.88

Table 9 – SO_2 results – Morfa Groundhog 2006 - 2007

Data capture at the base 15-minute logged means for 2006 is 97.3% and for 2007 is 89.6%, allowing direct comparison with the objective exceedence standards only for 2006.[19] The relevant percentile values for 2007 are included within table 9 above.

[19] *Technical Guidance LAQM.TG(03) page 7-7 box 7.2*

It is worthwhile noting that whilst traffic sources may contribute slightly to SO_2 concentrations at this site, local knowledge and past analysis would point to industrial sources being the prime contributors.

The Landore Railway Diesel Sheds carry out a 24-hour operation, servicing the Inter-City 125 High Speed Trains (HST). This operation involves long safety checks whilst each HST power unit is stationary of at least 20 minutes and is located within 250m of the Morfa Groundhog site to the south-west. The fuel used is of low sulphur content. The only other major industrial sources are the Corus Steelworks plant at Port Talbot and Aberthaw Power Station located within the Vale of Glamorgan. The Corus plant is located to the east / south-east of the Swansea conurbation with Aberthaw Power Station being located further east and south - see map 2 below.

Scatter plot 5 below indicates that the maximum concentrations once again emanate from a southerly/south easterly direction (met data from the Guildhall station has been used as previously explained). Local sources appear to be insignificant due to the tight grouping of the scatter.

Graphs representing the various averaging periods for 2006-2007 are shown below as chart 7 (15 minute means) chart 8 (1-hour means) and chart 9 (24-hour means). Breuer Plot 4 (using Guildhall met data) indicates maximum SO_2 concentrations from a southerly direction whilst the mean SO_2 concentrations emanate from an easterly direction. Given the exposed location of the Guildhall met station and the location of the Morfa station it is highly likely that these wind directions do not reflect the complex conditions within the lower Swansea Valley and do not accurately describe actual meteorological conditions at Morfa. All indications would still point to the industrial sources within Neath Port Talbot to be the primary sources.

Map 2 Swansea Sulphur Dioxide Monitoring Stations

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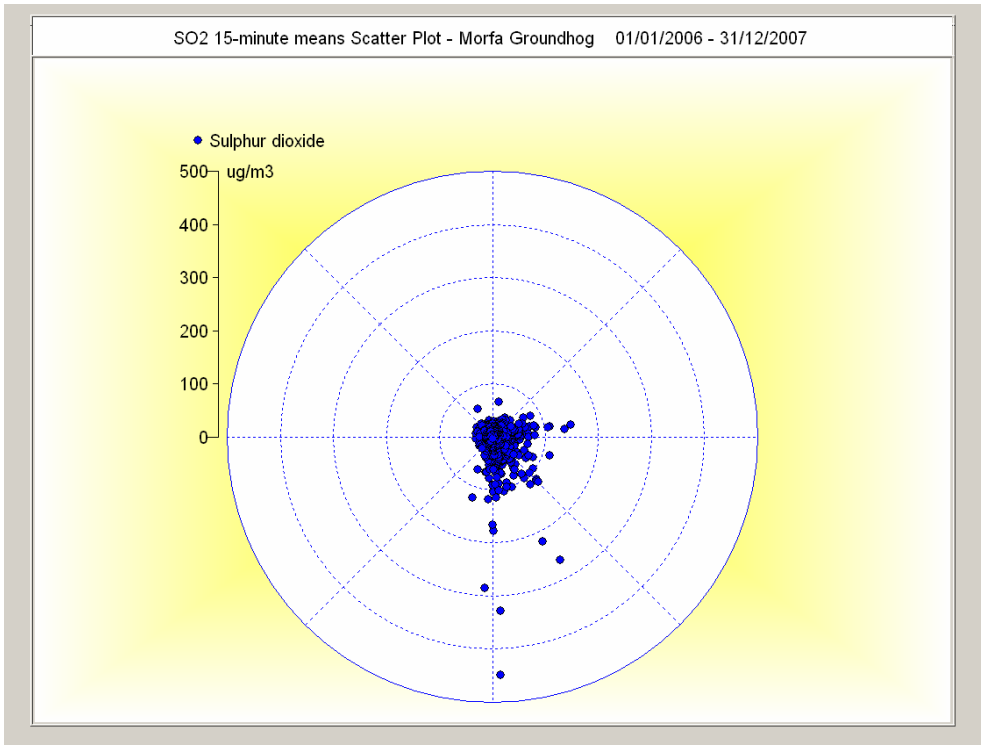


Scatter Plot 5 – Morfa 15 minute means 2006-2007

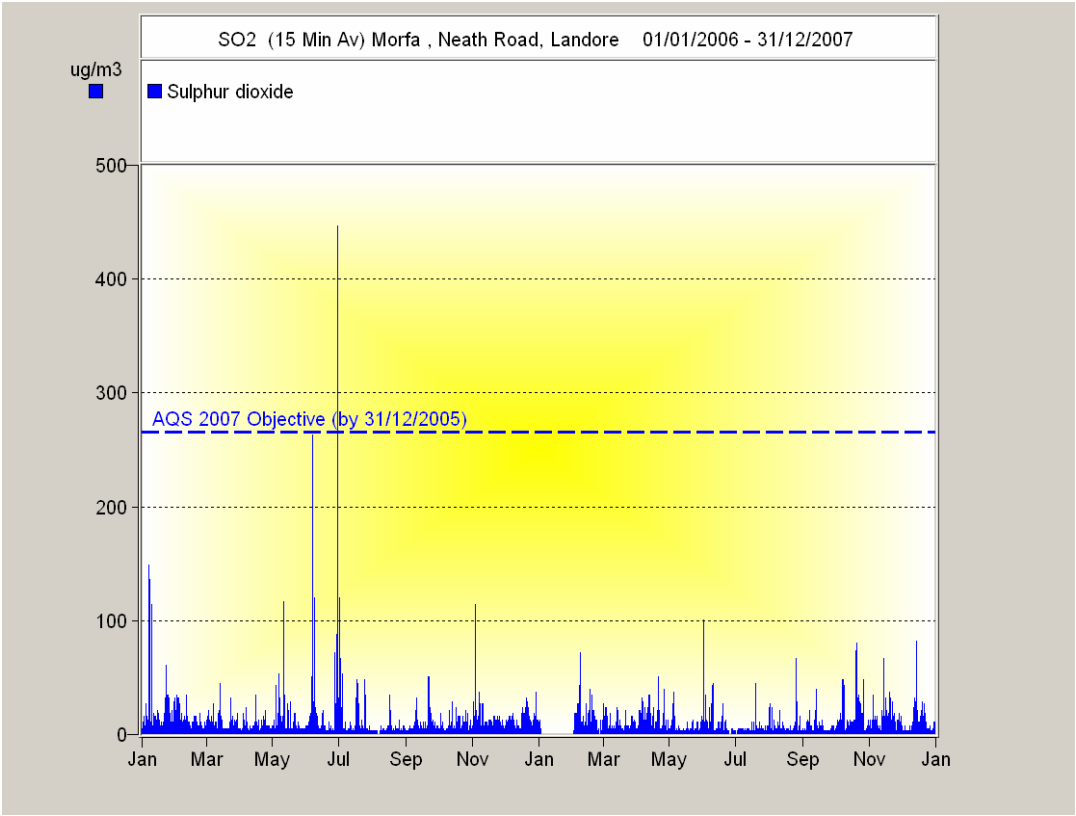


Chart 7 Morfa Groundhog 15 minute means 2006-2007

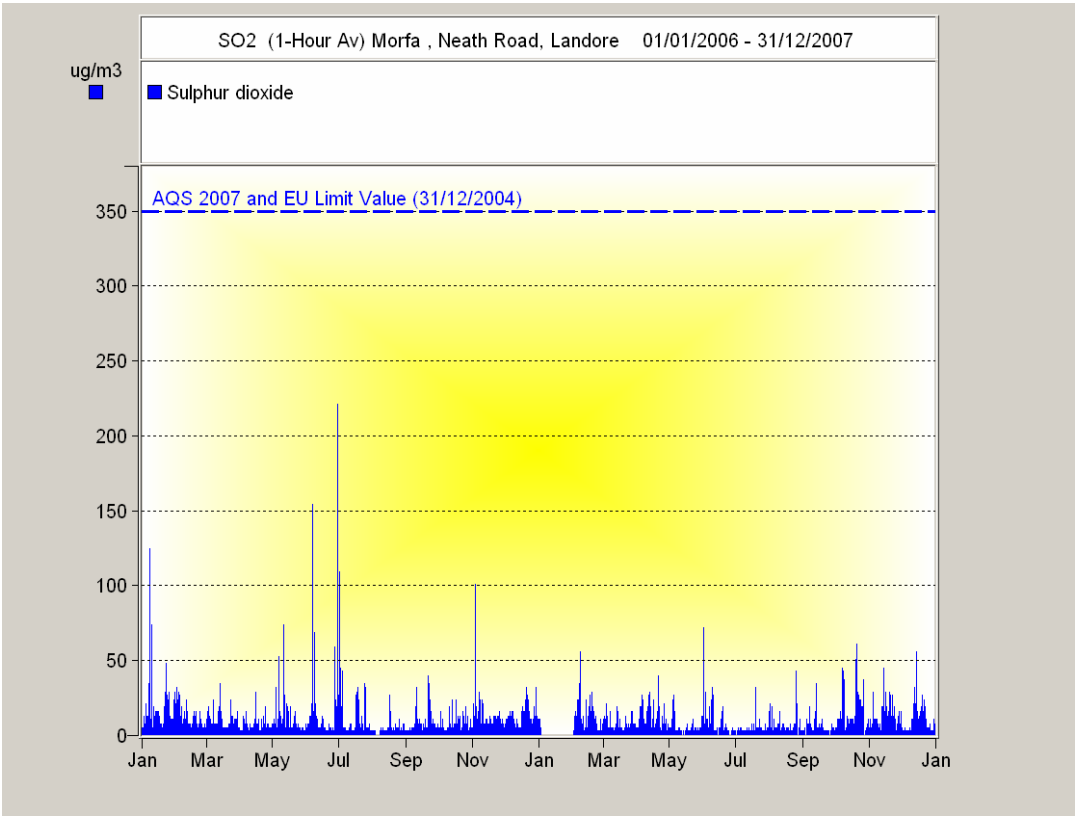


Chart 8 Morfa Groundhog 1-hour means 2006-2007

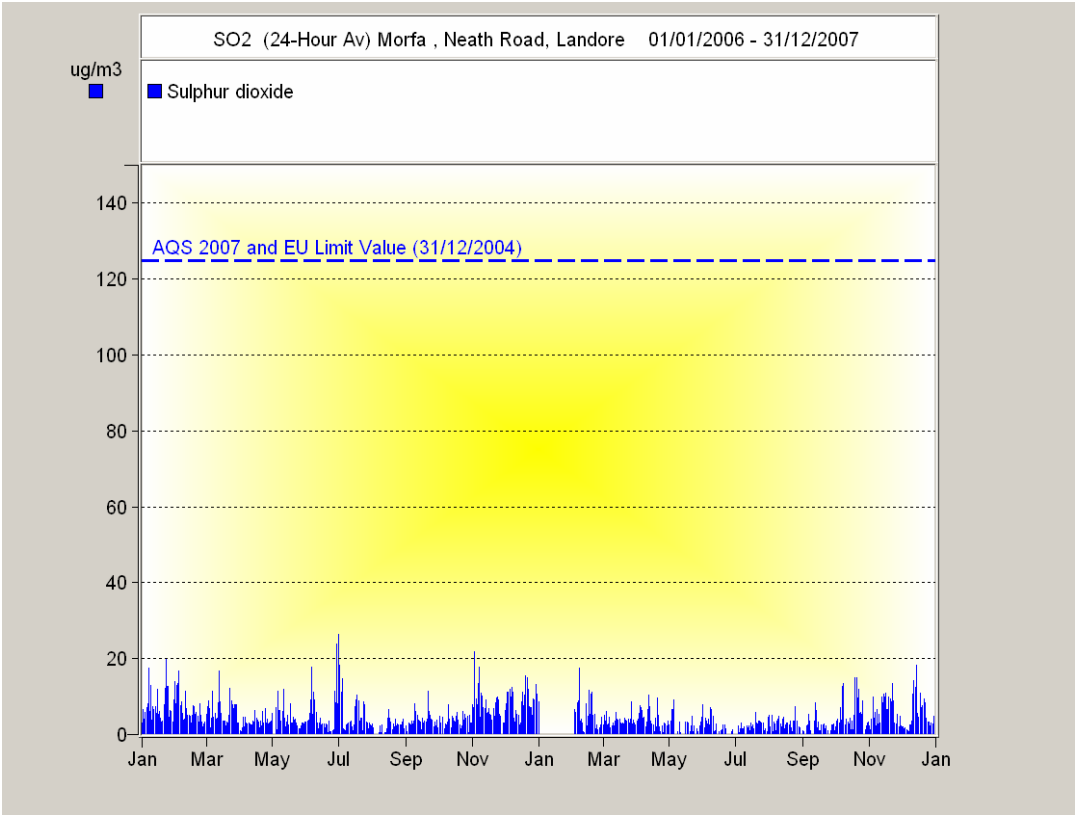
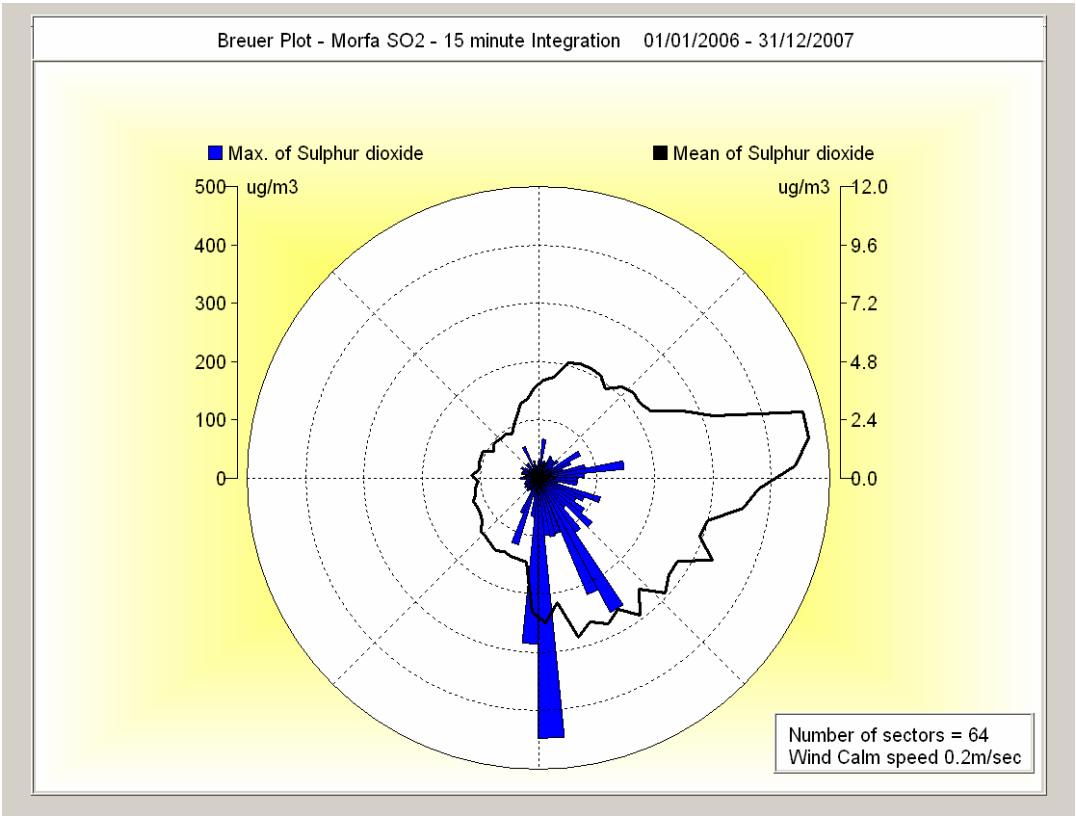


Chart 9 – Morfa Groundhog 24-hour means 2006-2007



Breuer Plot 4 Morfa Groundhog 15 minute SO_2 2006-2007

There is at present, no straightforward way to project forward to future years the number of likely exceedences etc. Compliance with each of the objective standards has been calculated from 2001 to 2007 and is presented below as table 10, enabling a brief discussion on SO_2 trends to be made.

Morfa Groundhog	Max 15-Min Mean μg/m^3 (266μg/m^3)	Max 1-hour Mean μg/m^3 (350μg/m^3)	Max 24-Hour Mean μg/m^3 (125μg/m^3)	Annual Mean
2001	130.44	98.42	30.85	6.01
Exceedences	0	0	0	-
2002	120.71	90.44	25.00	4.78
Exceedences	0	0	0	-
2003	274.48	153.21	26.37	5.05
Exceedences	1	0	0	-
2004	111.18	73.15	21.8	3.67
Exceedences	0	0	0	-
2005	73.60	50.37	15.35	3.47
Exceedence	0	0	0	-
2006	447	221	26.3	5.44
Exceedences	3	0	0	-
2007 *				3.75
99.9th Percentile	44.9	-	-	-
99.7th Percentile	-	35.03	-	-
99th Percentile	-	-	14.88	-

**Data capture for 2007 is 89.6% - Percentile values apply*
Table 10 - Morfa Groundhog SO_2 - 2001 - 2007

As the maximum averaging periods given above will vary from year to year, probably the easiest way to initially assess trends with the SO_2 concentrations is to look at the annual means returned from each of the years under consideration. Again, accepting that the meteorological conditions prevailing during 2003 were atypical, the same analysis has been carried out for 2006 with a similar opinion being formed to that of 2003 in that there was a greater than expected prevalence of south-easterly winds. A clear trend emerges from the annual mean data for years with typical meteorology with almost a halving of the concentrations being observed between 2001 and 2005. Whilst it has been stated above that the

maximum concentrations over the various averaging periods will fluctuate from year to year, this decrease in the SO_2 concentrations is also evident from the maximum concentrations recorded for all of the averaging periods (except for the atypical meteorological years 2003 and 2006). There continues therefore, to be a downward trend with regards to ambient SO_2 levels recorded within Swansea with all of the objective targets being met since monitoring began. The only exceedences that have ever been identified are short lived episodes of the 15-minute integration period. Even these did not produce an overall breach of the permitted number of exceedences per year. Factors that may account for the continued reductions may include increased and improved abatement techniques employed within the Corus plant at Port Talbot, the continuing decline in the burning of coal as a domestic heating source and the reduction in the sulphur content of fuels i.e. diesel.

3.2 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 within the existing Hafod Air Quality Management Area. These measurements take place at first floor level - a height of approximately 3 - 4 metres and less than 0.5m away from the front facade of the terraced dwellings. The DOAS transmitter ❶ is fixed externally to the front wall of a terraced dwelling that fronts onto Neath Road at one end of the open path measurement. The receiver module ❷ is located on the front wall of another dwelling that also fronts onto Neath Road at the other end of the open path measurement length. The receiver focuses the light received and transmits the light via fibre optic cable into a spectra analyser. Map 3 below shows an aerial photograph of the location of the transmitter and receiver heads.

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.

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 (U2)[20].

Map 3 - Aerial View Hafod OPSIS DOAS - Location of Transmitter and Receiver Heads

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

[20] *Source LAQM.TG(03) Appendix A page A1-42*

minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for each pollutant. The validation process produces the same cyclonic means within a separate database. All individual measurement points that have not met the QA/QC conditions (detailed below) are replaced with null values within the new dataset. The user can then compile 5 minute means from the validated dataset and undertake analysis.

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

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

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

- **QA/QC for Benzene**

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

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

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

Monitoring data from the site has been subject to interruption as the property owner at the transmitter site ❶ undertook extensive renovation works to the property. The transmitter head was removed from the front façade during these works to prevent damage. Data is therefore absent for significant periods of

2005 and 2006. The equipment was removed from the façade of the property at 11:00 on the 22nd April 2005 and was replaced at 10:00 16th May 2006. There is therefore significant data loss for both 2005 and 2006 with in total just over a years worth of monitoring data being lost. This is frustrating and regrettable but the loss is outside of the control of this authority.

To compound and frustrate matters further an Area Renewals Project commenced in January 2008 to properties at the receiving end ❷ of the open path measurement. This renewal project may require that during 2008 the receiver is removed to prevent damage. Discussions have taken place with the contractors to establish if limited monitoring will be feasible through any scaffolding but unfortunately, additional significant periods of monitoring data will be lost during 2008, as the renewals project is not scheduled to finish until late summer 2008.

3.2.1 Nitrogen Dioxide

Using the above QA/QC procedures, hourly means were produced for 2006 and 2007. A chart of these hourly means can be seen below within chart 10.

Data from 2006 and 2007 has been analysed for each of the objectives set within existing regulation and the Air Quality Strategy 2007. Results are presented below within table 11.

Data capture for 2006 does not permit the straight calculation of hourly exceedences[21] – the 99.8th percentile applies. The 99.8th percentile for 2006 is 140.48

[21] LAQM TG(03) box 6.2 page 6-16 (applies to data outside AQMA – assumption made that this approach is valid within AQMA as well)

Hafod DOAS	2006	2007
Annual Mean (40µg/m^3)	40.27	52.19
Max Hourly Conc. (200µg/m^3)	156.36	249.63
Exceedences	-	7
*Data capture %	*62.87%	97.5%

** see footnote 21 above*

Table 11 Hafod DOAS Nitrogen Dioxide 2006-2007

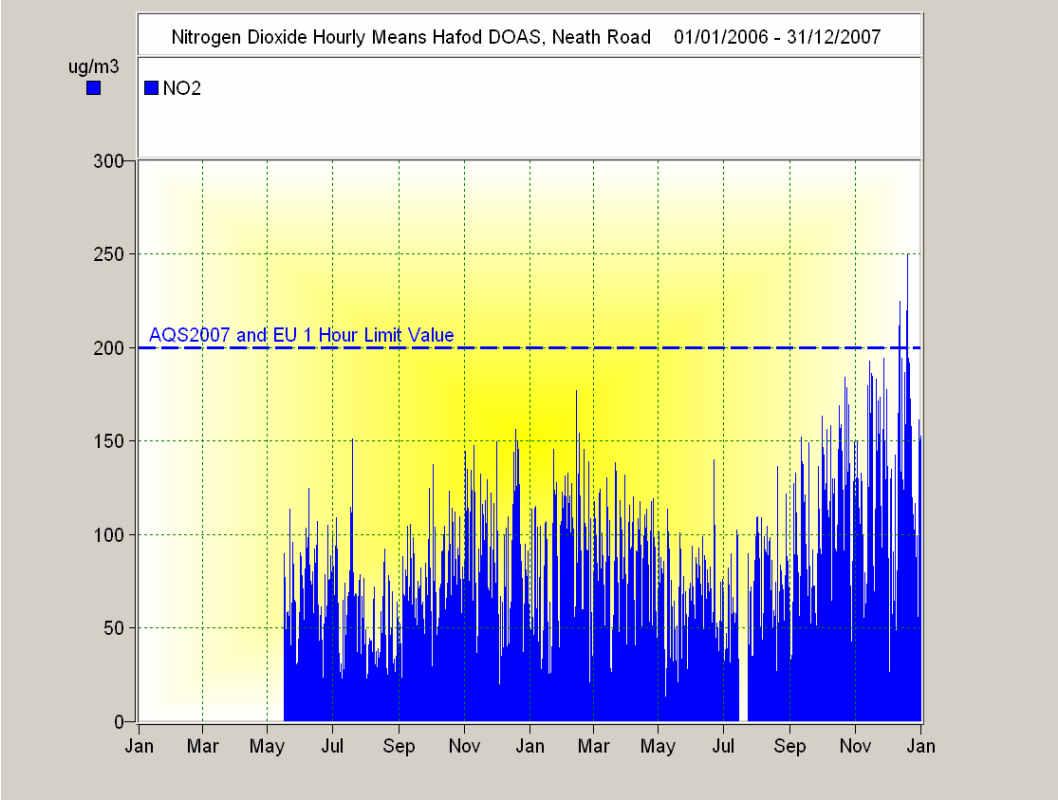


Chart 10 Hafod DOAS Nitrogen Dioxide Hourly Means 2006-2007

The exceedences seen at the Hafod DOAS during December 2007 were also seen at other monitoring locations within Swansea – see 3.1.3 above Morfa Groundhog for the 19th December 2007. As the Hafod DOAS is also located with the lower Swansea Valley approximately 0.5 miles from the Morfa Groundhog and the AQ500 Wind Profiler (located at the Morfa T.A. Centre), it is reasonable to assume that the same meteorological conditions influenced the maximum hourly concentrations recorded on the 19th December (see section 3.1.3. and Wind Profiler Charts 1 and 2). However, from chart 11 below it is

clear that exceedences of the 1 hour objective were also seen at the Hafod DOAS site on the 11th, 12th and 18th December 2007.

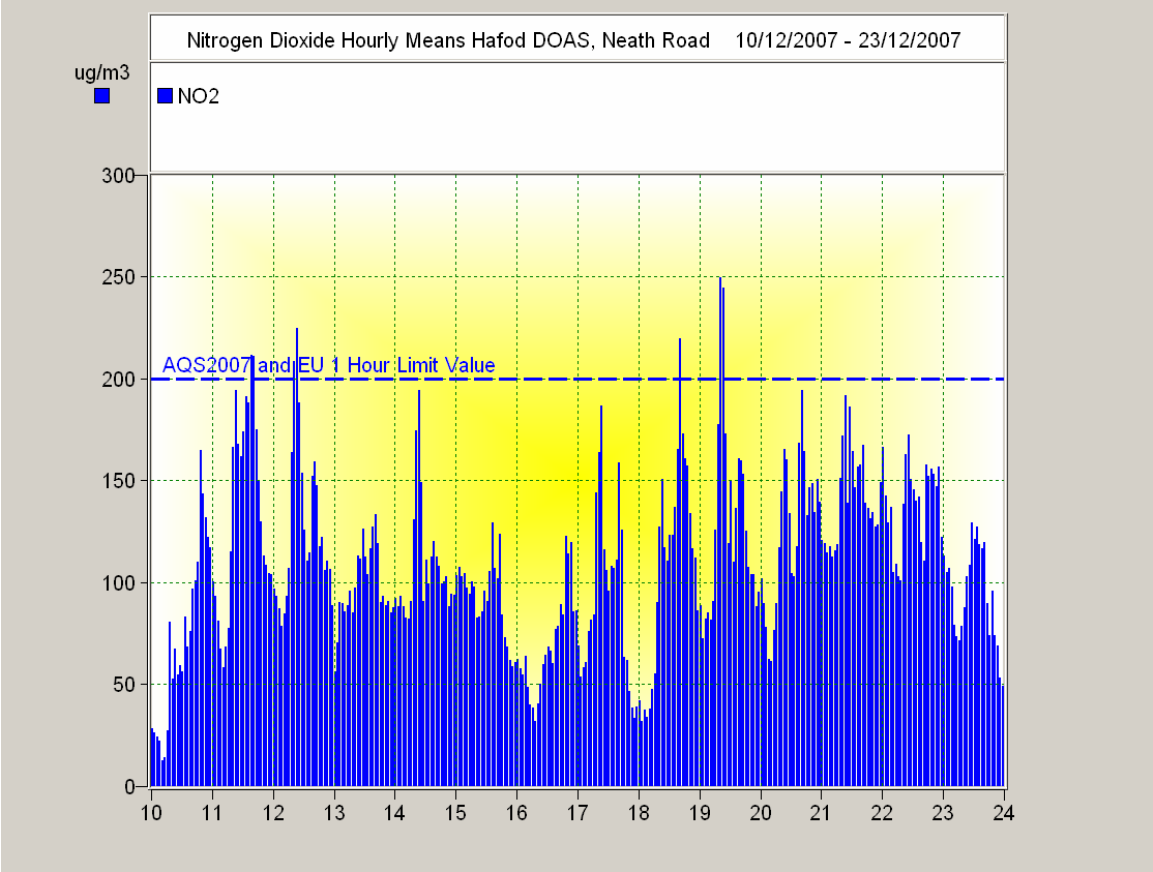
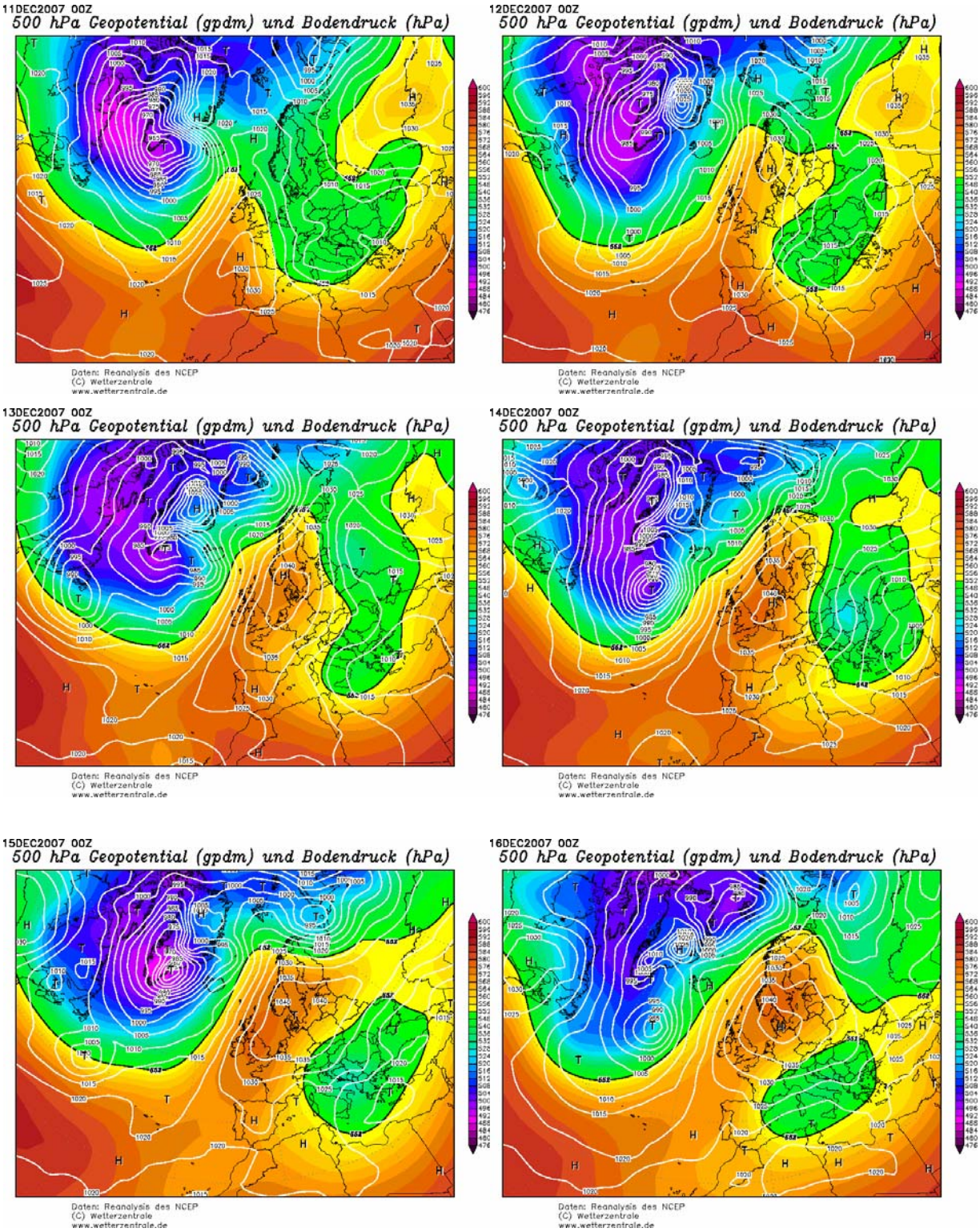


Chart 11 Hafod DOAS Nitrogen Dioxide Hourly means 10th – 23rd December 2007

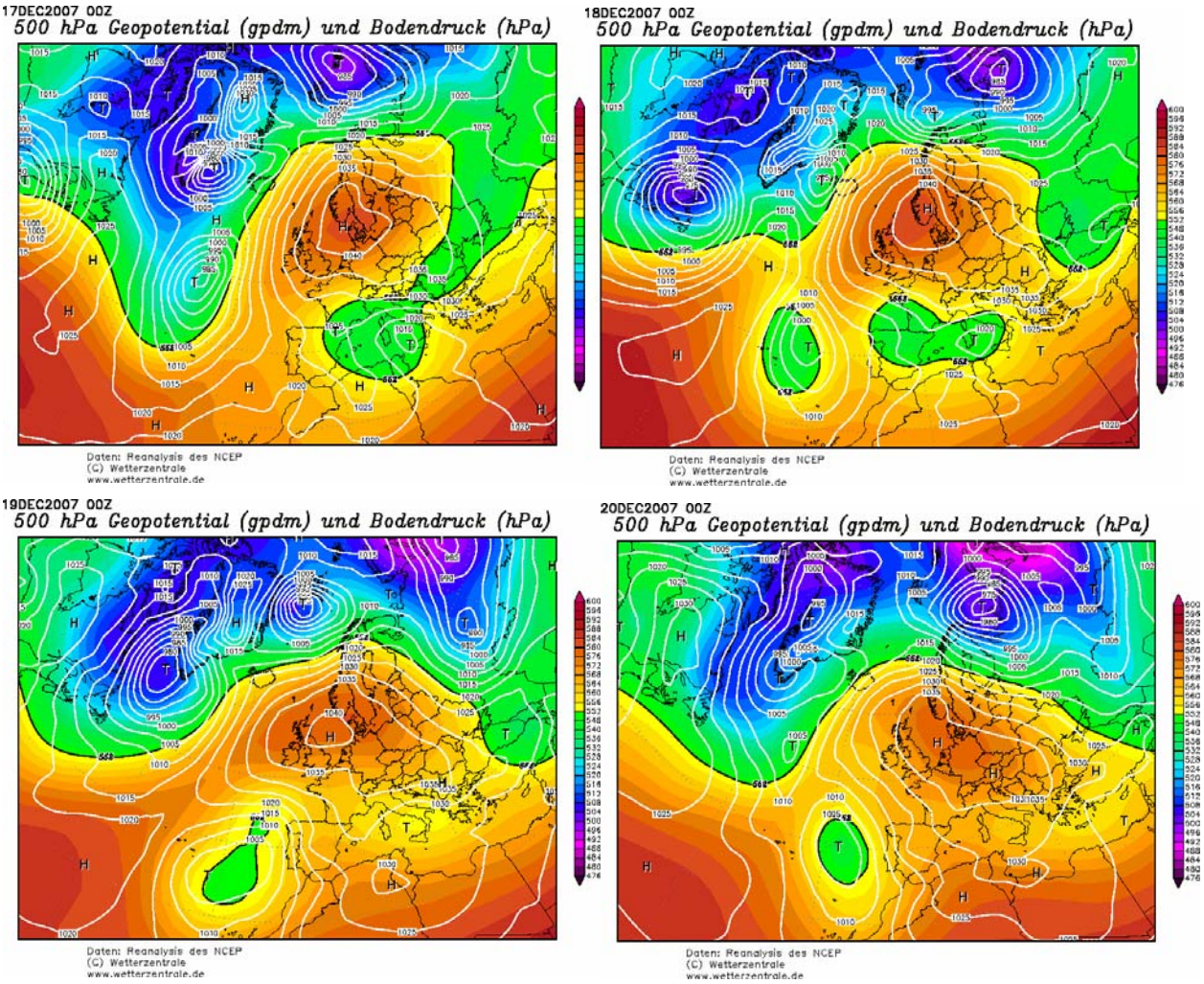
Surface Pressure charts from http://www.birdlist.co.uk/charts/birdmigration2007.htm are not available for the period leading up to and during this episode. However, 500hPa charts from http://www.wetterzentrale.de/archive/ra/2007 have been downloaded for the period 11th - 20th December 2007.

Charts for the period have been assembled into the panels Met Chart 2 and Met Chart 3 below for information.



Met Chart 2 11th December – 16th December 2007

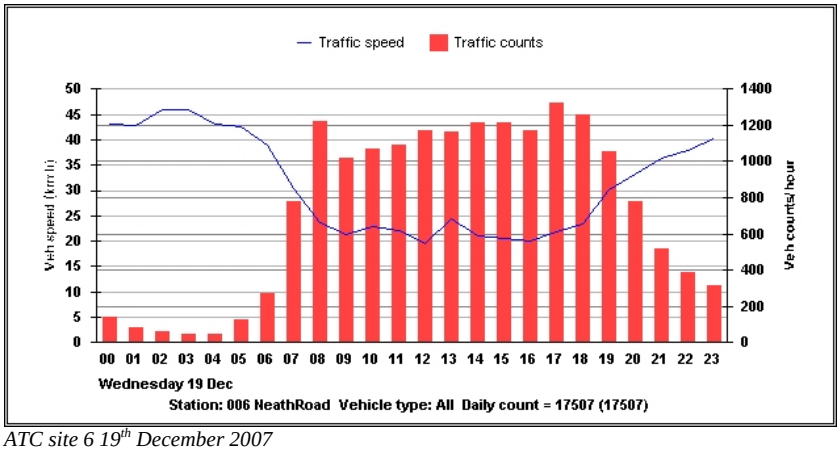
11th December: High Pressure (HP) extending over UK. 12th December: HP over UK and extending to HP over Scandinavia. 13th December: HP over UK slipping south east now centred over southern Sweden/Denmark introducing SW winds to UK. 14th December: HP now centred over Belgium. 15th December sees low pressure over Denmark with HP reforming over Denmark again on the 16th December.



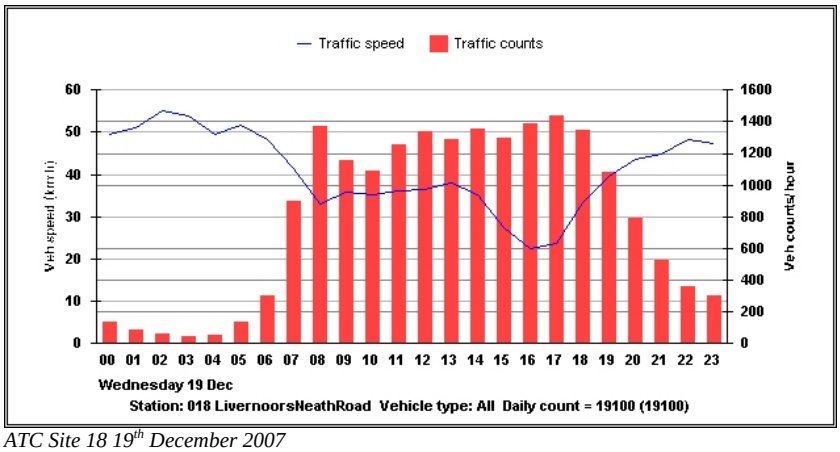
Met Chart 3 17th December – 20th December 2007

17th December: HP moving north east over southern Sweden and Norway. 18th December: HP centred over Norway winds over UK from south east direction. 19th December: HP sat over North Sea – winds again easterly over UK. 20th December: Low pressure approaching from south west. HP sinking and joining with another HP over central Europe.

The authority operate two GPRS traffic counters at either end of the open path measurement along Neath Road – site 6 just south (50 meters) of the transmitter location and site 18 which is approximately 30 meters north of the receiving station. Graphs of the traffic flow during the 19th December 2007 are shown below for information.



ATC site 6 19th December 2007



ATC Site 18 19th December 2007

From the summary statistics for the GPRS ATC's operated by the authority the following applies for the above sites:

Site 6: AADT = 14952 AWDT = 15576 HGV* content = 10.1%

Vehicle class contribution to total flow and mean speed in class			
Vehicle class:		Flow %:	Mean speed (km/h):
0	Unclassified vehicles	0.0	-
1	Motorcycles	1.3	21.9
2	Cars or light Vans	88.3	28.0
3	Cars or light Vans with Trailer	0.3	16.0
4	Heavy Van, Mini bus, L/M/HGV	7.4	26.6
5	Articulated lorry, HGV+Trailer	0.8	19.6
6	Bus	1.9	20.1

Table 12 GPRS ATC Site 6 Summary statistics 2007

** HGV content = total of class 4, 5 and 6 vehicles*

AADT = Annual Average Daily Traffic AWDT = Annual Weekday Daily Traffic

Site 18: AADT = 16200 AWDT = 17112 HGV* content = 8.9%

Vehicle class contribution to total flow and mean speed in class			
Vehicle class:		Flow %:	Mean speed (km/h):
0	Unclassified vehicles	0.0	-
1	Motorcycles	1.6	36.6
2	Cars or light Vans	89.3	42.9
3	Cars or light Vans with Trailer	0.1	35.7
4	Heavy Van, Mini bus, L/M/HGV	6.4	39.7
5	Articulated lorry, HGV+Trailer	0.4	33.3
6	Bus	2.1	32.2

Table 13 GPRS ATC Site 18 Summary statistics 2007

** HGV content = total of class 4, 5 and 6 vehicles*

AADT = Annual Average Daily Traffic AWDT = Annual Weekday Daily Traffic

Whilst the vehicle flow/composition on the 19th December does not vary greatly from the AADT/AWDT, what is evident from the air quality data is the confirmation of the effect that meteorological conditions have on the pollution loads within the Neath Road street canyon and the wider Lower Swansea Valley area.

The January 2006 update of LAQM.TG(03) indicates that the correction factors provided within the original LAQM.TG(03) guidance (box 6.7 and 6.8 page 6-29) to estimate annual mean concentrations in future years should no longer be used. The revised guidance indicates use of the Year Adjustment Calculator v2.2a (from http://www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls).

Using 2007 as the base year the projections shown within table 14 below are obtained in respect of the EU Limit target value for years 2008 - 2010 and also the existing regulations/Air Quality Strategy 2007.

Year	Actual Measurement μg/m^3	E.U.		AQS 2007/Regs (40μg/m^3)
		Limit Value μg/m^3	Projection μg/m^3	
2007	52.19	46	-	-
2008	-	44	50.41	-
2009	-	42	48.45	-
2010	-	40	46.69	46.69

Table 14 Hafod DOAS NO_2 Annual Mean projections 2008-2010

These projections all remain above the EU Limit value for years 2008-2009 and also at the compliance date of the 1st January 2010 when 40μg/m^3 is to be achieved. The projected value for 2010 also remains above the Air Quality Strategy target value of 40μg/m^3.

3.2.2 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 2006-2007. The objective for ozone is an 8-hour mean, not to exceed 100μg/m^3 on more than 10 occasions during the year with a compliance date of 31st December 2005.

Using the above QA/QC procedures, hourly means were produced for 2006 and 2007. The derived hourly means have then been used to calculate the 8-hour means. In order to form a valid 8-hour mean 75% of the hourly means were required to be present i.e. 6 out of every 8.

A chart of these 8 hourly means can be seen below within chart 12.

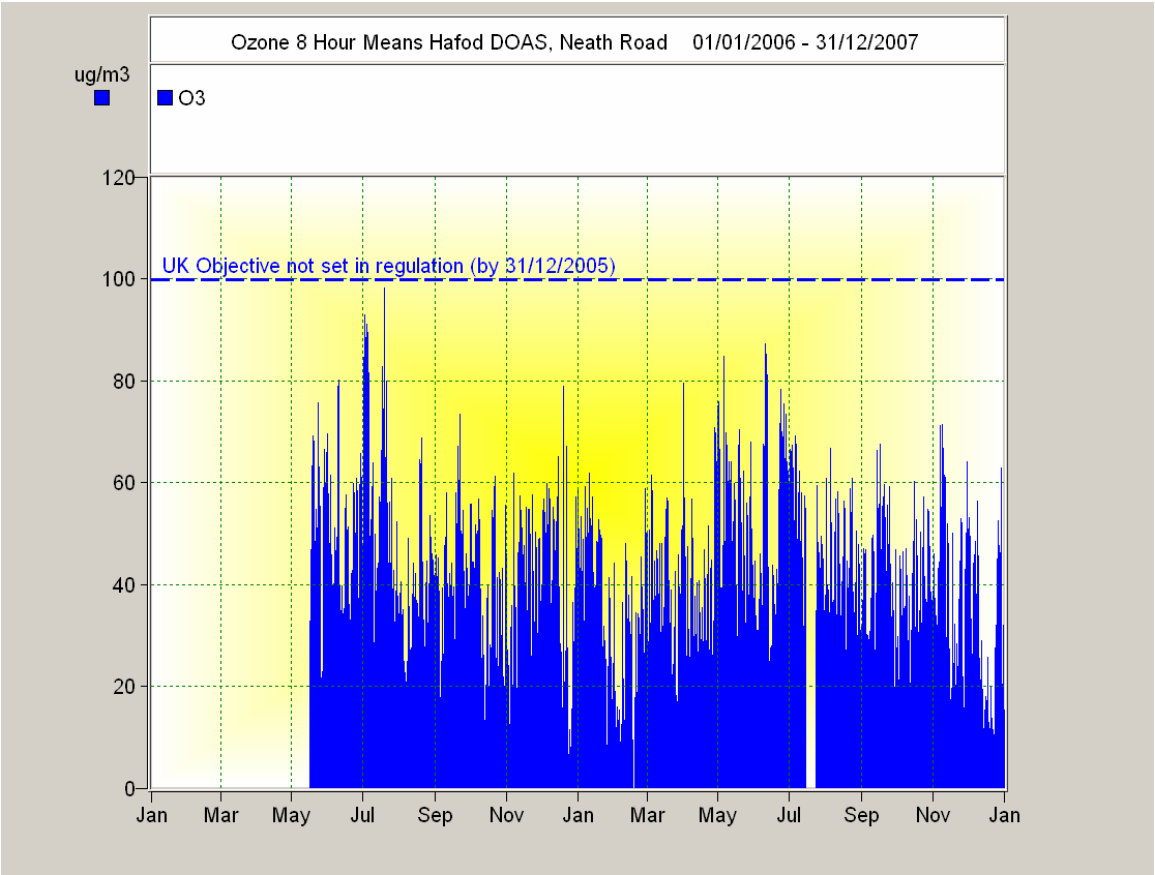


Chart 12 – Hafod DOAS Ozone 8-hour means 2006-2007

Data from 2006 and 2007 has been analysed for each of the objectives set within existing regulation and the Air Quality Strategy 2007. Results are presented below within table 15.

Hafod DOAS	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/m^3 (10 permitted)
2006	98.34	62.1%	0
2007	87.2	95%	0

Table 15 –Hafod DOAS 8-hour means 2006-2007

3.2.3 Benzene

The objective for benzene that is set in regulation and also included within the Air Quality Strategy 2007 indicates that an annual mean of 5µg/m^3 is to be achieved and maintained thereafter by the 1st January 2010.

Using the above QA/QC procedures, hourly means were produced for 2006 and 2007. However, the data capture for 2006 was only 47% and it has been decided to only present data from 2007 where the data capture rate (at 87%) provides some confidence into how representative the data and derived annual mean will actually be. LAQM.TG(03) and its subsequent revision in January 2006 make no mention as to acceptable real-time data capture rates. The guidance appears to make the assumption that monitoring will be undertaken by packed diffusion tubes over either 3, 6 months etc.

A chart of these hourly means for 2007 can be seen below within chart 12.

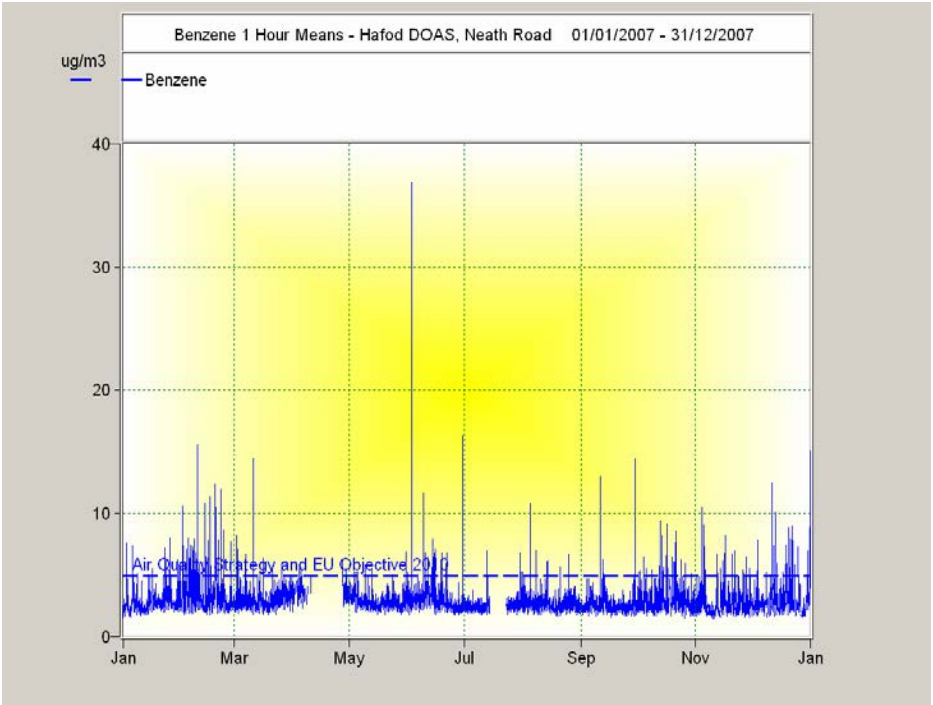


Chart 12 – Hafod DOAS Benzene 1-hour means 2007

The annual mean for 2007 is 2.93μg/m^3. LAQM.TG(03) provides a method to project annual average benzene concentrations in future years from measured roadside data[22]. Using this methodology, the following projections shown below in table 16 are obtained for the EU Limit values and Air Quality Strategy target dates.

Year	Actual Measurement μg/m^3	E.U.		AQS 2007/Regs (5μg/m^3)
		Limit Value μg/m^3	Projection μg/m^3	
2007	2.93	8	-	-
2008	-	7	2.82	-
2009	-	6	2.73	-
2010	-	5	2.67	2.67

Table 16 Hafod DOAS Benzene concentration in future year's projections

From the above projections it is anticipated that compliance will be attained at all the objective dates.

[22] LAQM.TG(03) page 3-6 box 3.4

3.3 Swansea Roadside AURN, 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 relocated site is detailed and outlined below and is now sited within the boundary of the Hafod Air Quality Management Area. 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 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 (U2)[23]. Map 4 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 inversion

[23] *Source LAQM.TG(03) Appendix A page A1-42*

that forms within the lower Swansea Valley and therefore, does not experience the elevated concentrations seen at the other monitoring stations during such conditions.

Reproduced from the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationary Office. Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. City & County of Swansea LA 100023509

Map 4 – Aerial view of Swansea Roadside AURN

All equipment is housed within an air-conditioned unit and operated continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring O_3, CO, SO_2 and NO_x, with Thermo TEOM's measuring PM_{10} and $PM_{2.5}$. The API gas analysers have been configured so that 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

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 recorded. All manual calibration data is then forwarded to AEA Energy and Environment to perform data management procedures. The data is then further subjected to full network QA/QC procedure's undertaken by AEA Energy and Environment on behalf of the Department of Environment, Food and Rural Affairs (DEFRA).

Hourly ratified data for the period 2007 covering the pollutants Carbon Monoxide, Ozone, Nitrogen Dioxide and Particulate Matter PM_{10} (TEOM) has been downloaded from the Air Quality Archive at http://www.airquality.co.uk/archive/flat_files.php?site_id=SWA1&zone_id=9 along with ratified 15-minute Sulphur Dioxide data from the same location. 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, Ozone, and SO_2 analysers are no longer collected (post 1st October 2007) or ratified by DEFRA (AEA Energy and Environment), this authority has decided to continue to fund their operation and data collection. The dataset for 2007 from 1st October onwards for the above mentioned pollutants will therefore be ratified by the authority.

3.3.1 Nitrogen Dioxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time NO_x analyser. The QA/QC procedures undertaken by NETCEN have resulted in ratified hourly data expressed in $\mu g/m^3$ being provided. The ratified hourly means have been used to calculate the objectives for the hourly and annual means.

Results obtained for 2007 are shown within table 18 below. A graph of the hourly means is given below as Chart 13. Ratified data capture of the 1-hour means for 2007 is 98%.

Swansea AURN	Annual Mean ($40\mu g/m^3$)	Max 1-hour ($200\mu g/m^3$)	Exceedences of 1-hour std (18 permitted)
	2007	2007	2007
	31.02	164	0

Table 18 - Swansea Roadside AURN- NO_2 Monitoring Data 2007

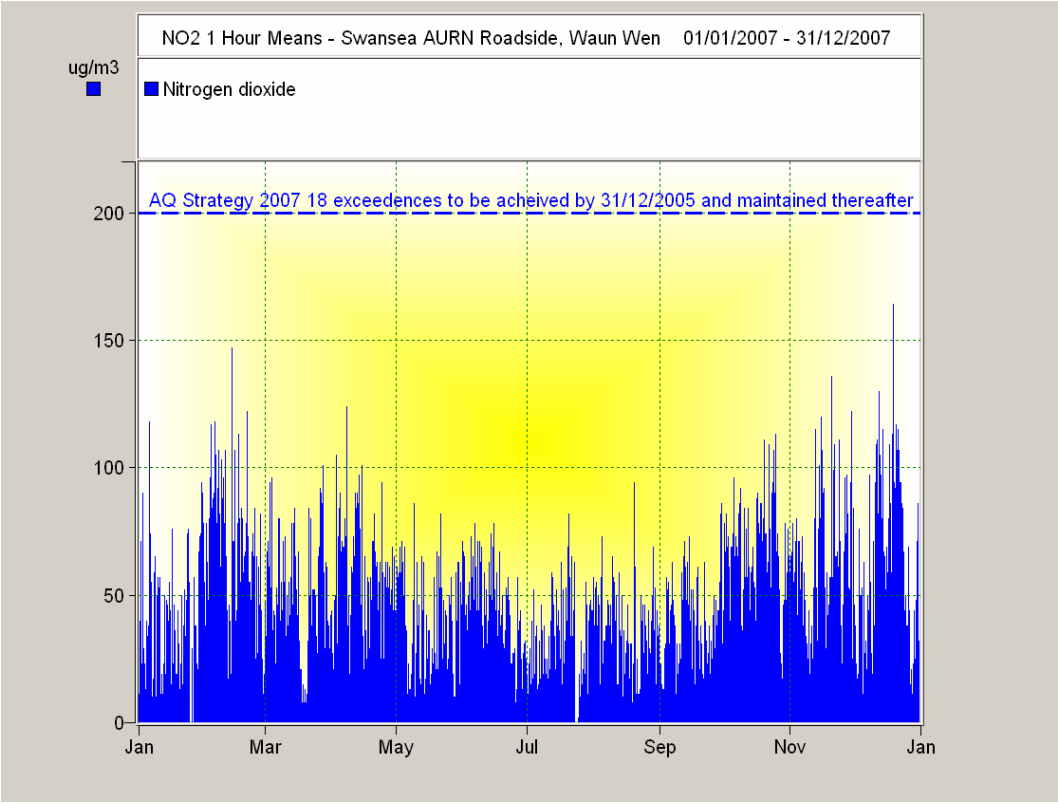
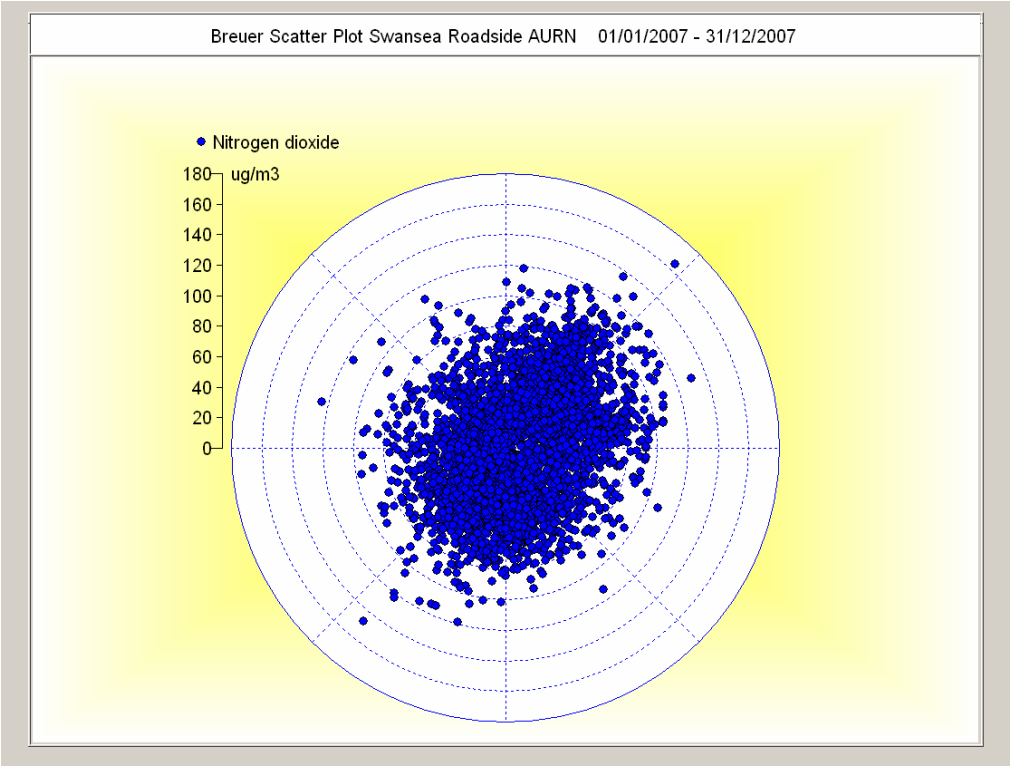


Chart 13 Swansea Roadside AURN NO_2 data 2007

Scatter Plot 6 below shows a tight grouping which would indicate that the sources are primarily of local origin.



Scatter Plot 6 – Swansea Roadside AURN NO_2 2007

The January 2006 update of LAQM.TG(03) indicates that the correction factors provided within the original LAQM.TG(03) guidance (box 6.7 and 6.8 page 6-29) to estimate annual mean concentrations in future years should no longer be used. The revised guidance indicates use of the Year Adjustment Calculator v2.2a (from http://www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls).

Using 2007 as the base year the projections, the future projections within table 19 are obtained in respect of the EU Limit target value for years 2008 - 2010 and also the existing regulations/Air Quality Strategy 2007. The Year Adjustment Calculator v2.2a is dated 19th January 2006 and was probably issued prior to the full impact of the increased primary NO_2 emissions being factored into the calculations.

Year	Actual Measurement µg/m^3	E.U.		AQS 2007/ Existing Regs (40µg/m^3)
		Limit Value µg/m^3	Projection µg/m^3	
2007	31.02	46	-	-
2008	-	44	29.96	-
2009	-	42	28.79	-
2010	-	40	27.75	27.75

Table 19 Swansea Roadside AURN NO_2 Annual Mean projections 2008-2010

Whilst the projections within table 19 show compliance at the 1st January 2010, it should be noted that all indications as to likely future trends are currently pointing to an increase in nitrogen dioxide concentrations in the coming years.

Ideally, monitoring data should be available for at least 5 years before trends in NO_2 concentrations can be meaningfully discussed. Monitoring only commenced at this site during September 2006 so the current extent of the dataset precludes any meaningful discussion on trends.

3.3.2 Thermo Inc FDMS PM_{10}

The Thermo FDMS system was installed upon commissioning of the site, and went live on the 26th September 2006, providing equivalency with the EU reference gravimetric method – section 5.5.3[24] .

The data collected for 2006 from the FDMS 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

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

are outlined here for information as the operation of the FDMS units differs substantially from that of the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[25]. 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 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 units are : Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. However, the FDMS unit will not directly produce a PM_{10} mass concentration. 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.

AEA Energy and Environment has produced a new LSO operating procedure for the FDMS units. One of the more problematic issues with use of the FDMS units that this authority has found is the routine changing of both the purge filter (within the chiller unit) and the "normal" tapered element filter within the sensor unit. The chiller unit is held at approximately 4°C - upon removal of the filter housing, condensation can be seen on the filter holder. It is this authorities

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

experience that should the new 47mm Pallflex TX40 MFAB filter be installed without ensuring the filter holder is dry then this can (and most certainly does) produce very noisy/spiky data. Correct orientation of the 47mm Pallflex TX40 MFAB filter within the filter holder is critical as incorrect orientation will result in poor quality data being returned. The 47mm filter and tapered element sensor unit filter should always be exchanged at the same time. Whilst the TEOM units did take up to 1-2 hours to stabilise after the sensor unit filter exchange and status code 4 OK being reached, the FDMS units can, and do, take even longer to stabilise. Should the site suffer a power failure or air conditioning failure then it is recommended that 3 hours data post resolution of either condition should be deleted from the dataset.

Data collected from the FDMS unit has an integration period of 1-hour. PM_{10} mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Opsis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present[26]

There have been numerous problems since the commissioning of the site in September 2006 with the installation of the Thermo Inc FDMS PM_{10} analyser, resulting in significant periods of data loss. During 2007, there were three periods where data has been removed from the dataset. There are: 24th – 26th January 2007 (6 monthly service); 5th March – 26th March 2007 (Sensor Unit fault(s)); 21st May – 21st June 2007(uncertainty in data due to swap out of loan/replacement sensor units). These issues have resulted in a ratified data capture rate of 82.2%.

[26] *LAQM.TG(03) Monitoring A1-38*

Chart 14 below shows the FDMS PM_{10} daily means for 2007.

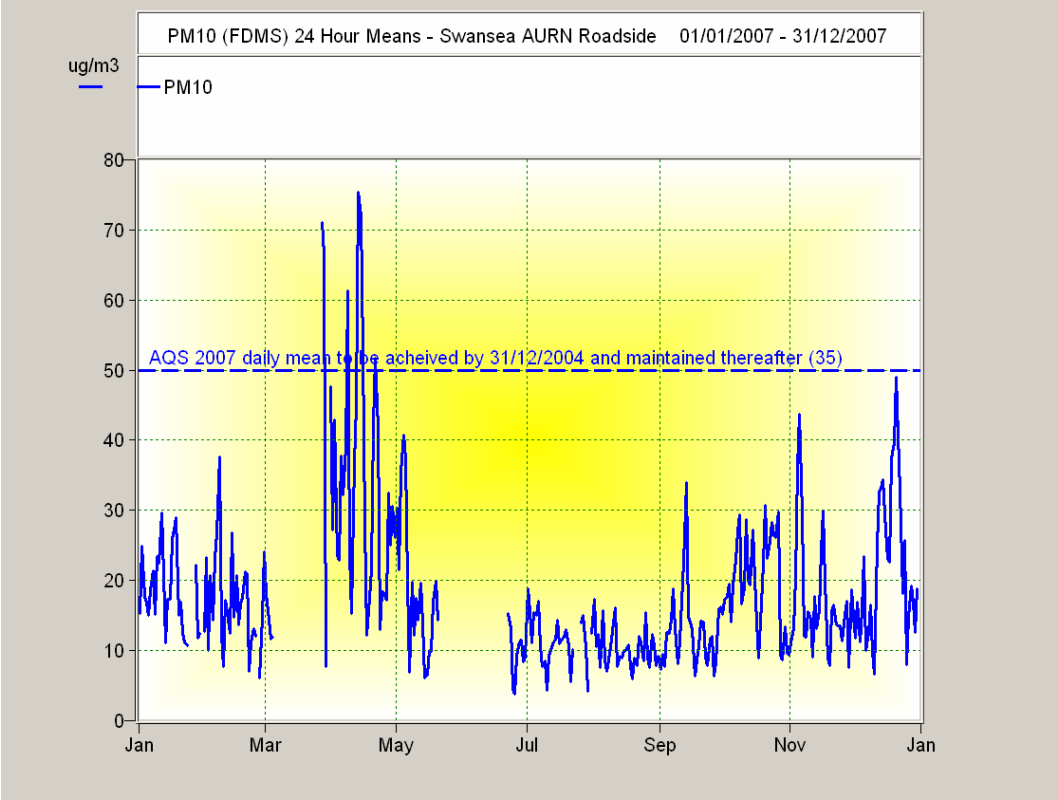


Chart 14 – Swansea Roadside AURN PM_{10} (FDMS) Daily Means 2007

Table 20 below provides brief summary information for the FDMS PM_{10} monitoring activities for 2007.

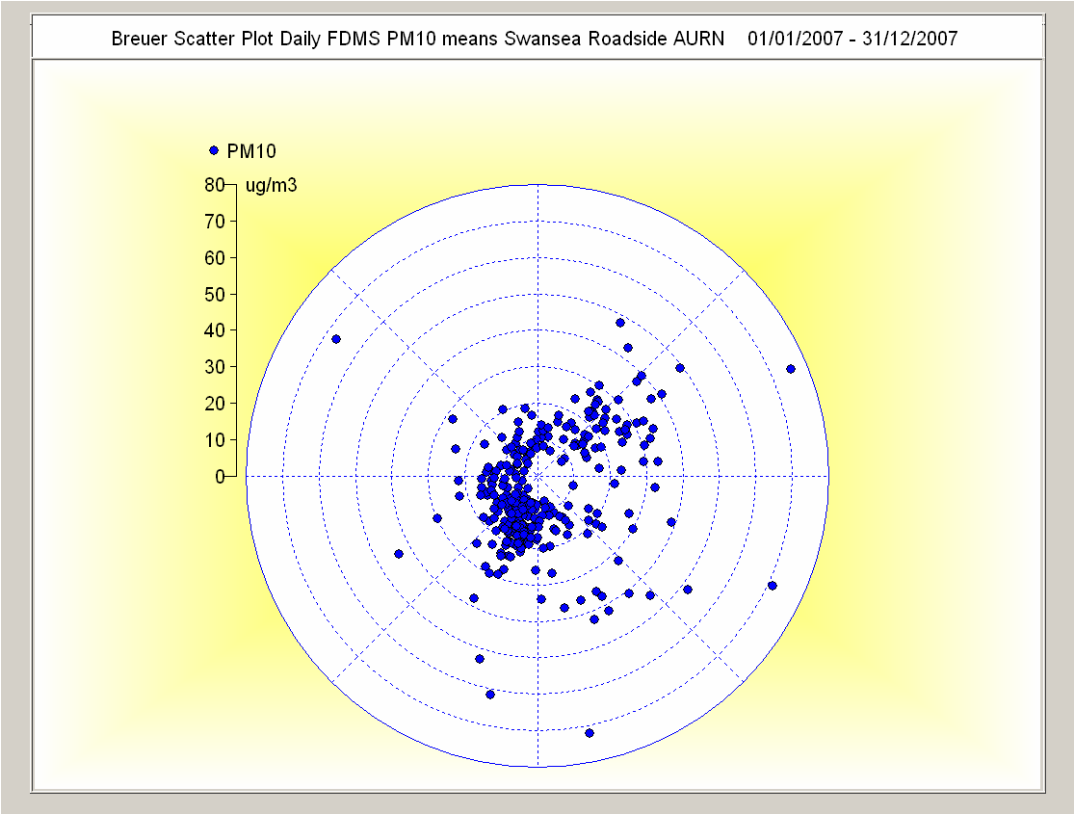
Data capture for 2007 was 82.2% therefore, direct compilation of 24-hour exceedences rather than the use of the 90th percentile of 24-hour means is not valid for 2007.[27] The 90th percentile for 2007 is given below within table 20 which summarises the monitoring activities for 2007.

Scatter Plot 7 is provided for information and suggests that maximum daily averaged concentrations during 2007 emanate from an easterly direction.

[27] LAQM.TG(03) Box 8.4 page 8-22

Swansea Roadside AURN PM_{10} (FDMS) 2007	Annual Mean ($40\mu g/m^3$)	Max Daily Mean ($\mu g/m^3$)	Max 1-hour mean ($\mu g/m^3$)
	18.29	75.33	240
Date of Max	-	13/04/2007	07/04/2007
Data Capture	82.2%		
90th Percentile	32.53		

Table 20 PM_{10} (FDMS) Swansea Roadside AURN 2007



Scatter Plot 7 – Swansea AURN FDMS PM_{10} 24-hour means 2007

Ideally, monitoring data should be available for at least 5 years before trends in PM_{10} concentrations can be meaningfully discussed. Monitoring only commenced at this site during September 2006 so the current extent of the dataset precludes any meaningful discussion on trends.

3.3.3 Thermo Inc FDMS $PM_{2.5}$

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

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

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[28]. 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 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 units are : Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. However, the FDMS unit will not directly produce a $PM_{2.5}$ mass concentration. The $PM_{2.5}$ mass concentration is obtained via post processing of the volatile and non volatile

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

mass parameters by creating a calculated channel within the database to subtract volatile mass from the non volatile mass.

AEA Energy and Environment has produced a new LSO operating procedure for the FDMS units. One of the more problematic issues with use of the FDMS units that this authority has found is the routine changing of both the purge filter (within the chiller unit) and the “normal” tapered element filter within the sensor unit. The chiller unit is held at approximately 4°C - upon removal of the filter housing, condensation can be seen on the filter holder. It is this authorities experience that should the new 47mm Pallflex TX40 MFAB filter be installed without ensuring the filter holder is dry then this can (and most certainly does) produce very noisy/spiky data. Correct orientation of the 47mm Pallflex TX40 MFAB filter within the filter holder is critical as incorrect orientation will result in poor quality data being returned. The 47mm filter and tapered element sensor unit filter should always be exchanged at the same time. Whilst the TEOM units did take up to 1-2 hours to stabilise after the sensor unit filter exchange and status code 4 OK being reached, the FDMS units can, and do, take even longer to stabilise. Should the site suffer a power failure or air conditioning failure then it is recommended that 3 hours data post resolution of either condition should be deleted from the dataset.

Data collected from the FDMS unit has an integration period of 1-hour. $PM_{2.5}$ mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Opsis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the

calculated hourly means were specified to be present[29]. Whilst LAQM.TG(03) (or its January 2006 amendment) provides no direct guidance on $PM_{2.5}$, it has been assumed that whatever guidance is subsequently produced (in the awaited 2007/2008 Technical Guidance) will be broadly similar.

There have been numerous problems since the commissioning of the site in September 2006 with the installation of the Thermo Inc FDMS $PM_{2.5}$ analyser, resulting in significant periods of data loss. During 2007, there were several periods where data has been removed from the dataset. There are: 1st – 5th January 2007; 16th - 18th January 2007; 24th – 26th January 2007; 1st -2nd March 2007; 7th – 21st May 2007(leak test failure and uncertainty in data due to swap out of loan/replacement sensor units). These issues have resulted in a ratified data capture rate of 90.7%. Chart 15 below shows the FDMS $PM_{2.5}$ daily means for 2007 with summary data within table 21.

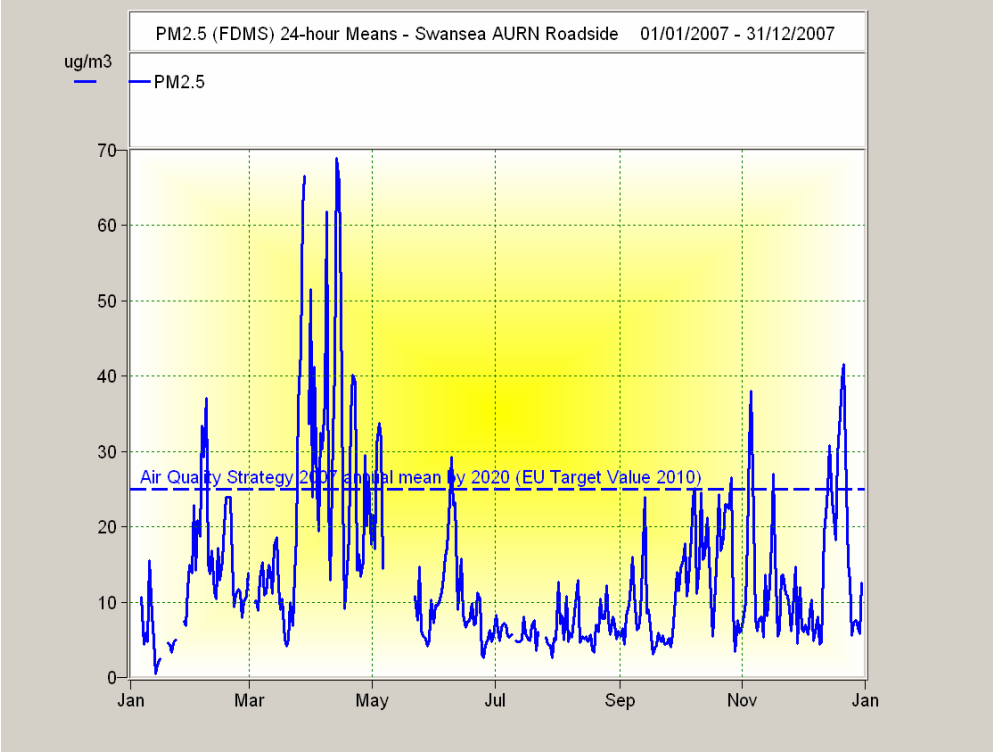


Chart 15 $PM_{2.5}$ Daily Means Swansea Roadside AURN 2007

[29] *LAQM.TG(03) Monitoring A1-38*

Swansea Roadside AURN $PM_{2.5}$ (FDMS) 2007	Annual Mean ($25\mu g/m^3$)	Max Daily Mean ($\mu g/m^3$)	Max 1-hour mean ($\mu g/m^3$)
	13.84	68.9	262
Date of Max	-	13/04/2007	07/04/2007
Data Capture	90.7%		

Table 21 – Summary $PM_{2.5}$ data – Swansea Roadside AURN 2007

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 $25\mu g/m^3$ 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.

3.3.4 Carbon Monoxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time CO analyser. . The QA/QC procedures undertaken by NETCEN have resulted in ratified hourly data expressed in mg/m^3 being provided (to 1st October 2007). The ratified hourly means have then been used to calculate the maximum running 8-hour means. In order for a running average to be valid, 75% data capture is required i.e. 6 hourly averages out of every 8 must be valid. The running 8-hour mean for a particular hour, is the mean of the hourly average concentrations for that hour and the preceding 7 hours. The average period is stepped forward by one hour for each value, so running mean values are given for the periods 00:00 – 07:59, 01:00 – 08:59 etc. There are, therefore, 24 possible 8-hour means in a day (calculated from hourly data). The maximum daily running 8-hour mean is the maximum 8-hour running mean measured on any one day. [30] A chart representing the 8-hour running means during 2007 is given below as chart 16.

There have been no exceedences of the maximum daily 8-hour running mean of 10mg/ m^3 recorded at this site during 2007. The date for compliance with the Air Quality (Amendment)(Wales) Regulations 2002 objective standard was the 31st December 2003. The Air Quality Strategy 2007 also retains the same, with compliance to be achieved and maintained thereafter.

Data capture for the 8-hour running means during 2007 was 98% allowing direct comparison with the objective standard. Data post 1st October 2007 has been ratified by this authority.

[30] *Source LAQM.TG(03) – Monitoring – Calculation of exceedence statistics, paragraph A1.104 page A1-37.*

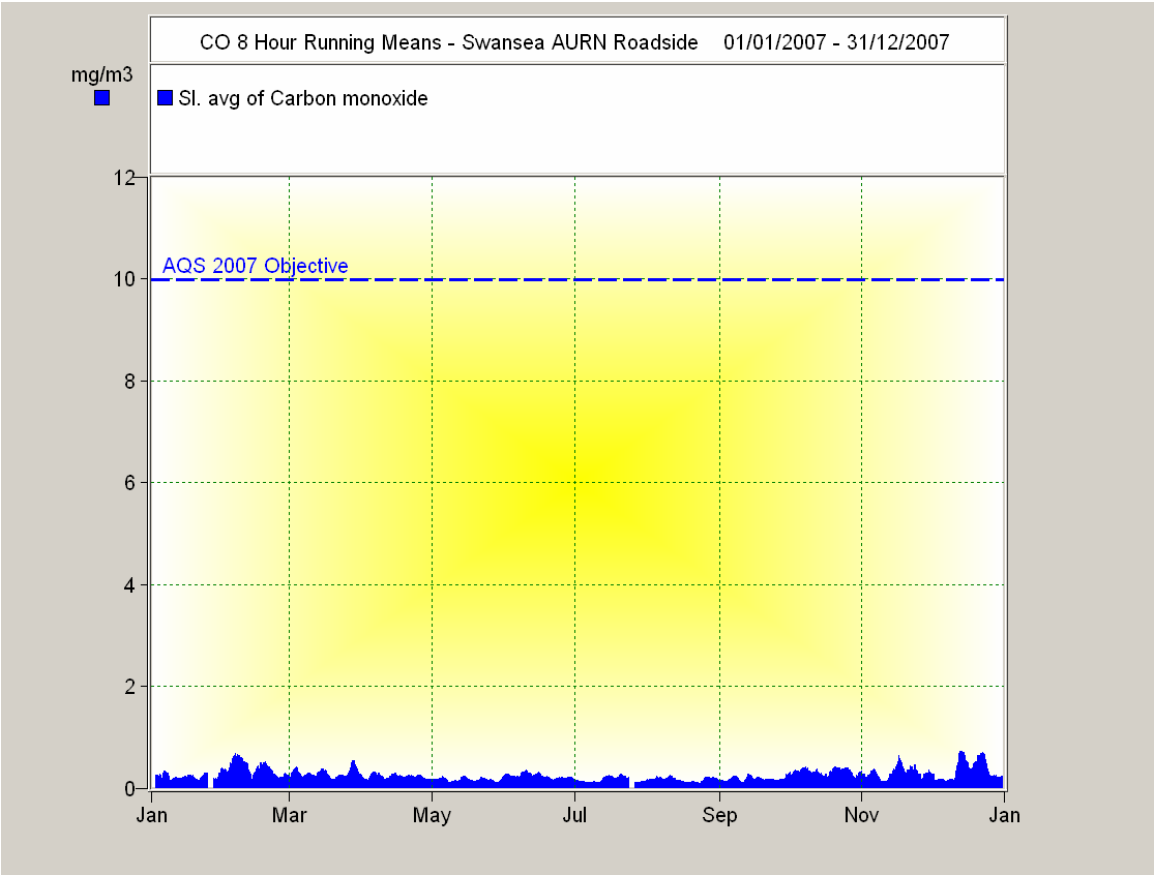


Chart 16 Swansea Roadside AURN CO 8 hour running means 2007

The maximum running 8 hour mean seen during 2007 was 0.74mg/m^3 on the 13th December 2007.

3.3.5 Sulphur Dioxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time SO_2 analyser. The QA/QC procedures undertaken by AEA Energy and Environment have resulted in ratified 15-minute and 1-hour data expressed in µg/m^3 being provided (upto 1st October 2007). The ratified 15-minute means have been used to calculate the objectives for the 15-minute objective with the ratified 1-hourly means being 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[31].

Data from 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 22. Data from September-December 2006 is excluded from analysis due to the limited amount of data available for 2006.

Ratified data capture at the base 15-minute logged means for 2007 is 95.4%, allowing direct compilation of the number of exceedences[32].

The ratified data capture at 1-hour integration for 2007 is 97% and for the 24-hour dataset is 98% allowing direct compilation of the number of exceedences rather than use of the 99.7th and 99th percentiles respectively.

No exceedence of the 15-minute objective was observed during 2007.

Graphs representing the various averaging periods for 2007 and detailed within table 22 below are shown below as chart 17 (15-minute means), chart 18(1-hour means) and chart 19 (24-hour means).

[31] *LAQM.TG(03) Monitoring A1-38*
[32] *Technical Guidance LAQM.TG(03) page 7-7 box 7.2*

Swansea Roadside AURN	Max 15-Min Mean µg/m^3 (266µg/m^3)	Max 1-hour Mean µg/m^3 (350µg/m^3)	Max 24-Hour Mean µg/m^3 (125µg/m^3)
2007	101.08	88.91	33.46
Date of Max	20/10/2007	20/10/2007	14/12/2007
Time of Max	11:15	11:00	-
Wind Direction @ Max conc.	87°	98°	67°

Table 22 Swansea Roadside AURN (Carmarthen Road) SO_2 Monitoring data 2007

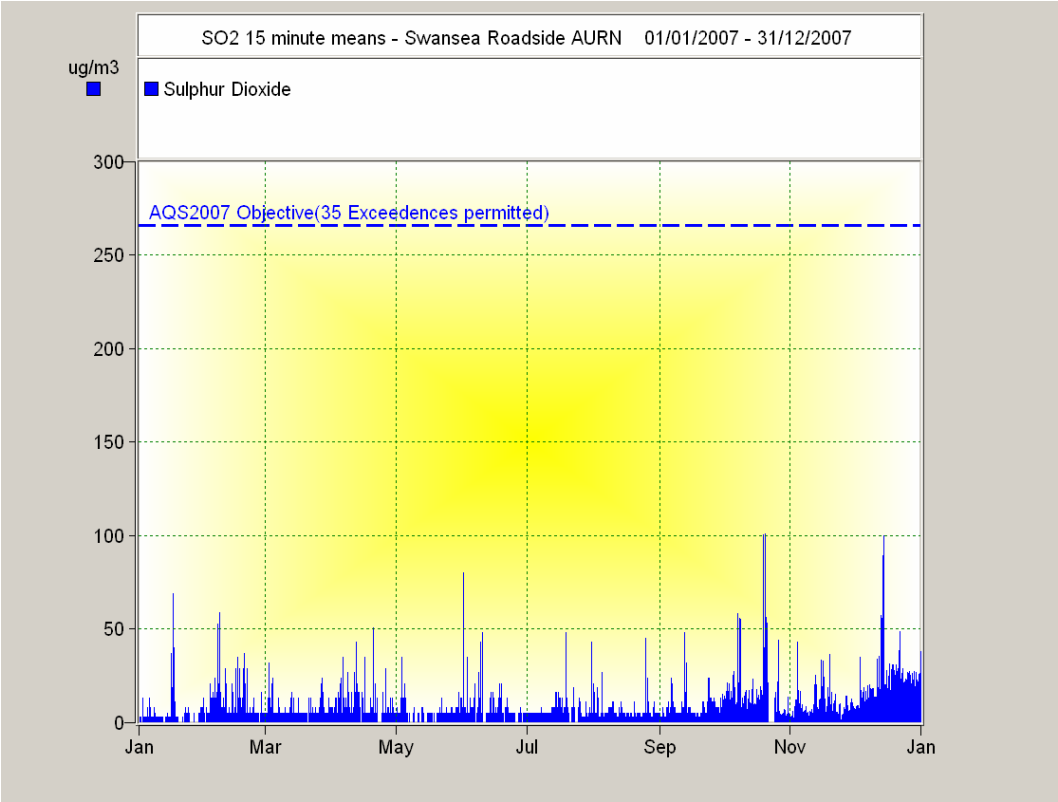


Chart 17 Swansea Roadside AURN 15-minute SO2 2007

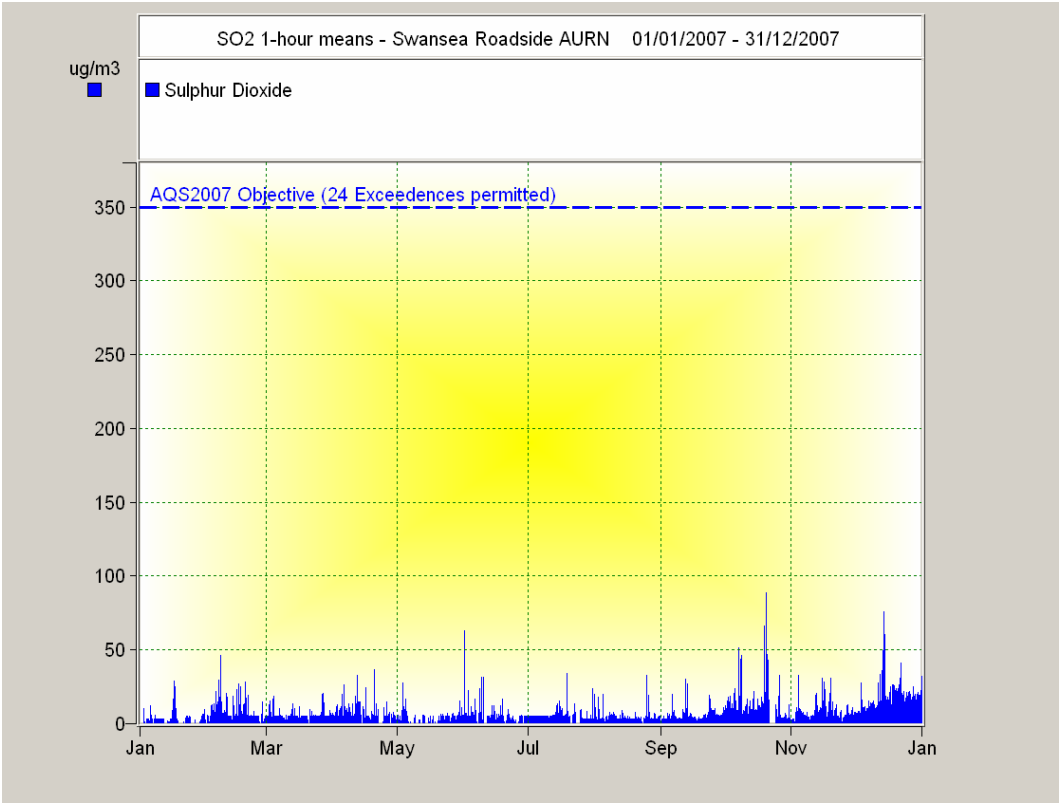


Chart 18 Swansea Roadside AURN SO_2 1-hour means 2007

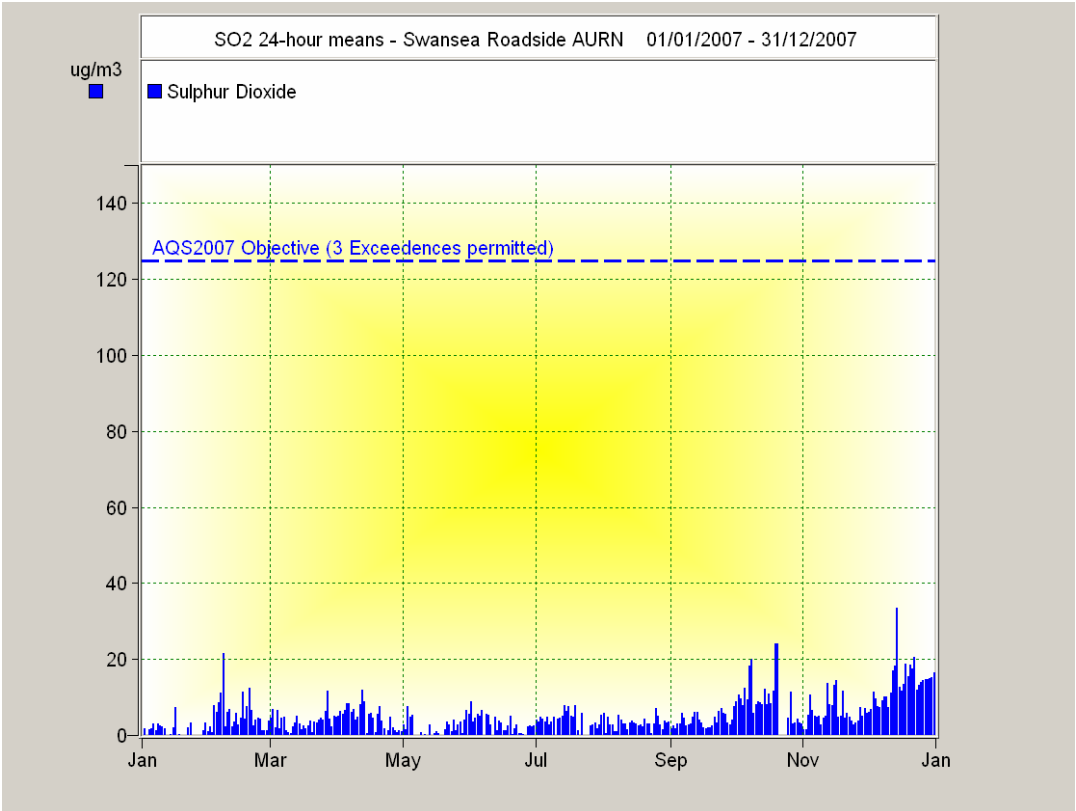


Chart 19 Swansea Roadside AURN SO_2 24-hour means 2007

3.3.6 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 2007. The objective for ozone is an 8-hour mean not to exceed 100μg/m^3 on more than 10 occasions with a compliance date of 31st December 2005

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time ozone (O_3) analyser. The ratified 1-hour means provided by NETCEN have been imported into the software package OPSIS Enviman Reporter. The 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.

The results from the monitoring during 2007 are presented below as table 23 and show compliance with the existing obligations.

Swansea Roadside AURN)	Max 8-hour Mean (μg/m^3)	Data capture %	Exceedences of 8-hour objective 100μg/m^3 (10 permitted)
2007	115.25	98%	3

Table 23 - Ozone 8-hour means – Swansea Roadside AURN 2007

A chart of the ozone measurements undertaken during 2007 is given below as chart 20.

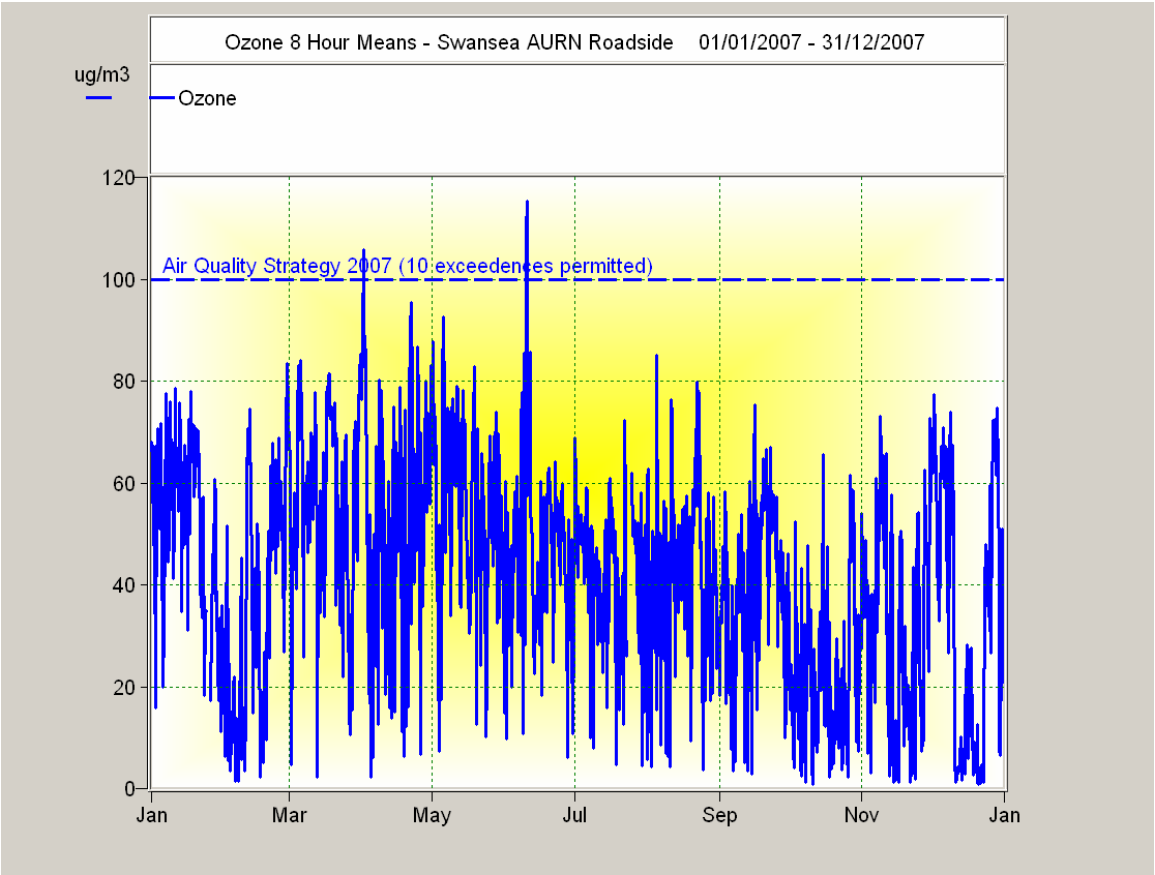


Chart 20 Ozone 8 hour means Swansea Roadside AURN 2007

What is noticeable for chart 20 above is the relatively low levels recorded during parts of December 2007 – this would indicate extensive photochemistry ongoing as NO_2 levels during this period (mentioned within this report for the monitoring stations equipped with chemiluminescent NO_x analysers) were elevated.

3.4 Automatic Monitoring Data from outside of an Air Quality Management Area.

3.4.1 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 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 Kerbside (U2)[33]. Map 5 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, H_2S, CO, SO_2 and NO_x, with an R&P TEOM measuring PM_{10}. The R&P TEOM measuring PM_{10} was upgraded to a Thermo FDMS unit again measuring PM_{10} 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

[33] *Source LAQM.TG(03) Appendix A page A1-42*

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Map 5 -Aerial view - Morriston Groundhog

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 are removed from any subsequent analysis. The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data is re-scaled according to the calibration factors obtained on a fortnightly basis. The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. Since the awarding of the contract by the Welsh Assembly Government to AEA to run the Welsh Air Quality Forum in April 2004, all equipment and calibration gases stored on site is fully audited yearly by AEA Energy and

Environment. The L10 cylinders are replaced on a regular basis and are to a certified and traceable standard.

3.4.2 Nitrogen Dioxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time NO_x analyser. 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[34]. 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.

Data from 2006 and 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 24. For the sake of completeness, data is also shown from 2004. A graph of the 2006-2007 measurements is shown below as chart 21. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

Morriston Groundhog											
Annual Mean (40µg/m^3)				Max 1-hour (200µg/m^3)				Exceedences of 1-hour std (18 permitted)			
2004	2005	2006	2007	2004	2005	2006	2007	2004	2005	2006	2007
21.4	29.9	31.8	36.1	136.9	144.1	167.2	230.5	0	0	0	1

Table 24 - Nitrogen Dioxide monitoring data - Morriston Groundhog 2004 - 2007

[34] *LAQM.TG(03) Monitoring A1-37*

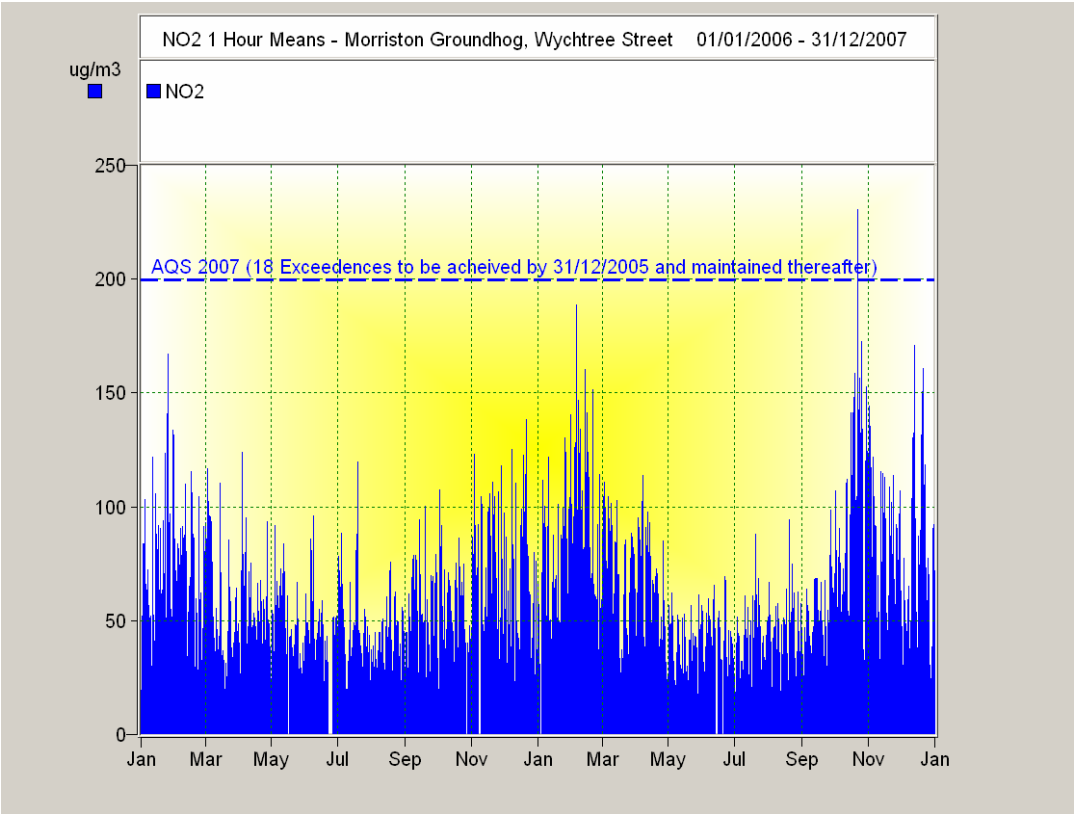
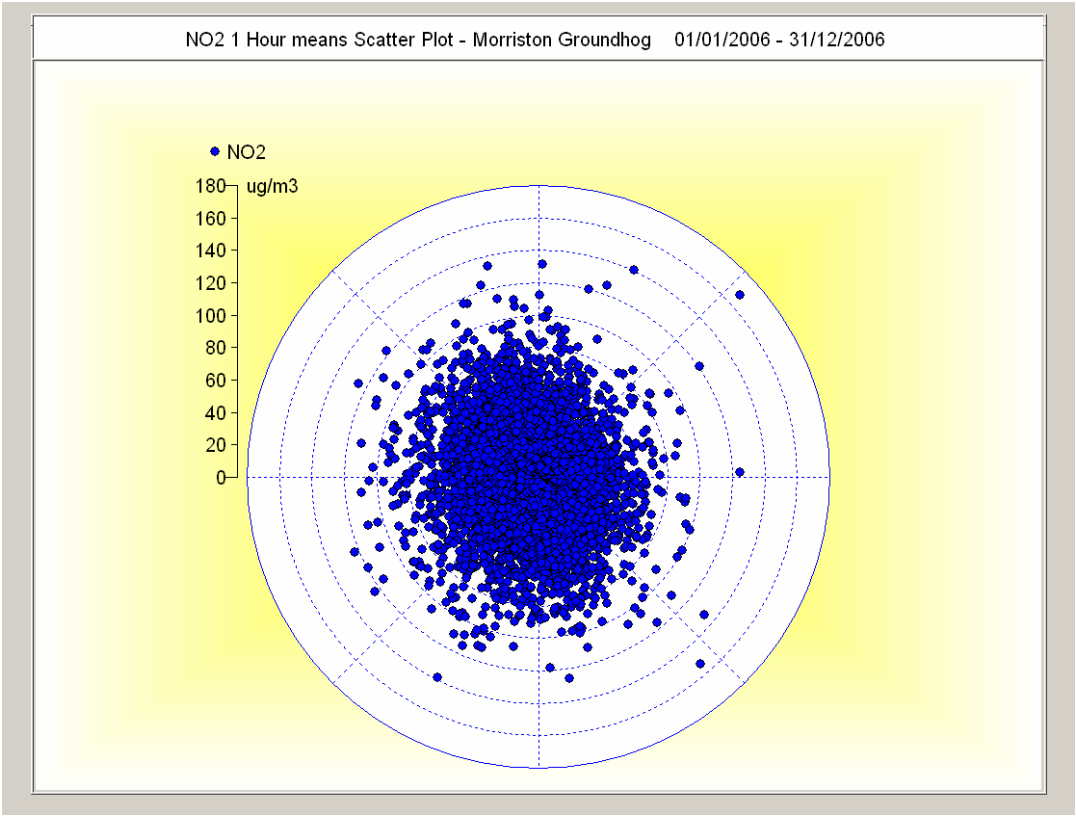


Chart 21 NO_2 1 Hour means Morriston Groundhog 2006-2007

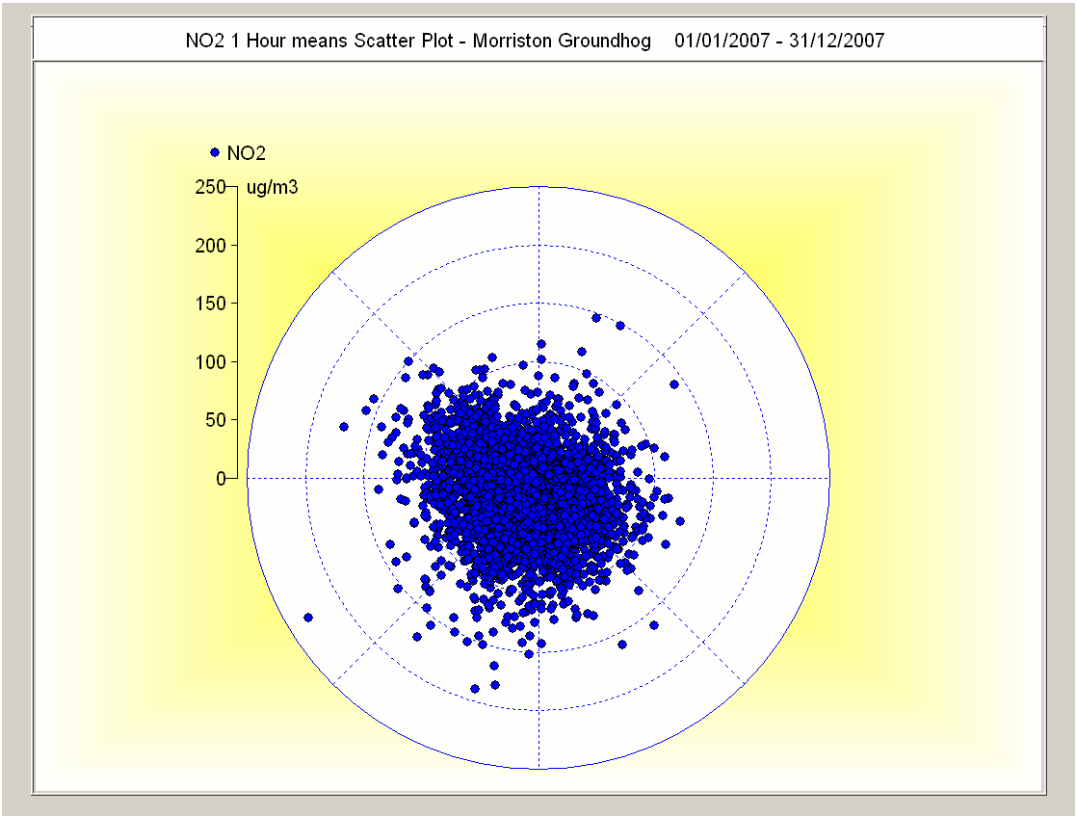
The annual NO_2 means for 2006 and 2007 are below the 40µg/m^3 objective for both 2005 and the EU Limit Value objective in 2010. Hourly NO_2 data capture for 2006 is 96 %, and for 2007 is 97%. These data capture rates permit the direct compilation of hourly exceedences rather than the use of the 99.8th percentile of hourly means[35].

Scatter Plots 6 and 7 below show the scatter in the data for the respective years. There is not discernable pattern from the data.

[35] LAQM TG(03) box 6.2 page 6-16



Scatter Plot 6 NO_2 1 Hour Means Morriston Groundhog 2006



Scatter Plot 7 NO_2 1 Hour Means Morriston Groundhog 2007

What is most noticeable is the indications of a start in the reversal of the previously identified reduction trend in annual mean NO_2 concentrations both nationally and locally here in Swansea. The 2007 annual mean concentration when viewed alongside the last couple of years does seem to confirm the reversal of the previously identified reduction trend. This new upward trend with NO_2 concentrations has been observed at numerous other roadside sites throughout the UK. From literature already published on this reversal of the NO_2 reduction trend it is thought likely that oxidation catalysts fitted to newer EURO classification vehicles are emitting greater concentrations of primary NO_2 direct from the exhaust tailpipe.

If this trend continues, then, despite the fact that the Morriston Groundhog is located within a fairly open aspect of the lower Swansea valley area it could result in failure to comply with the Air Quality Strategy 2007 targets and the EU Limit Value in 2010.

The January 2006 update of LAQM.TG(03) indicates that the correction factors provided within the original LAQM.TG(03) guidance (box 6.7 and 6.8 page 6-29) to estimate annual mean concentrations in future years should no longer be used. The revised guidance indicates use of the Year Adjustment Calculator v2.2a (from http://www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls).

Using 2007 as the base year the projections shown within table 25 below are obtained in respect of the EU Limit target value for years 2008 - 2010 and also the existing regulations/Air Quality Strategy 2007. The Year Adjustment Calculator v2.2a is dated 19th January 2006 and was probably issued prior to the full impact of the increased primary NO_2 emissions being factored into the calculations.

Year	Actual Measurement $\mu g/m^3$	E.U.		AQS 2007/ Existing Regs ($40\mu g/m^3$)
		Limit Value $\mu g/m^3$	Projection $\mu g/m^3$	
2007	36.1	46	-	-
2008	-	44	34.87	-
2009	-	42	33.5	-
2010	-	40	32.3	32.3

Table 25 Morriston Groundhog NO_2 Annual Mean projections 2008-2010

Whilst the projections within table 25 show compliance at the 1st January 2010, it should be noted that all indications as to likely future trends are currently pointing to an increase in nitrogen dioxide concentrations in the coming years. The rise in the annual mean concentrations at the Morriston site since 2004 is testament to this.

3.4.3 Particulate Matter PM_{10}

The particles objectives (PM_{10}) for 2010 announced by the Welsh Assembly Government on the 18th September 2002 were provisional objectives and were not included in Regulation for purposes of LAQM in Wales. These particle objectives are unlikely to be set in regulation given the Air Quality Strategy 2007 retaining the existing objectives within The Air Quality (Wales) Regulations 2000 as amended by the Air Quality (Amendment)(Wales) Regulations 2002. Therefore, the City and County of Swansea are only required to review and assess PM_{10} particles as prescribed in the existing regulations.

The situation regarding particles is likely to change further with the exposure reduction proposals for $PM_{2.5}$ contained within the 2007 Strategy (European obligations still under discussion).

3.4.3.1 Rupprecht & Patashnick Co., Inc. TEOM

A Rupprecht & Patashnick Co., Inc. TEOM measured particulate Matter PM_{10} at the Morriston Groundhog site until the 27th October 2006 at 11am. On this date, the existing R&P TEOM system was removed from site and upgraded to the Thermo Inc FDMS PM_{10} system. The Thermo FDMS system was installed on the same date with valid data commencing from 17:00 hours providing equivalency with the EU reference gravimetric method. In hindsight, it may have been prudent to delay the upgrade until January 2007 and obtain a full year of measurement with the existing R & P TEOM PM_{10} system.

The logged 15-minute means from the R & P Co. Inc TEOM 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[36]. 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 daily 24-hour means and the annual mean. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the hourly means were specified to be present[37].

All results are presented in $\mu g/m^3$ and have been corrected with the interim default correction factor of 1.3 to estimate gravimetric concentration. For ease of comparison, results from the previous years (2004 and 2005) are shown alongside the results for 2006 within table 26 below. A chart representing the 24-hour daily means from 2006 is given below as chart 22 and a Scatter Plot representing the scatter of the 24-hour means during 2006 as Scatter Plot 8

[36] *LAQM.TG(03) Monitoring A1-37*
[37] *LAQM.TG(03) Monitoring A1-38*

Morriston Groundhog PM_{10} (TEOM)	Annual Mean ($40\mu g/m^3$)			24-hour Exceedences ($50\mu g/m^3$) (35 permitted)		
	2004	2005	2006	2004	2005	2006
	22.68	22.47	24.54 *	6	0	3 *

Table 26 PM_{10} (TEOM) Monitoring Results 2004-2006 Morriston Groundhog

** Data capture for 2006 80.8% due to upgrade to Thermo FDMS unit 27th October 2006*

* Data capture for 2006 was 80%. Direct compilation of 24-hour exceedences rather than the use of the 90th percentile of 24-hour means is therefore not permitted.[38] The 90th percentile for 2006 is 36.7

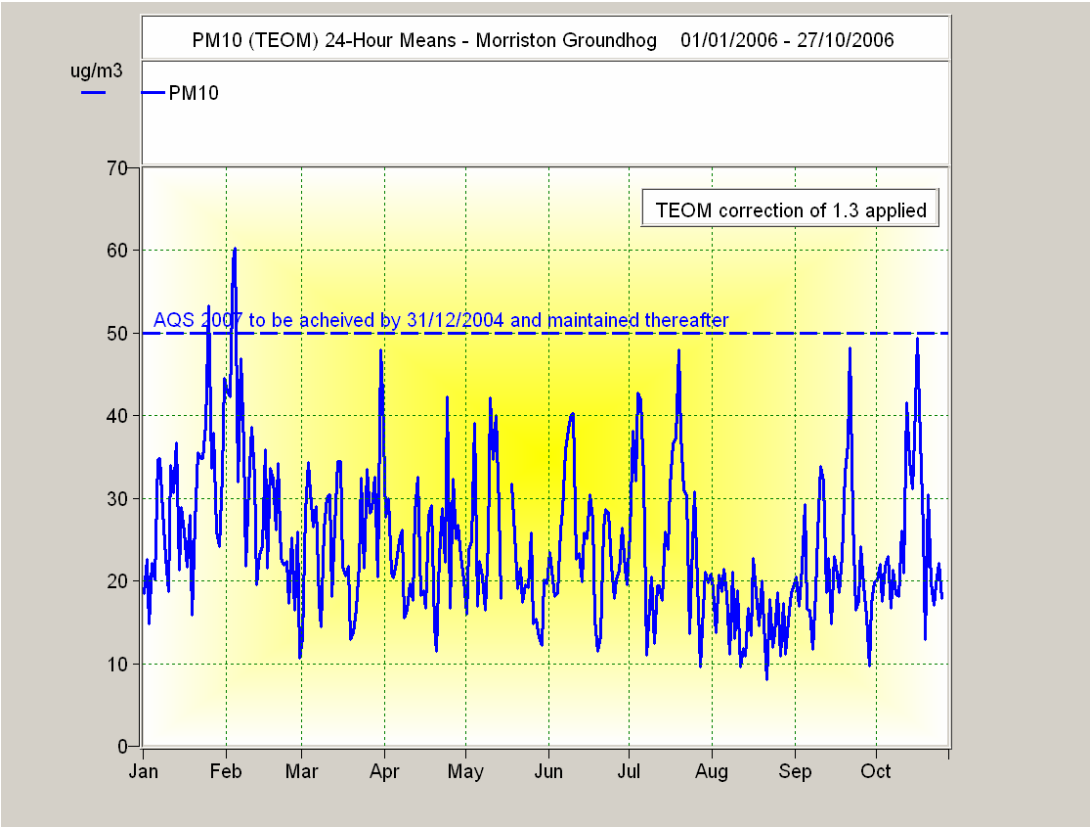
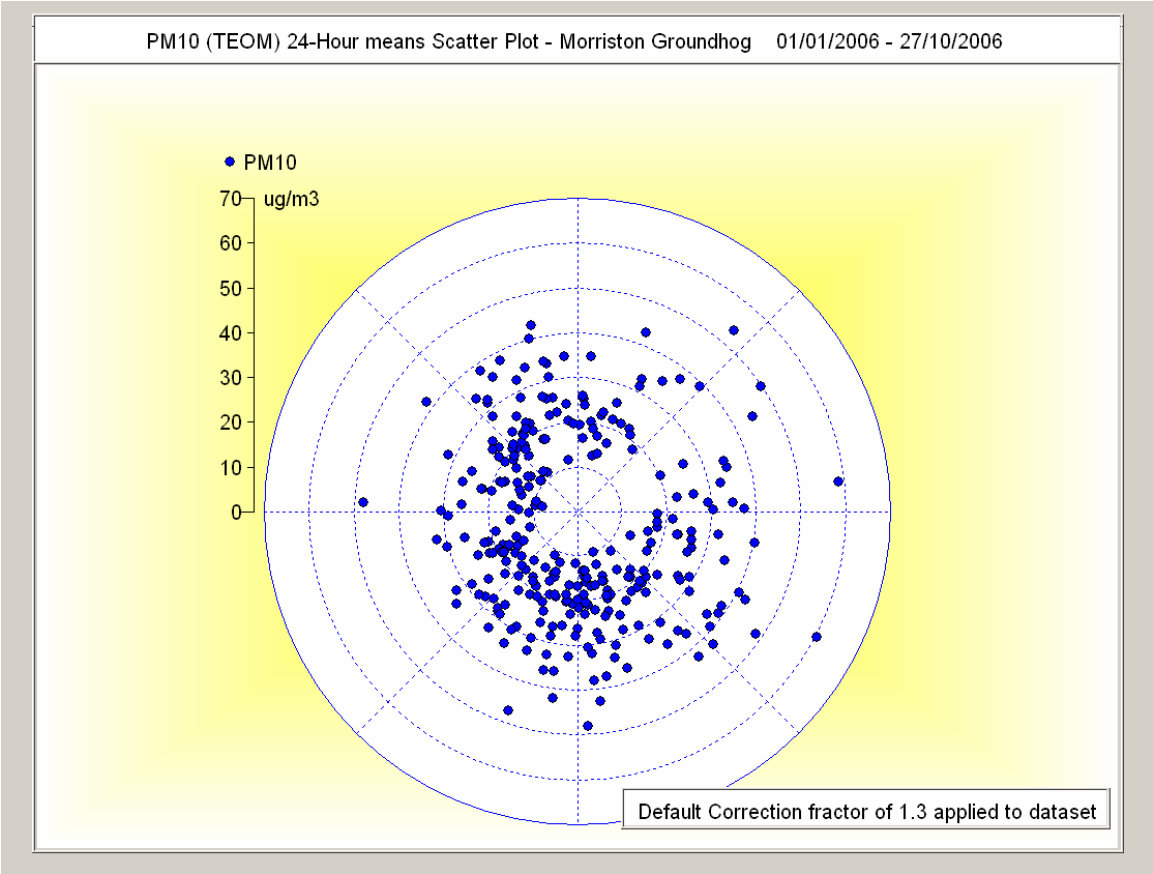


Chart 22 PM_{10} (TEOM) 24 hour means Morriston Groundhog 2006

From table 26, it is evident that the data (TEOM) is showing compliance with the existing objectives during 2005 and 2006 both in respect of the annual mean concentrations and permitted number of exceedences. The results for 2006 do

[38] LAQM.TG(03) Box 8.4 page 8-22

not represent a full year of measurements with only 80% data capture due to the upgrade of the R & P TEOM commencing 27th October 2006.



Scatter Plot 8 – PM_{10} (TEOM) 24-hour means Morriston Groundhog 2006

The scatter indicates no dominating direction during 2006 but hints at the more elevated levels during 2006 to be from a south-easterly and north-easterly direction.

In previous analyses undertaken of PM_{10}, elevated levels of PM_{10} emanating from a south-easterly direction has been associated with the heavy industry located in Port Talbot: notably, the Corus steel plant.

3.4.3.2 Thermo Inc FDMS PM_{10}

The Thermo FDMS system was installed on the 27th October 2006, providing equivalency with the EU reference gravimetric method – section 5.5.3[39]
The dataset collected from the FDMS system is not directly comparable to the historical R&P TEOM dataset even given that the use of the advised interim default correction factor was advised to estimate the EU reference gravimetric method. This correction factor has been called into dispute by various studies at diverse locations throughout the UK deriving differing correction factors.

The data collected for 2006 from the FDMS unit amounts to just over two months at best and is reported here merely for information purposes. Additionally, brief operational issues that have been identified are outlined here for information as the operation of the FDMS units differs substantially from that of the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[40]. 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 provides hourly integration data and has been configured as per DEFRA's FDMS parameter protocol. 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

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

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

Dew Point, Sample Dew Point, Filter loading, Noise, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. However, the FDMS unit will not directly produce a PM_{10} mass concentration. 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.

AEA Energy and Environment has produced a new LSO operating procedure for the FDMS units. One of the more problematic issues with use of the FDMS units that this authority has found is the routine changing of both the purge filter (within the chiller unit) and the "normal" tapered element filter within the sensor unit. The chiller unit is held at approximately 4°C - upon removal of the filter housing, condensation can be seen on the filter holder. It is this authorities experience that should the new 47mm Pallflex TX40 MFAB filter be installed without ensuring the filter holder is dry then this can (and most certainly does) produce very noisy/spiky data. Correct orientation of the 47mm Pallflex TX40 MFAB filter within the filter holder is critical as incorrect orientation will result in poor quality data being returned. The 47mm filter and tapered element sensor unit filter should always be exchanged at the same time. Whilst the TEOM units did take up to 1-2 hours to stabilise after the sensor unit filter exchange and status code 4 OK being reached, the FDMS units can, and do, take even longer to stabilise. Should the site suffer a power failure or air conditioning failure then it is recommended that 3 hours data post resolution of either condition should be deleted from the dataset.

Data collected from the FDMS unit has an integration period of 1-hour. PM_{10} mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Opsis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further

processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present[41]

Chart 23 below shows the period 28th October – 31st December 2007. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

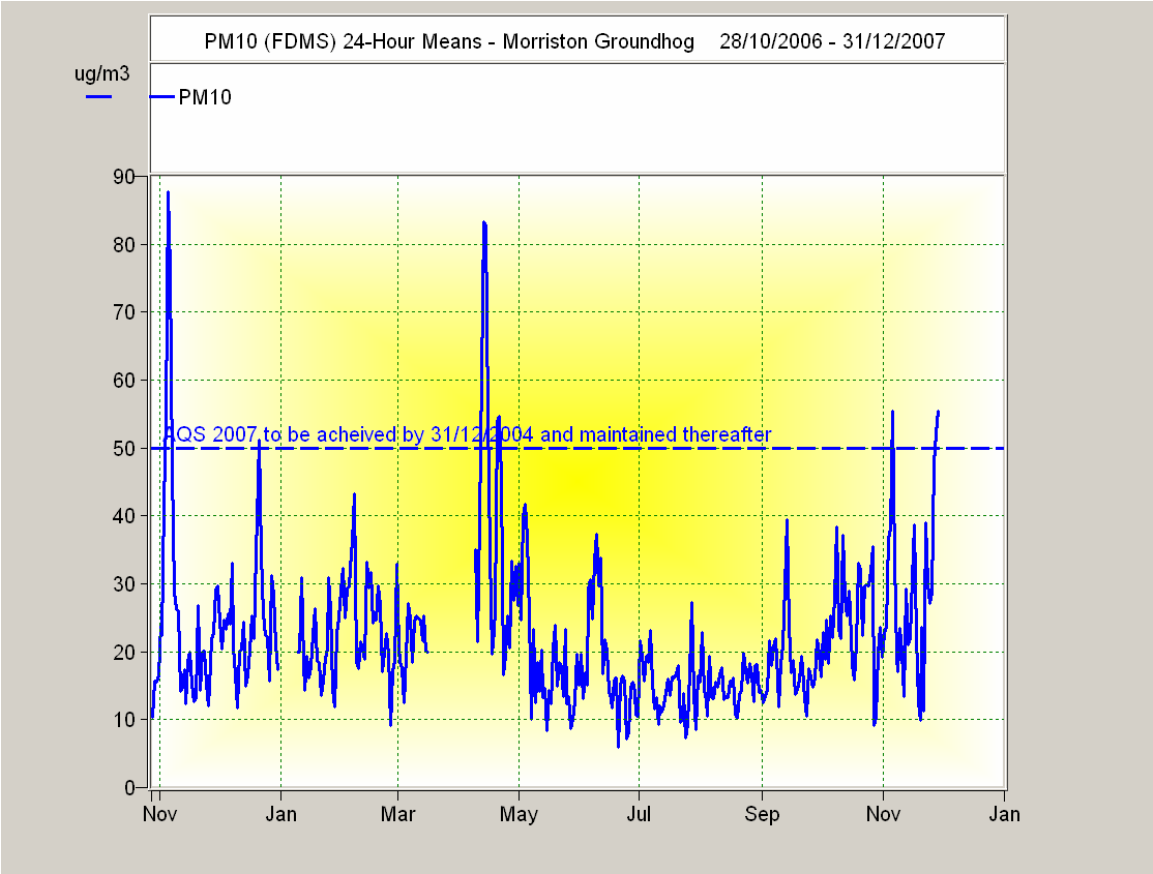


Chart 23PM_{10} (FDMS) 24 hour means Morriston Groundhog 2007

There have been some ongoing issues with the FDMS unit at Morriston. Data capture for 2007 is below the recommended capture rate as there have been three significant periods of faults within the unit. The first issue arose between the 31st December 2006 and the 8th January 2007, the second between the 17th March 2007 and the 10th April 2007 and lastly from the 29th November 2007 to

[41] *LAQM.TG(03) Monitoring A1-38*

the 1st February 2008. Data capture rates will also therefore be affected for 2008. The faults identified include corruption of the software within the control unit and lately status error codes as a result of ice within the chiller unit and the filter usage increasing by up to 40% a day.

Data capture for 2007 was 79.5%, direct compilation of 24-hour exceedences rather than the use of the 90th percentile of 24-hour means is therefore not valid for 2007.[42] The 90th percentile for 2007 is given below within table 27 which summarises the monitoring activities for 2007.

Morriston Groundhog PM_{10} (FDMS) 2007	Annual Mean (40µg/m^3)	Max Daily Mean (µg/m^3)	Max 1-hour mean (µg/m^3)
	21.56	83.25	224
Date of Max	-	13/4/2007	5/11/2007
Data Capture	79.5%	-	-
90th Percentile	33.4	-	-

Table 27 PM_{10} (FDMS) Morriston Groundhog 2007

3.4.4 Carbon Monoxide

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time CO analyser. 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. Data capture of less than 75% for the hour therefore excludes that

[42] LAQM.TG(03) Box 8.4 page 8-22

hour from any analysis. The derived hourly means have then been used to calculate the running eight hour means.

The running 8-hour mean for a particular hour, is the mean of the hourly average concentrations for that hour and the preceding 7 hours. The average period is stepped forward by one hour for each value, so running mean values are given for the periods 00:00 – 07:59, 01:00 – 08:59 etc. There are, therefore, 24 possible 8-hour means in a day (calculated from hourly data). In order for a running average to be valid, 75% data capture is required i.e. 6 hourly averages out of every 8 must be valid. The maximum daily running 8-hour mean is the maximum 8-hour running mean measured on any one day. [43]

All results are presented in mg/m^3 by multiplying the logged result in ppm by the conversion factor of 1.16 [44] to produce results expressed in mg/m^3.
The CO 8-hour running mean data has been examined for 2006 -2007 and the results are summarised below in table 28. The results for 2006-2007 are also shown as chart 23 below. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

For ease of comparison with results from the previous year, the results obtained from 2001 - 2005 are also shown within table 28 below. The date for compliance with the Air Quality (Amendment)(Wales) Regulations 2002 objective standard was the 31st December 2003. The Air Quality Strategy 2007 also retains the same, with compliance to be achieved and maintained thereafter. The date for compliance with the EU objective of a maximum daily 8-hour running mean of 10mg/ m^3 was 2005.

[43] *Source LAQM.TG(03) – Monitoring – Calculation of exceedence statistics, paragraph A1.104 page A1-37.*
[44] *Technical Guidance LAQM.TG(03)Appendix B - Conversion factors page A1-44*

All objectives have been comfortably met before the compliance dates.

Year	Max 8-hour running mean
2001	4.61 mg/m^3
2002	2.31 mg/m^3 *
2003	2.07 mg/m^3
2004	2.83 mg/m^3
2005	1.96 mg/m^3
2006	1.36 mg/m^3
2007	1.63 mg/m^3

Table 28 – Morriston Groundhog CO 8 hour means 2001-2007

** Data capture for 2002 88.73%*

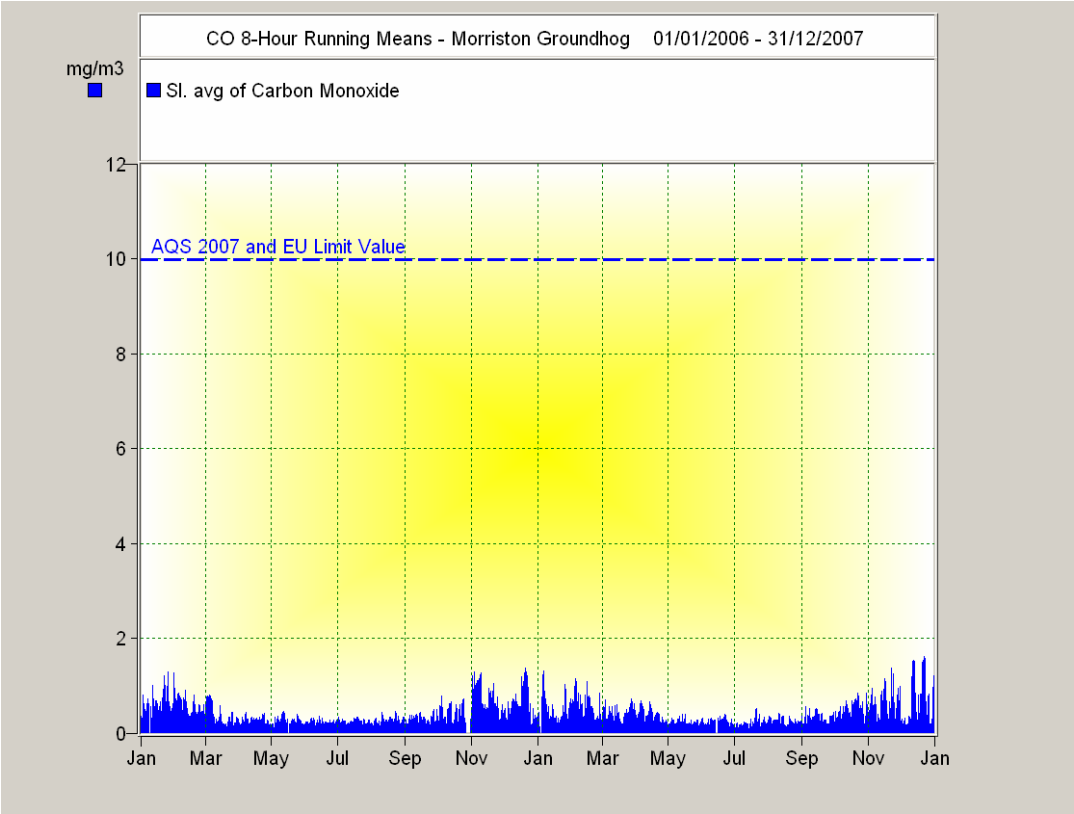


Chart 23 CO Running 8 hour means Morriston Groundhog 2006-2007

Data capture for the 8-hour running means during 2006 was 97.1% and for 2007 was 98.5 % allowing direct comparison with the objective standard.

3.4.5 Sulphur Dioxide

An Advanced Pollution Instrumentation (API) real-time SO_2 analyser measures $S0_2$ at the Morriston Groundhog site. 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. 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 daily 24-hour means. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the hourly means were specified to be present[45].

All results are presented in $\mu g/m^3$ by multiplying the logged result in ppb by the conversion factor of 2.66 [46] to produce results expressed in $\mu g/m^3$.

Data from 2006 and 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 29. One exceedence of the 15-minute objective was observed during 2006. Graphs representing the various averaging periods for 2006 - 2007 and detailed within table 29 below are shown below as chart 24 (15-minute means), chart 25 (1-hour means) and chart 26 (24-hour means).

Data capture at the base 15-minute logged means for 2006 is 94.7 % and for 2007 is 96.1 % allowing direct comparison with the objective standards and not the percentile values[47]. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

[45] *LAQM.TG(03) Monitoring A1-38*
[46] *Technical Guidance LAQM.TG(03)Appendix B - Conversion factors page A1-44*
[47] *Technical Guidance LAQM.TG(03) page 7-7 box 7.2*

Morriston Groundhog	Max 15-Min Mean µg/m^3 (266µg/m^3)	Max 1-hour Mean µg/m^3 (350µg/m^3)	Max 24-Hour Mean µg/m^3 (125µg/m^3)
2006	270.9	143.8	18.29
Exceedences	1	0	0
Date of Max	06/06/2006	06/06/2006	03/11/2006
Time of Max	13:15	13:00	-
Wind Direction @ Max conc.	156°	155°	179°
2007	120	101	18.5
Exceedences	0	0	0
Date of Max	01/05/2007	01/05/2007	19/10/2007
Time of Max	19:45	19:00	-
Wind Direction @ Max conc.	148°	116°	299°

Table 29 Morriston Groundhog $SO_2$2005-2006

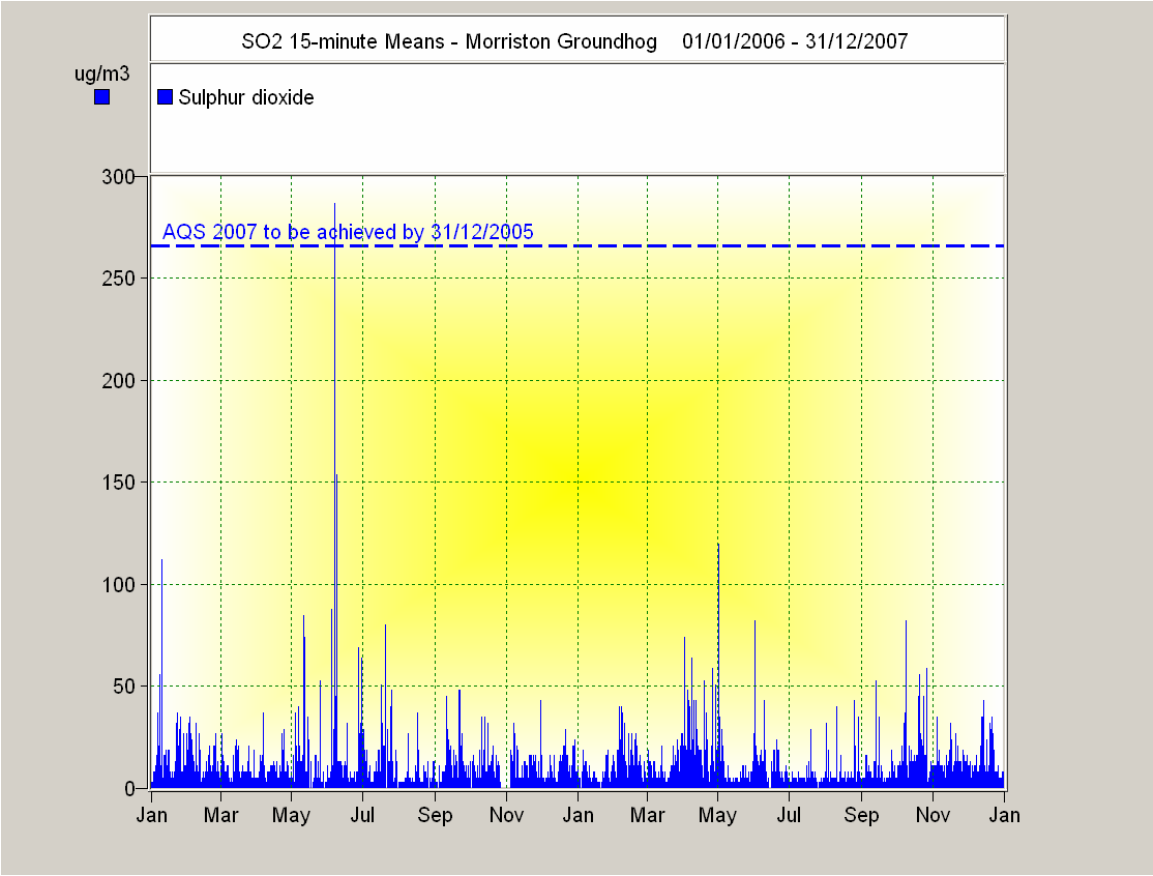


Chart 24 – 15-minute SO_2 2006-2007 Morriston Groundhog

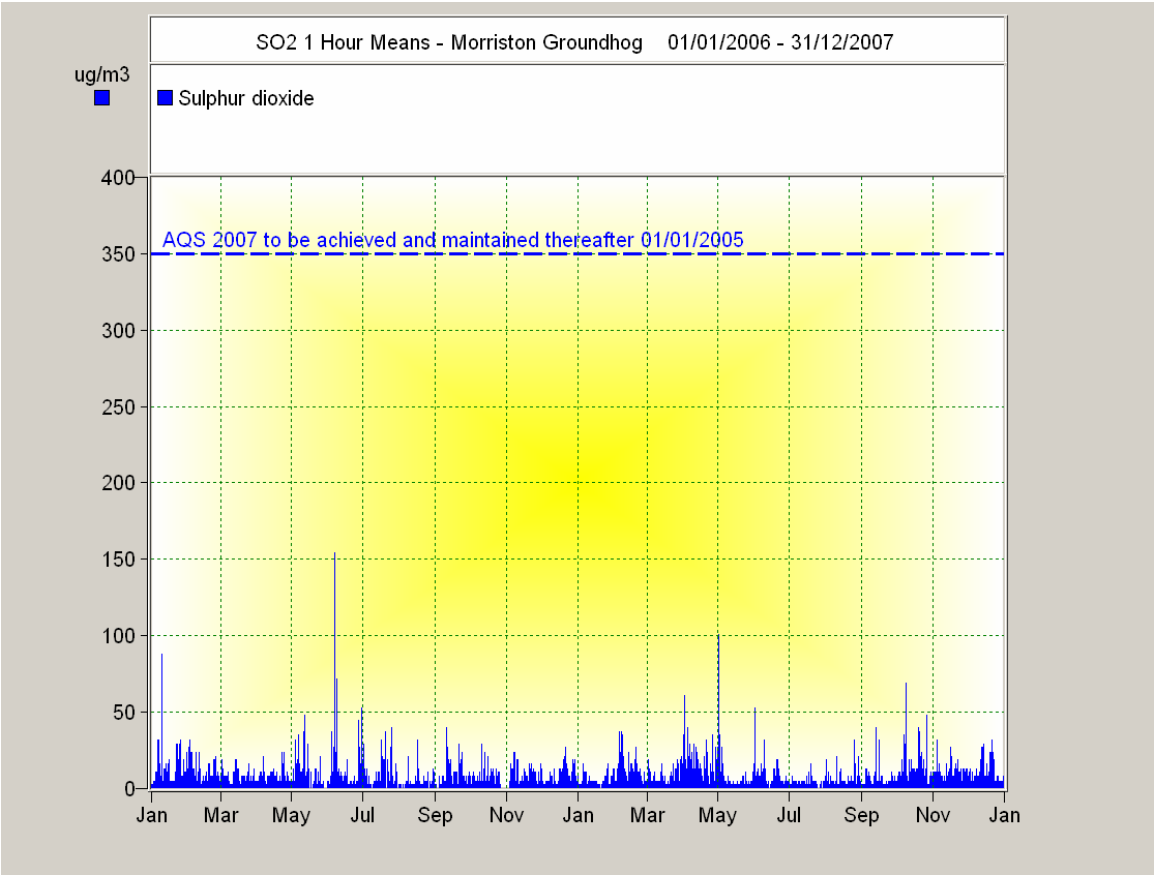


Chart 25 – 1 hourSO_2 means Morriston Groundhog 2006-2007

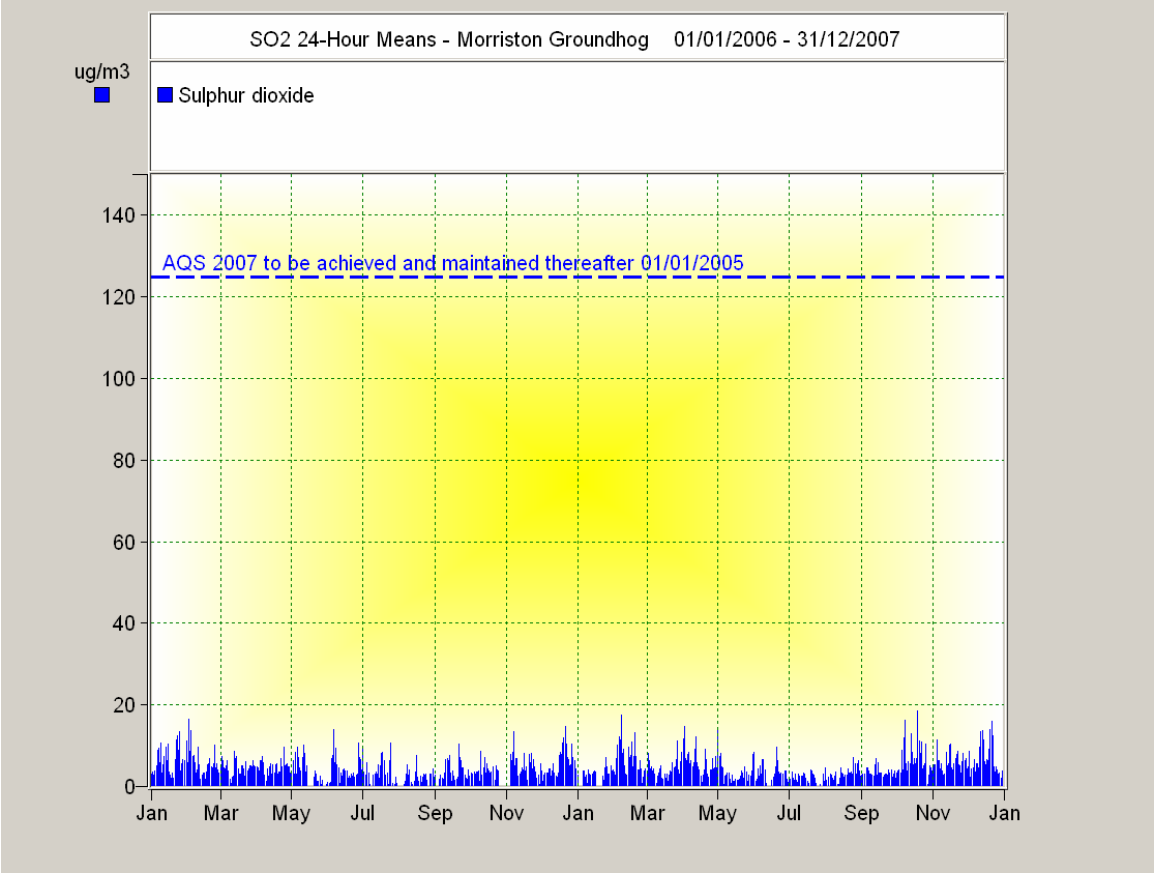
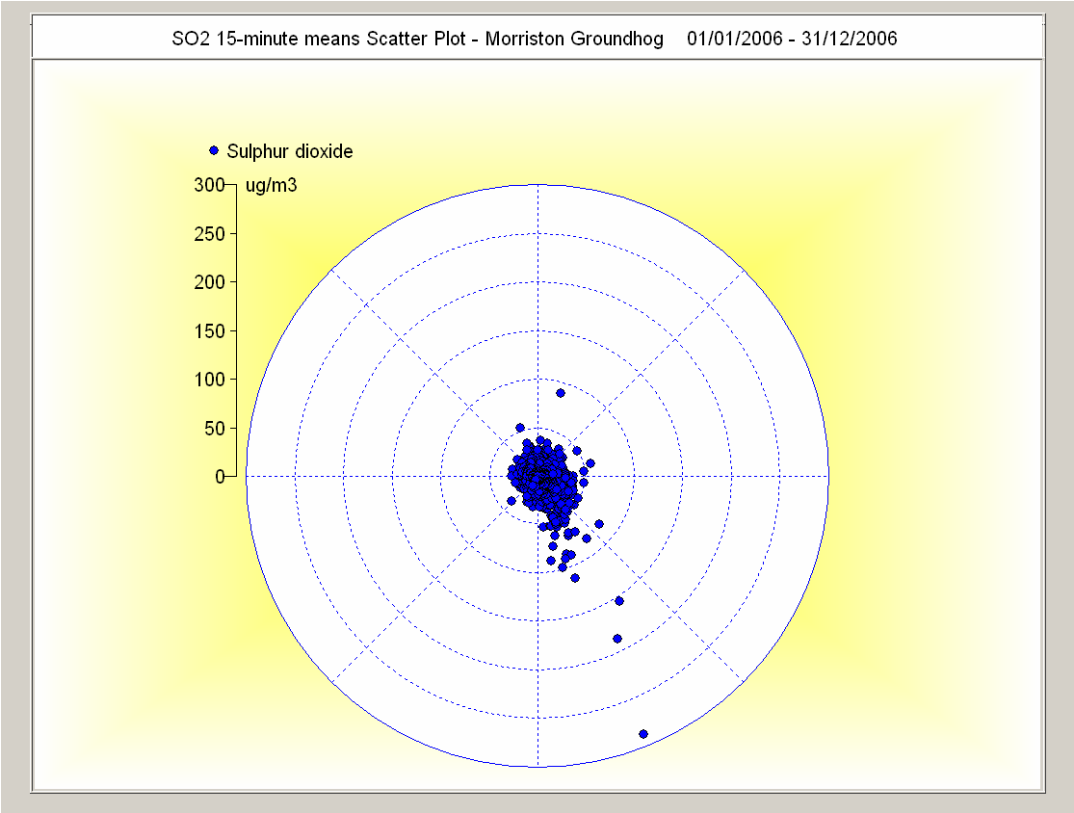


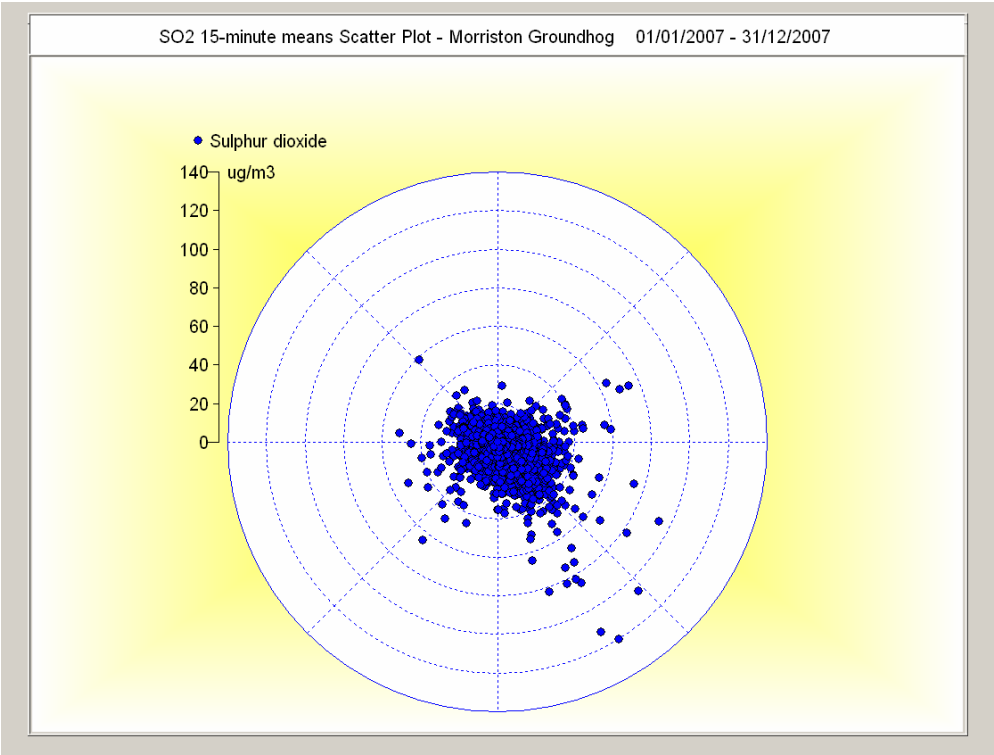
Chart 26 – 24-hour SO_2 means Morriston Groundhog 2006-2007

Scatter plots for 2006 (scatter plot 9) and 2007 (scatter plot 10) are shown below.



Scatter Plot 9 15 minute SO_2 means Morriston Groundhog 2006

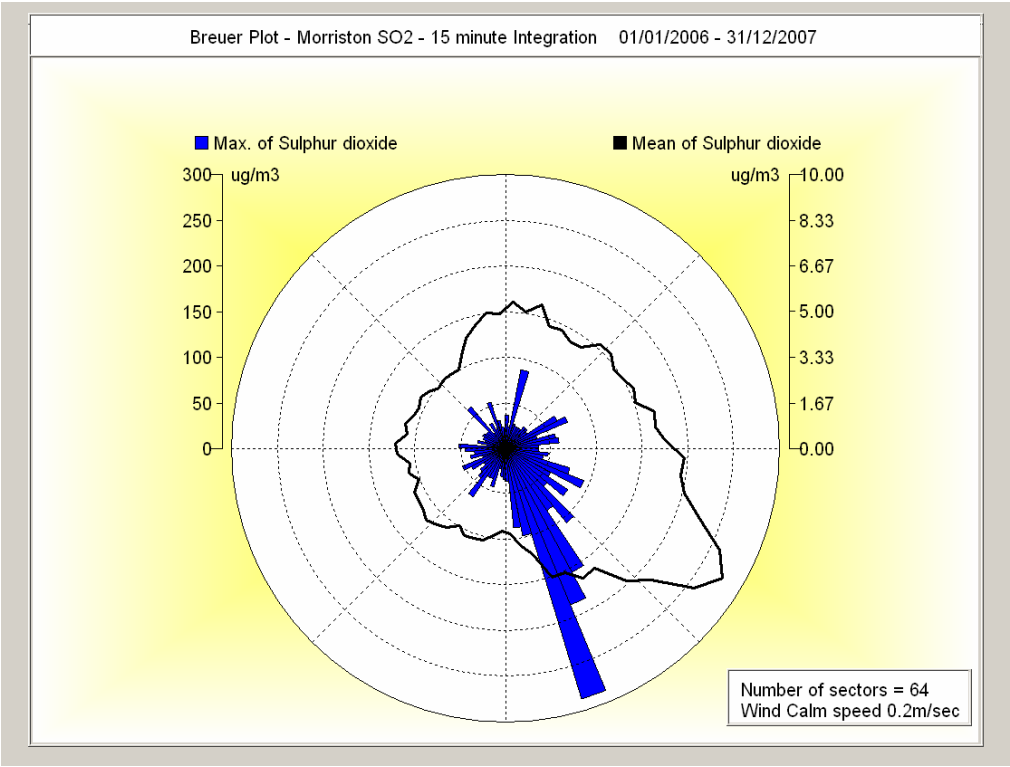
The scatter of the 15-minute means for 2006 is interesting in that it does show yet again the south-easterly source of higher SO_2 concentrations.



Scatter Plot 10 SO_2 15 minute means Morriston Groundhog 2007

These Scatter Plots clearly show and reinforces that elevated concentrations of SO_2 are consistently from this south-easterly sector.

Breuer Plot 5 below serves merely to reinforce the SO_2 source located to the south-east as the primary source of SO_2 concentrations within Swansea. Previous analysis (for 2005) had shown an additional SO_2 source at the Morriston Groundhog as originating from Morganite Electrical Carbon Ltd (See Progress Report 2007). This source is now not as prominent within this dataset, as it is only just possible to see the influence of this source from the north-east sector within the latest analysis.



Breuer Plot 5 – SO_2 concentrations Morriston Groundhog 2006-2007

There is at present, no straightforward way to project forward to future years the number of likely exceedences etc. Compliance with each of the objective values has been calculated from 2001 to 2006 and is presented below as table 30, enabling a brief discussion on SO_2 trends to be made.

Morriston Groundhog	Max 15-Min Mean µg/m^3 (266µg/m^3)	Max 1-hour Mean µg/m^3 (350µg/m^3)	Max 24-Hour Mean µg/m^3 (125µg/m^3)	Annual Mean
2002	122.30 #	72.06 #	24.25#	3.48#
Exceedences	0	0	0	-
2003	189.30	114.27	21.4	3.32
Exceedences	0	0	0	-
2004	98.12	68.02	18.73	3.08
Exceedences	0	0	0	-
2005	84.52	55.34	15.06	3.05
Exceedences	0	0	0	-
2006	270.9	143.8	18.29	3.52
Exceedences	1	0	0	-
2007	120	101	18.5	4.6
Exceedences	0	0	0	-

Table 30 - Morriston Groundhog SO_2 - 2001 - 2006
 # Data capture for 2002 87.31%

As the maximum concentrations recorded within the various averaging periods given above will vary from year to year again, the easiest way to initially assess trends with the SO_2 concentrations is to look at the annual means returned from each of the years under consideration. Again, a similar pattern to that seen at the Morfa Groundhog site is apparent from the data. Accepting that the meteorological conditions prevailing during 2003 and 2006 were atypical, the same analysis has been carried out for 2006 with a similar opinion being formed to that of 2003 in that there was a greater than expected prevalence of south-easterly winds. Whilst these atypical conditions during 2006 have resulted in the only exceedence recorded at the Morriston site, it is clear that SO_2 concentrations at Morriston continue to show an overall reduction trend. All objectives will continue to be met with ease, probably even during periods of atypical meteorology.

3.4.6 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 2006-2007. The objective for ozone is an 8-hour mean not to exceed 100μg/m^3 on more than 10 occasions with a compliance date of 31st December 2005

Measurements are undertaken with an Advanced Pollution Instrumentation (API) real-time NO_x analyser. 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. Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to

calculate the 8-hour means. In order to form a valid 8-hour mean 75% of the hourly means were required to be present i.e. 6 out of every 8.

The results from the monitoring during 2006-2007 are presented below as table 31 and show non-compliance during 2006 with the objective standard.

Morriston Groundhog	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/m^3 (10 permitted)
2006	152.20	98.8 %	15
2007	114	98%	4

Table 31 - Ozone 8-hour means - Morriston Groundhog 2005-2006

A chart of the ozone measurements undertaken during 2005-2006 is given below as chart 27. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

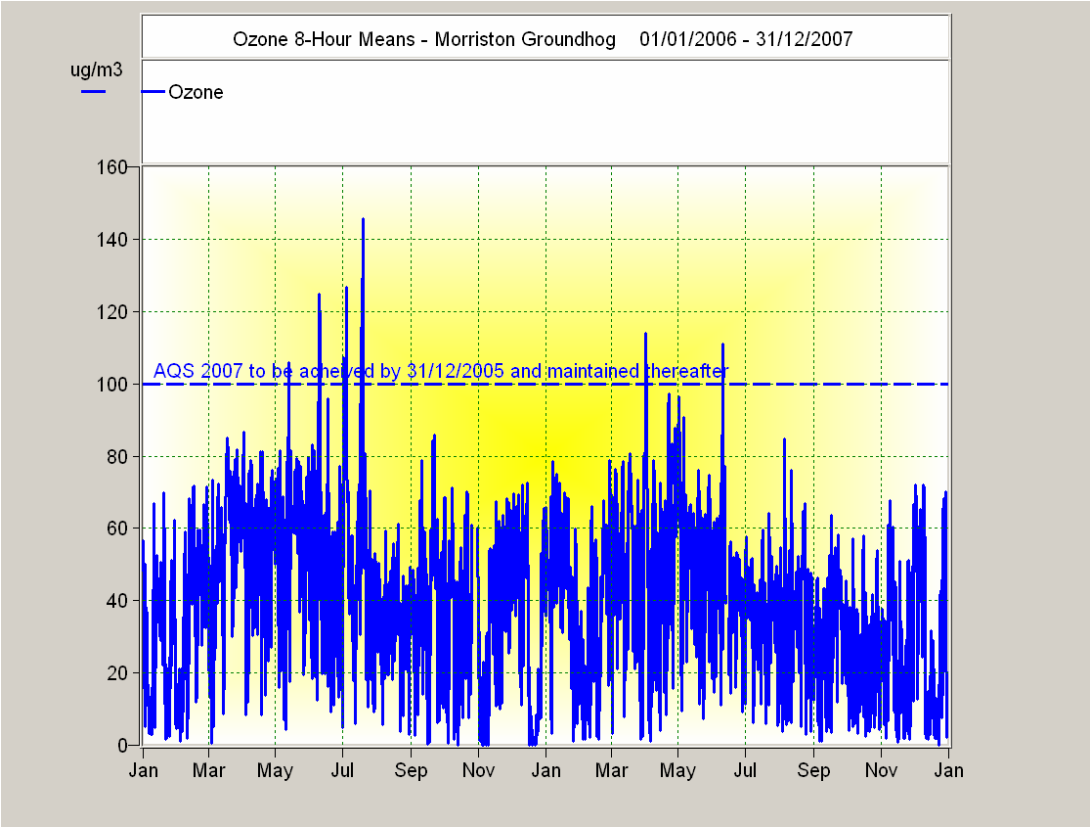


Chart 27 Ozone 8 Hour Means Morriston Groundhog 2006-2007

During 2006, the 15 exceedences occurred at the Morriston Groundhog during 3 distinct periods: 9th - 10th June, 1st - 4th July and the 17th - 19th July 2006. In order to determine if these elevated levels were due to local circumstances or part of a much wider regional episode, ratified and verified data has been downloaded from the Air Quality Archive for the Cardiff and Neath Port Talbot AUN Stations and imported into the Enviman databases.

Chart 28 below details the above periods from 4 monitoring stations namely Morriston, Swansea AURN, Neath Port Talbot AURN and Cardiff AURN. It is evident that elevated levels were recorded during the periods mentioned at all monitoring sites and that the exceedences monitored at Morriston were part of much wider regional episodes. The general assumption is that NO_x precursors to an ozone episode would emanate from Eastern Europe. Data within chart 28 would tend to support this with wind directions between approx 70° - 160° indication corresponding 8 hour mean ozone exceedences, but, additionally within chart 15 is evidence that ozone exceedences were observed during wind directions from within the 260° - 350° range.

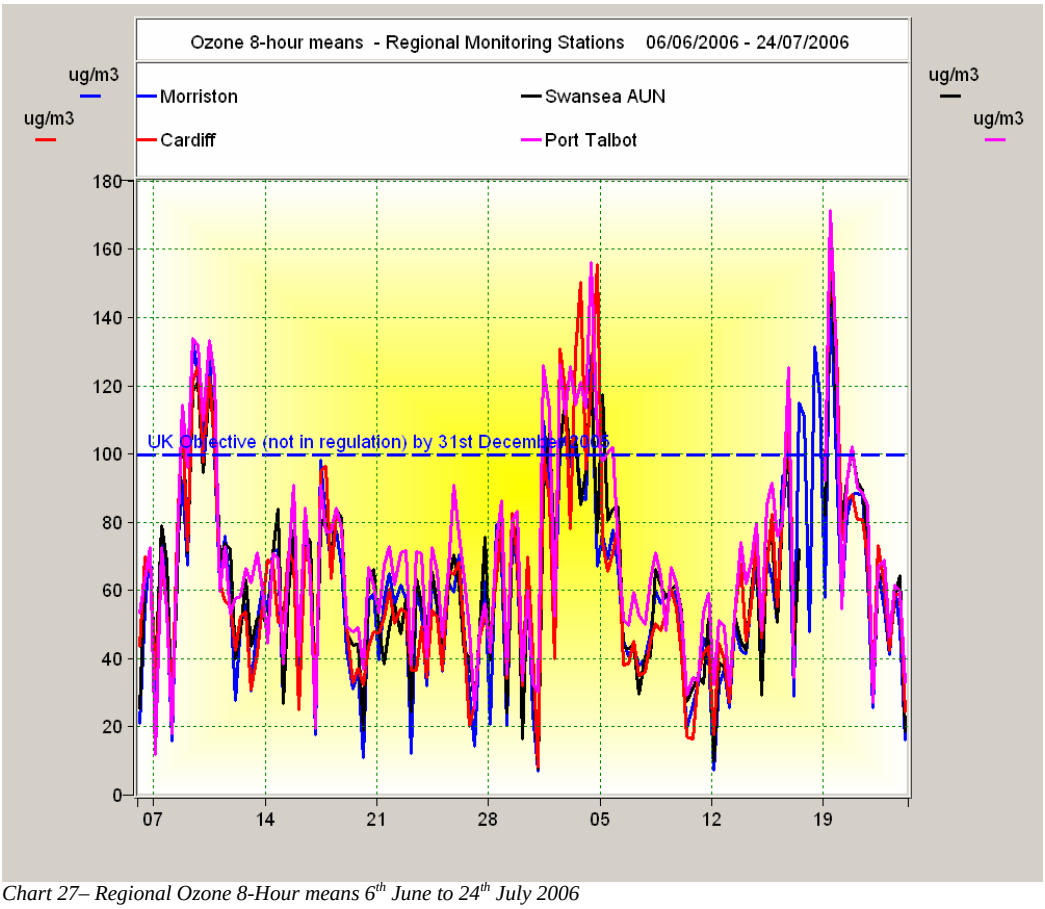


Chart 27– Regional Ozone 8-Hour means 6th June to 24th July 2006

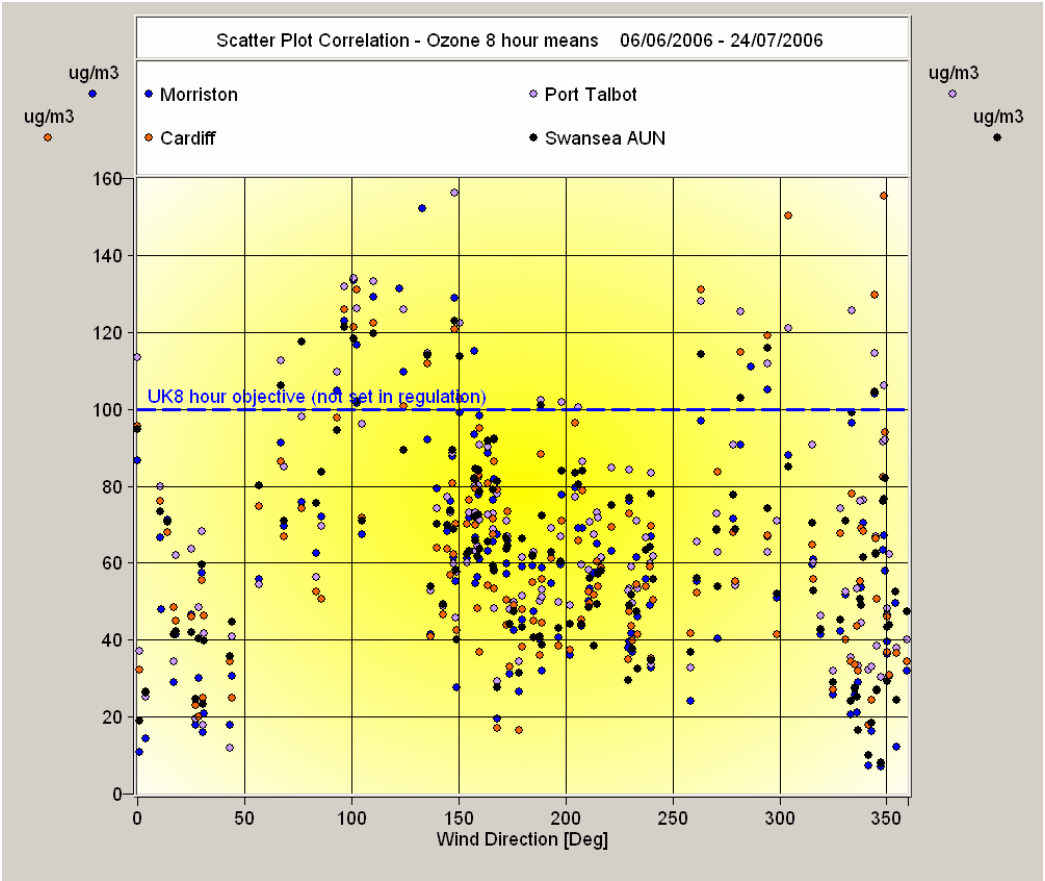
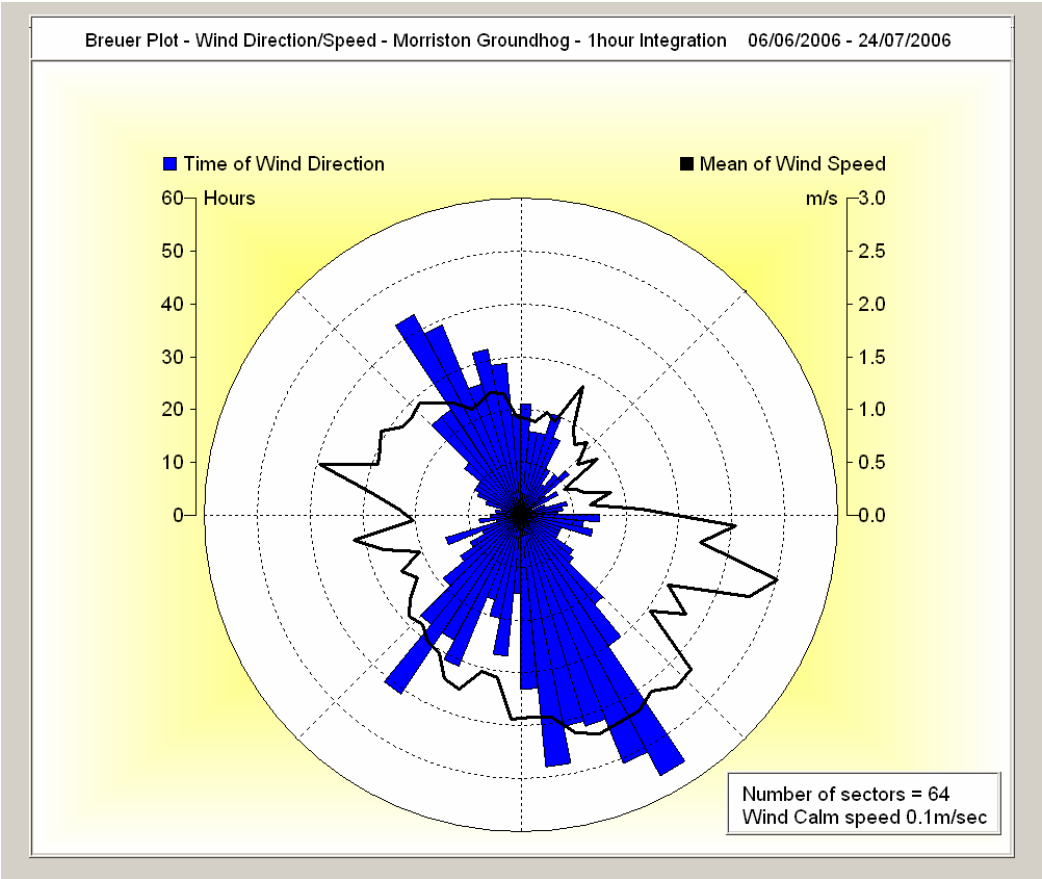


Chart 28 Scatter Plot Correlation 8 Hour Ozone Means 6th June to 24th July 2006



Breuer Plot 6 – Wind Direction Morriston Groundhog 6th June – 24th July 2006

A Breuer Plot for the period 6th June – 24th July 2006 is shown above as Breuer Plot 6. Breuer Plot 6 shows 3 distinct periods where the wind direction was from a north-westerly direction, a south-westerly and a south-easterly direction. The period 9th - 10th June, was predominantly from a south-easterly direction. The period 1st - 4th July was predominantly from a north-westerly with a small element of a south-easterly direction with the period 17th - 19th July 2006 being predominantly from a south-easterly with a small period of north-westerly winds. An indication of the period of time in hours where the wind was within the above directions is given within Breuer Plot 6. Despite there being an intervening significant period of south-westerly winds, chart 28 above indicates as expected, that this direction does not result in elevated ozone levels as the fetch is from a relatively clean air mass within the Irish Sea and beyond.

Critically for the above periods there were dates where data was absent from the analysis. This mainly spanned the last period between 17th- 19th July for the Swansea AUN, Neath Port Talbot and Cardiff AUN sites. The Swansea AUN was being audited by AEA Energy and Environment on the 10th July between 11:00 to 14:00 hours with Neath Port Talbot being audited on the same day between 07:00 and 09:00 hours. The Cardiff station appears to have been audited on the 12th July between 08:00 – 10:00hrs. All 3 stations had their 6 monthly service and calibration checks by respective equipment support contractors during the 17th - 19th July with all services being complete by 12:00 hrs on the 19th July.

3.4.7 Hydrogen Sulphide (H_2S)

There are some local industrial emissions sources of H_2S within the Enterprise Zone. These discharges are to both air and water. Odour complaints from local businesses have been received in the past by the authority resulting from the discharges into the main foul sewerage system. However, the more predominant local source is from vehicles fitted with catalytic converters.

The Expert Panel on Air Quality has not published any regulatory standards and the World Health Organisation does not propose a health-based guideline value, although there are very clear health risks to exposure above odour threshold. European Directive 80/778/EEC requires that hydrogen sulphide should be undetectable organoleptically. Results from the 2006-2007 monitoring are presented below as chart 29. Data from the 1st July 2007 to 31st December 2007 remains provisional at this stage.

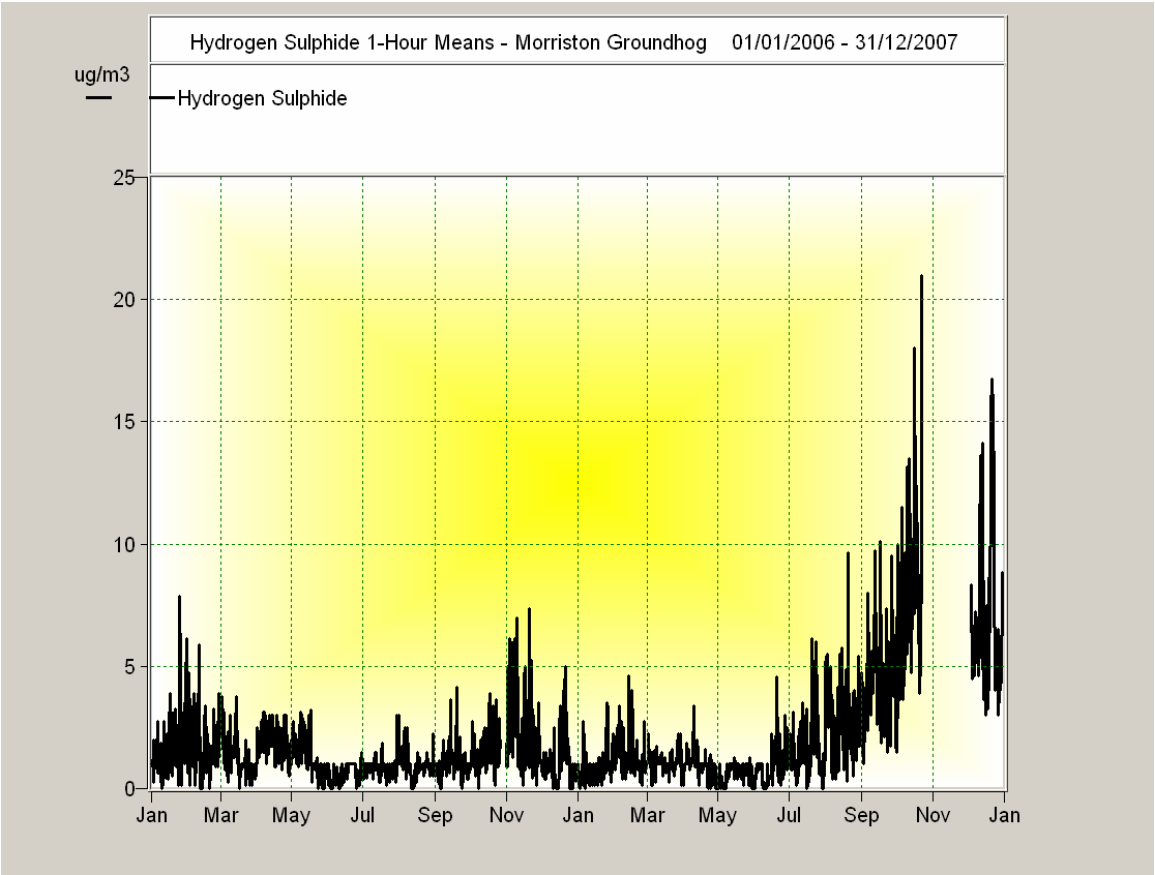


Chart 29 Hydrogen Sulphide 1-hour means 2006-2007 Morriston Groundhog

3.5 St.Thomas DOAS, Pentreguinea Road

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 has an annual average daily traffic flow (AADT) of approximately 22,500 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 (see Sec 7 action point 10).

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 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 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 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 existing Hafod Air Quality Management Area. The extent of the existing order can be seen within map 6.

Quay Parade Bridges are to the south of this location. Congestion extends from Quay Parade bridges up Pentreguinea Road with congestion being seen as far north as the Morfa Shopping Parc in Landore. There are numerous dwellings located along this section of Pentreguinea Road with an application already received for residential development on the former St.Thomas Station Yard Site located between Pentreguinea Road and the River Tawe (see map 6 below and see sec 6.3.2). An application for formal planning consent was received during 2005 but was rejected due to the intensity of the development. A modified scheme will be resubmitted shortly to include an element of social housing as a result of the appeal process. The WAG Planning Panel are yet to issue its formal decision.

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

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

measurements permitted on the individual cycled means for 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 280-meter measurement path and not a "point measurement" as seen within other "traditional or conventional" monitoring equipment/locations. It should also be noted that the DOAS methodology of monitoring does not comply with the EU Directive methods of measurement (chemiluminescent for NO_2, UV fluorescence for SO_2 etc) at present but the system has recently achieved MCERTS certification and TUV certification.

3.5.1 Nitrogen Dioxide

Data capture commenced on the 12th September 2005. Data from 2006 and 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 32. A chart of the data can be seen below as

chart 30. Data capture for 2006 is 94.8% and for 2007 is 98.6% allowing direct compilation of the exceedence statistics[48].

St Thomas DOAS					
Annual Mean (40µg/m^3)		Max 1-hour (200µg/m^3)		Exceedences of 1-hour std (18 permitted)	
2006	2007	2006	2007	2006	2007
44.6	37	158	165.5	0	0

Table 32 -St Thomas DOAS – NO_2 1-hour data 2006-2007

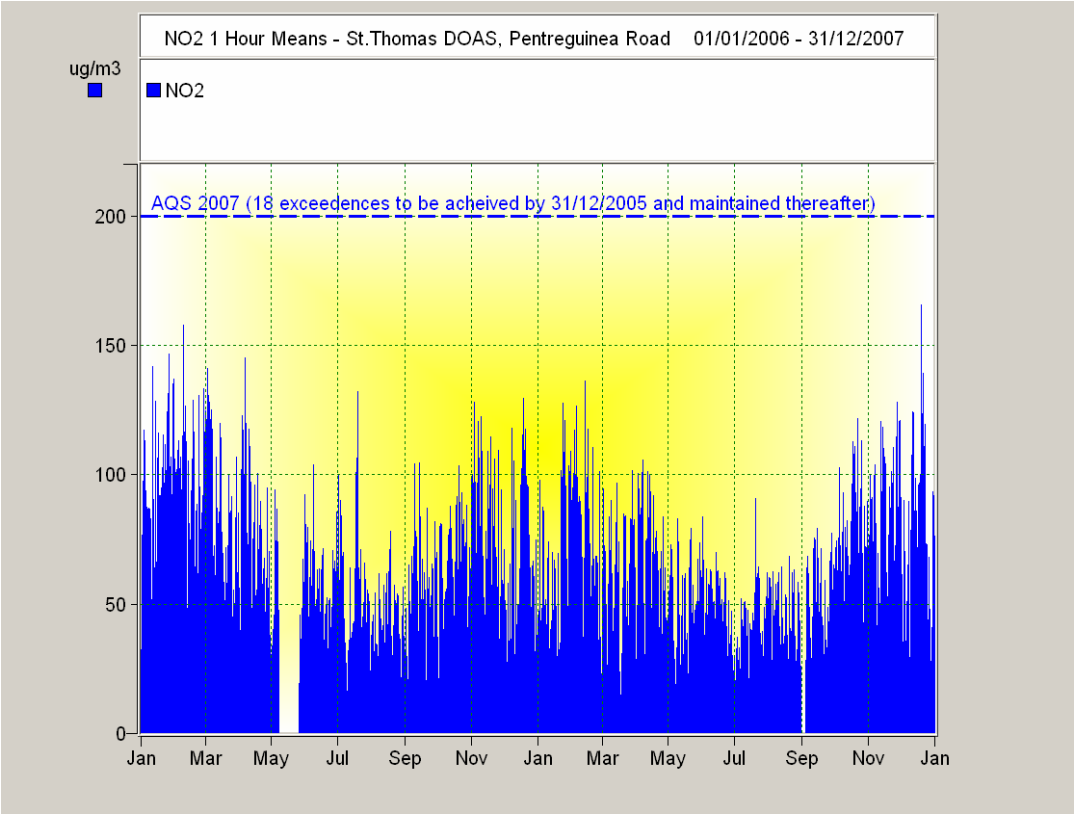


Chart 30 St.Thomas DOAS NO_2 1 hour means 2006-2007

As can be seen within table 32 above, the annual mean exceeded the 40µg/m^3 standard during 2006 and was in reality was also close to exceedence during 2007. Part of the open path of 280m borders the existing Hafod Air Quality Management Area. In light of these results, it is proposed to amend the boundary of the existing Hafod Air Quality Management Area.

[48] LAQM TG(03) box 6.2 page 6-16

3.5.2 Sulphur Dioxide

Data capture commenced on the 12th September 2005. Data from 2006 and 2007 has been analysed for each of the objectives averaging periods and the results are presented below within table 33.

Charts of the data can be seen below, within chart 31 (15 minute means), chart 32 (1-hour means) and chart 33 (24-hour means). Data capture for 2006 is 93.6% and for 2007 is 91.2 % allowing direct compilation of the exceedence statistics[49].

St.Thomas DOAS	Max 15-Min Mean μg/m^3 (266μg/m^3)	Max 1-hour Mean μg/m^3 (350μg/m^3)	Max 24-Hour Mean μg/m^3 (125μg/m^3)
2006	266.46	138.5	34.6
Exceedences	1	0	0
Date of Max	29/06/2006	09/01/2006	23/01/2006
Time of Max	09:45	11:00	-
Wind Direction @ Max conc.	177°	80°	68°
2007	162.2	85.4	36
Exceedences	0	0	0
Date of Max	12/04/2007	14/12/2007	14/12/2007
Time of Max	14:45	12:00	-
Wind Direction @ Max conc.	175°	76°	68°

Table 33 St.Thomas DOAS SO_2 measurements 2006-2007

There was one exceedence of the 15-minute objective during 2006. All objectives have been met and it is anticipated that they will continue to be met.

Scatter Plot 11 below confirms that maximum concentrations emanate from an easterly direction.

[49] *Technical Guidance LAQM.TG(03) page 7-7 box 7.2*

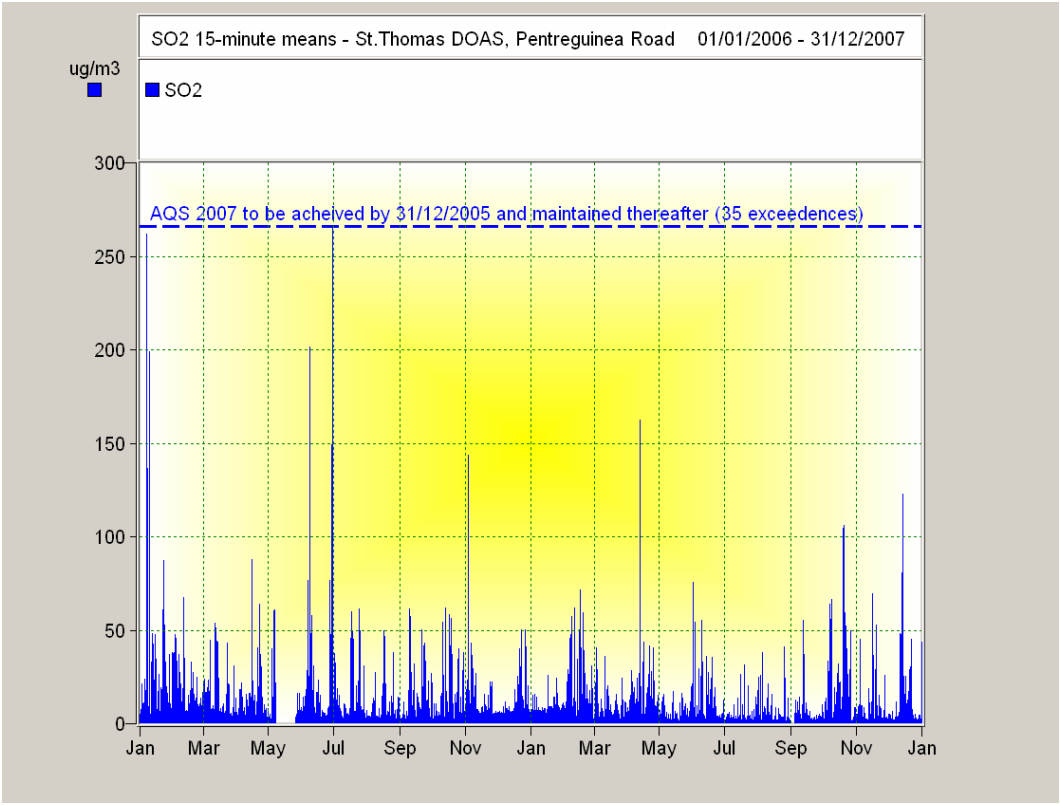


Chart 31 St.Thomas DOAS 15-minute SO_2 means 2006-2007

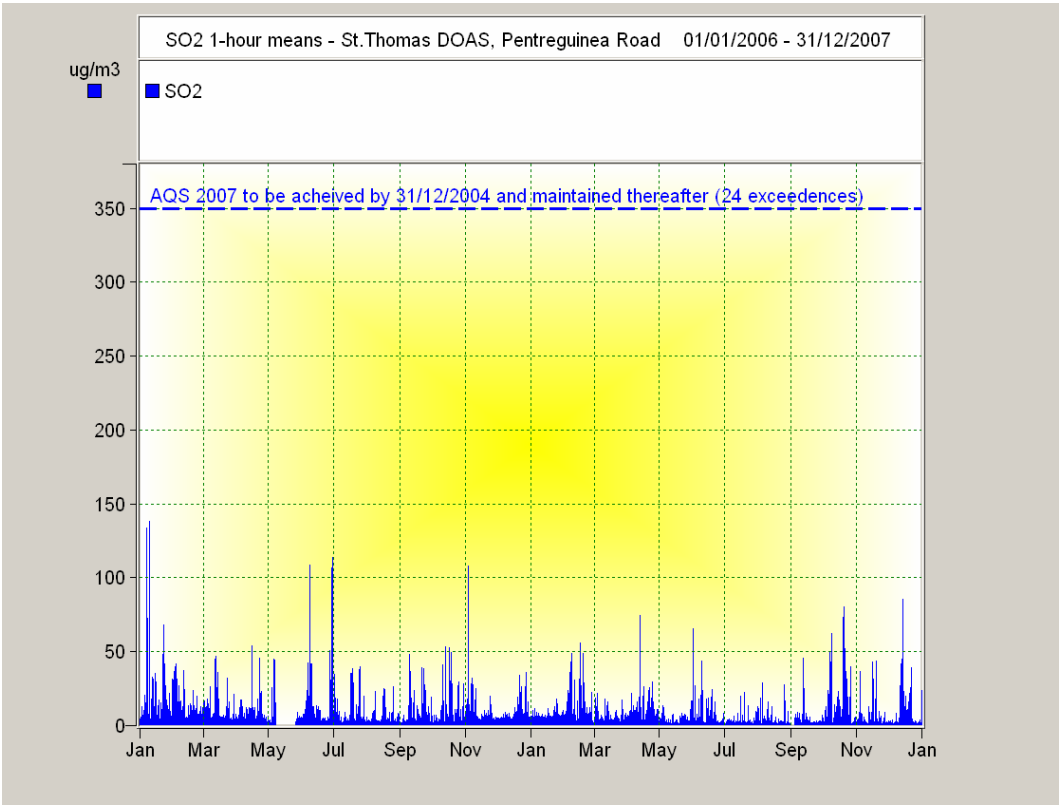


Chart 32 St.Thomas DOAS 1-hour SO_2 means 2006-2007

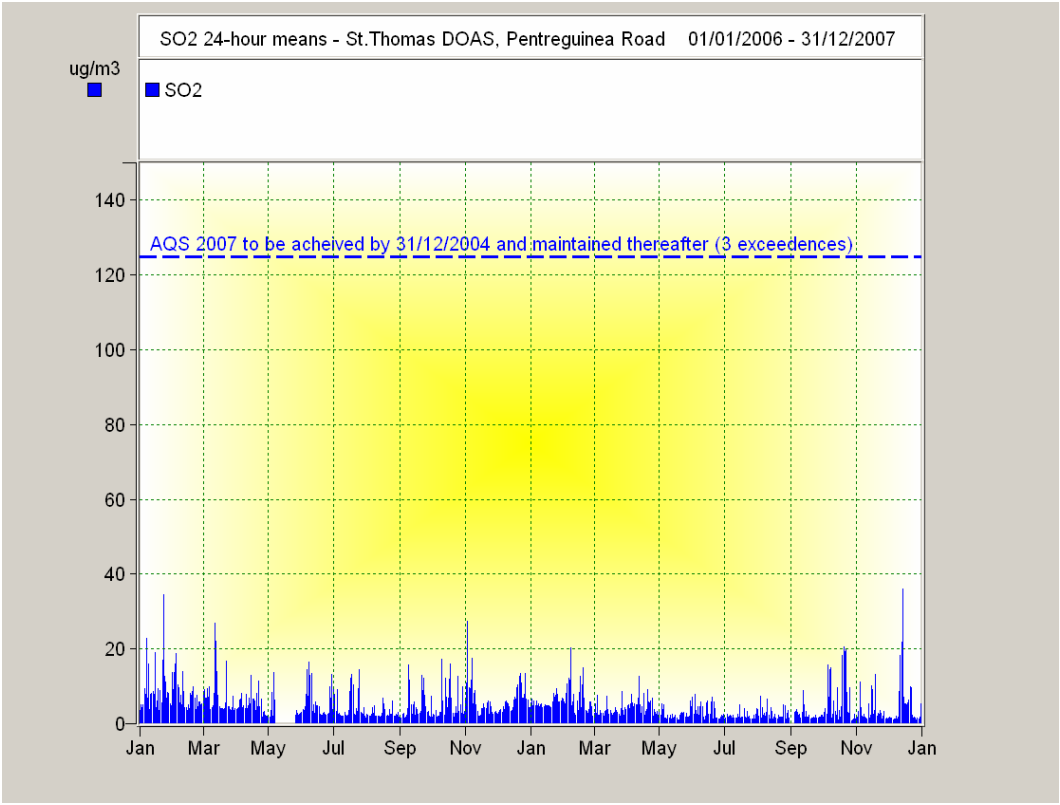
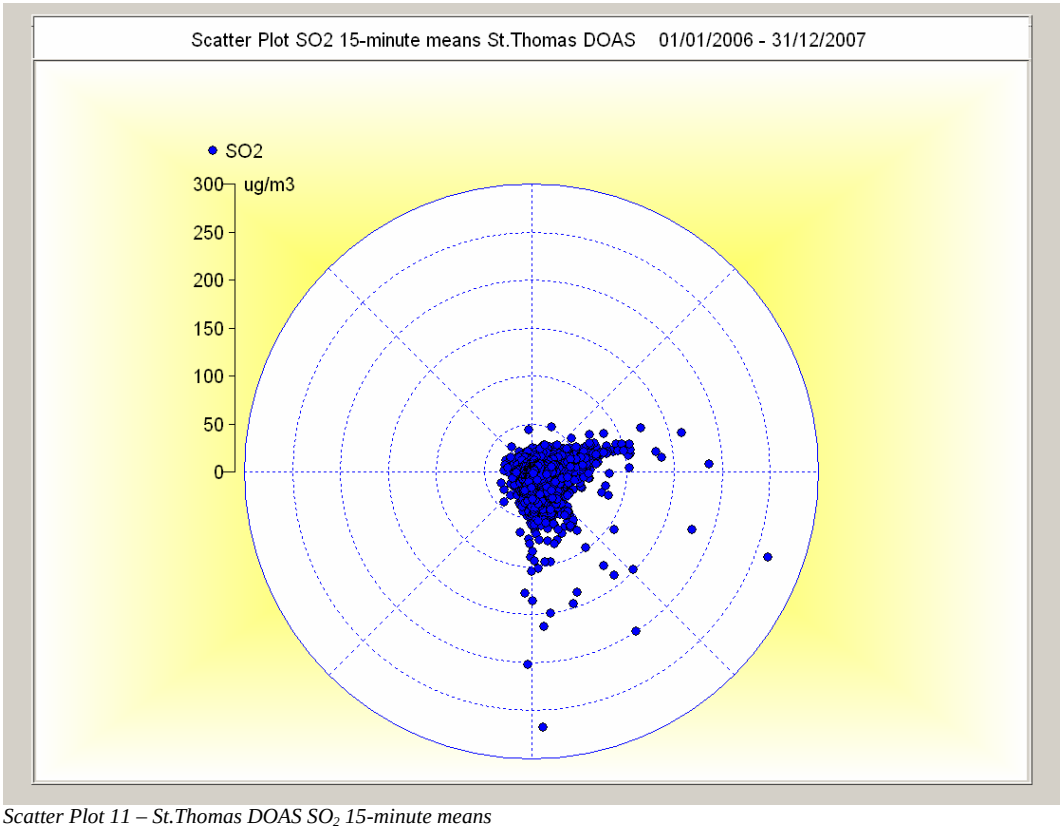


Chart 33 St.Thomas DOAS 24-hour SO_2 means 2006-2007



Scatter Plot 11 – St.Thomas DOAS SO_2 15-minute means

3.5.3 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 2006 - 2007. The Air Quality Strategy 2007 objective for ozone is an 8-hour mean not to exceed 100µg/m^3 on more than 10 occasions with a compliance date of 31st December 2005.

The results from the monitoring during 2006-2007 are presented below as table 34 and show non-compliance during 2006 with the objective standard. Whilst 2007 saw the maximum permitted number of exceedences of ten, the fact that the number of exceedences was not much higher can, in all probability, be put down to the poor summer weather. A chart of the data is given below as chart 34.

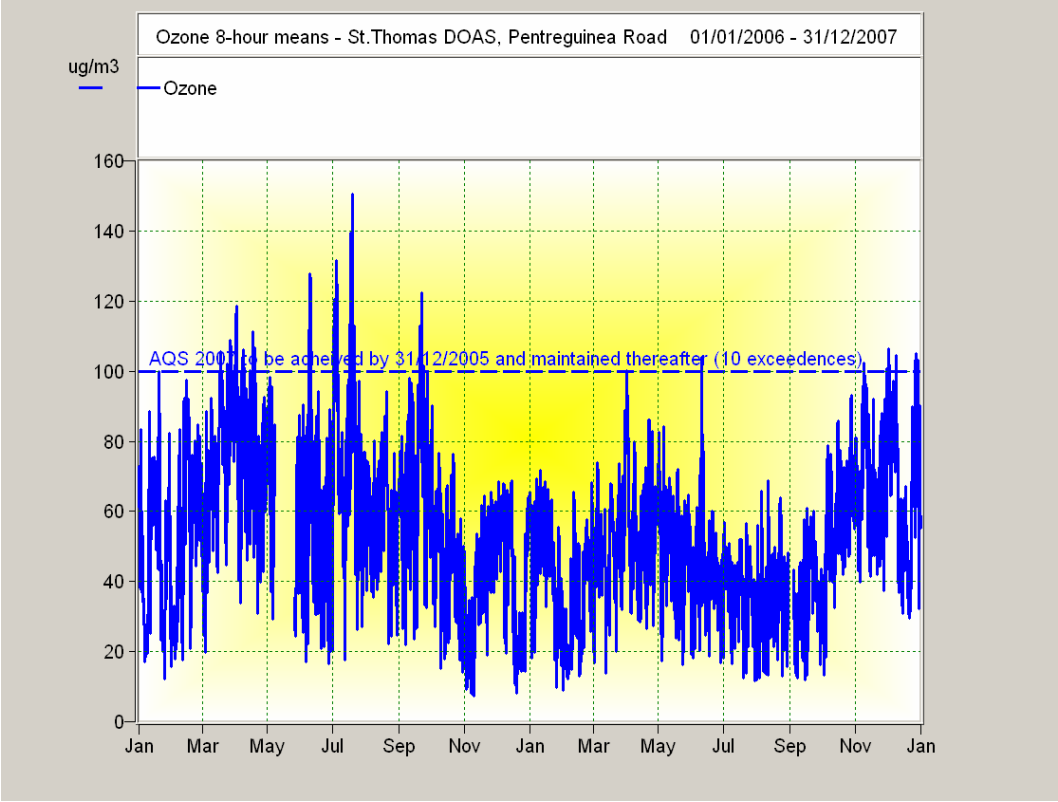


Chart 34 St.Thomas DOAS 8-hour Ozone means 2006-2007

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

Table34 – St Thomas DOAS Ozone 8-hour means 2006-2007

4 Non Automatic Monitoring Data – Passive Nitrogen Dioxide Diffusion Tubes

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

This contract laboratory has been operating for over 18 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 issue 11. All tubes are prepared by spiking acetone:triethanolamine (50:50) onto grids prior to the tubes being assembled. The tubes were desorbed with distilled water and the extract analysed using a segmented flow autoanalyser with ultraviolet detection.

4.1 Deriving a local bias corrector factor for Swansea

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 as such tri located diffusion tubes were located on the sample intake at each of the authority's chemiluminescent analyser sites at the Swansea Roadside AURN, Morfa and Morriston Groundhog sites between 3rd January 2007 and 4th January 2008. This survey has been extended and will operate for the whole of 2008 to compare the yearly derived bias factor between 2007 and 2008 to establish if a bias correction factor is required year on year. This co-location work would appear to be required to be repeated yearly given the advice within section 6.3.1 of the report prepared by AEA Energy and Environment on behalf of DEFRA and the Devolved Administrations: NO_2 Diffusion Tubes for LAQM: Guidance note for Local Authorities[50]. Whilst the bias correction factor(s) that have been derived for Swansea would appear to be valid only for the correction of diffusion tubes exposed during 2007, there is little alternative available at present but to use the 2007 bias correction factor for those diffusion tubes exposed during 2006.

The authority had raised concerns over the use of the "national bias factor" as suggested in the relevant guidance in place of the laboratory derived factor. This situation has been discussed in greater detail in both the Detailed Assessment Report dated December 2005 and the Supplementary Detailed Assessment Reports dated April 2006 produced by the authority.

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

The results of the tri-location studies are provided below. The NO_x chemiluminescent analyser data from the Morfa and Morriston Groundhog stations has been rescaled and ratified by the QA/QC procedures undertaken by the authority. Ratified data has been obtained for the Swansea Roadside AURN via the UK Air Quality Archive at
http://www.airquality.co.uk/archive/flat_files.php?site_id=SWA1&zone_id=9
AEA Energy and Environment undertake the QA/QC work on behalf of DEFRA at this site.

4.1.1 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[51] to determine tube bias as well as checking the accuracy and precision of the diffusion tube measurements. The results can be seen below.

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

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	03/01/2007	31/01/2007	28.0	33.0	30.3	30	2.5	8	6.2	23.49	89.1	Good	Good
2	31/01/2007	05/03/2007	53.8	50.8	48.2	51	2.8	6	7.0	40.8	96.58	Good	Good
3	05/03/2007	04/04/2007	32	30.5	31.4	31	0.8	2	1.9	30.31	96.7	Good	Good
4	04/04/2007	04/05/2007	26	36.9	33.5	32	5.6	17	13.9	39.59	95.79	Good	Good
5	04/05/2007	30/05/2007	26.2	24.2	24	25	1.2	5	3.0	21	96.98	Good	Good
6	30/05/2007	04/07/2007	56.9	43.7	39.5	47	9.1	19	22.6	28	97.22	Good	Good
7	04/07/2007	31/07/2007	22.3	25	26.5	25	2.1	9	5.3	20	89.85	Good	Good
8	31/07/2007	24/08/2007	26.7	22	22	24	2.7	12	6.7	19	97.31	Good	Good
9	24/08/2007	02/10/2007	29.9	29.1	28.9	29	0.5	2	1.3	22	96.7	Good	Good
10	02/10/2007	01/11/2007	54.8	52.4	42.8	50	6.3	13	15.8	43	93.48	Good	Good
11	01/11/2007	27/11/2007	45.2	51.2	42.5	46	4.5	10	11.1	37.39	95.26	Good	Good
12	27/11/2007	04/01/2008	45.3	51.4	54.1	50	4.5	9	11.2	39.84	94.44	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

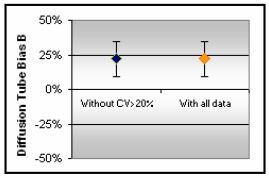
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Swansea AUN Roadside

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	0.83 (0.75 - 0.93)
Bias B	20% (8% - 33%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	9
Automatic Mean:	30 μgm^{-3}
Data Capture for periods used:	95%
Adjusted Tubes Mean:	30 (28 - 34) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.83 (0.75 - 0.93)
Bias B	20% (8% - 33%)
Diffusion Tubes Mean:	37 μgm^{-3}
Mean CV (Precision):	9
Automatic Mean:	30 μgm^{-3}
Data Capture for periods used:	95%
Adjusted Tubes Mean:	30 (28 - 34) μgm^{-3}



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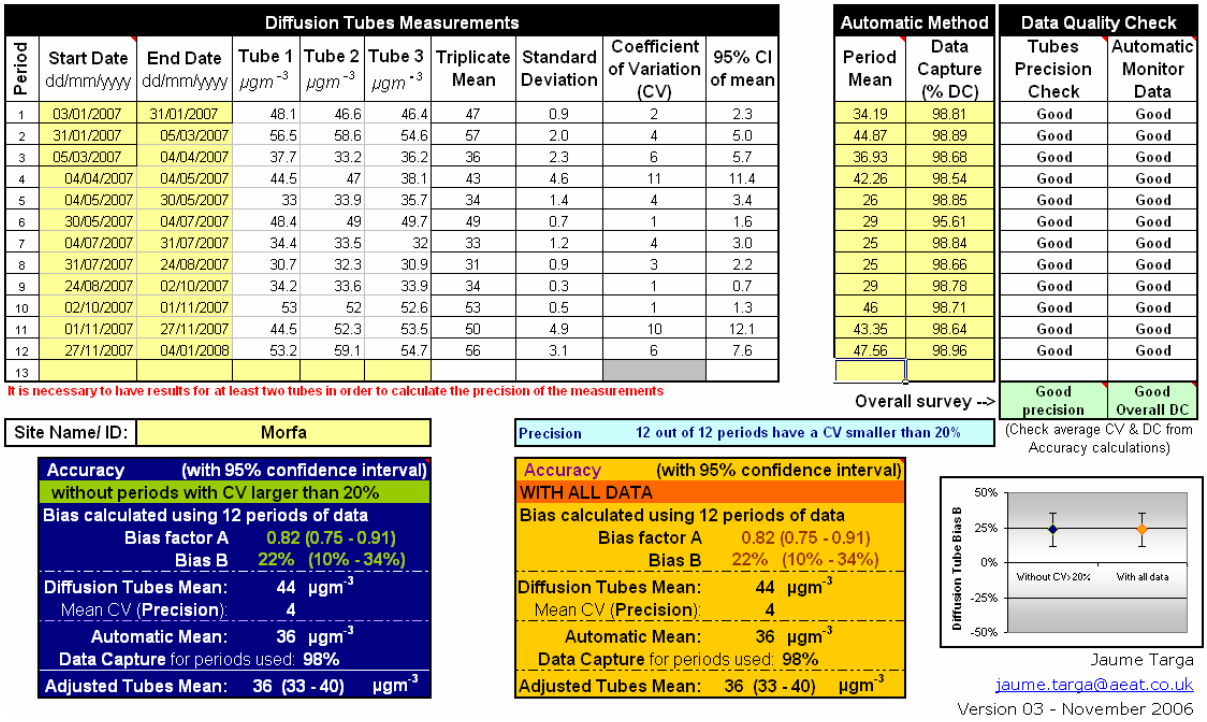
Bias correction factor 1 – Swansea Roadside AURN

The derived bias correction factor of 0.83 (0.75-0.93) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 20% (8% - 33%)

4.1.2 Morfa Groundhog 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[52] to determine tube bias as well as checking the accuracy and precision of the diffusion tube measurements. The results can be seen below.

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



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	03/01/2007	31/01/2007	48.1	46.6	46.4	47	0.9	2	2.3	34.19	98.81	Good	Good
2	31/01/2007	05/03/2007	56.5	58.6	54.6	57	2.0	4	5.0	44.87	98.89	Good	Good
3	05/03/2007	04/04/2007	37.7	33.2	36.2	36	2.3	6	5.7	36.93	98.68	Good	Good
4	04/04/2007	04/05/2007	44.5	47	38.1	43	4.6	11	11.4	42.26	98.54	Good	Good
5	04/05/2007	30/05/2007	33	33.9	35.7	34	1.4	4	3.4	26	98.85	Good	Good
6	30/05/2007	04/07/2007	48.4	49	49.7	49	0.7	1	1.6	29	95.61	Good	Good
7	04/07/2007	31/07/2007	34.4	33.5	32	33	1.2	4	3.0	25	98.84	Good	Good
8	31/07/2007	24/08/2007	30.7	32.3	30.9	31	0.9	3	2.2	25	98.66	Good	Good
9	24/08/2007	02/10/2007	34.2	33.6	33.9	34	0.3	1	0.7	29	98.78	Good	Good
10	02/10/2007	01/11/2007	53	52	52.6	53	0.5	1	1.3	46	98.71	Good	Good
11	01/11/2007	27/11/2007	44.5	52.3	53.5	50	4.9	10	12.1	43.35	98.64	Good	Good
12	27/11/2007	04/01/2008	53.2	59.1	54.7	56	3.1	6	7.6	47.56	98.96	Good	Good
13													
										Overall survey -->		Good precision	Good Overall DC

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

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Morfa

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	0.82 (0.75 - 0.91)
Bias B	22% (10% - 34%)
Diffusion Tubes Mean:	44 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	36 (33 - 40) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.82 (0.75 - 0.91)
Bias B	22% (10% - 34%)
Diffusion Tubes Mean:	44 μgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	36 (33 - 40) μgm^{-3}

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Bias correction factor 2 – Morfa Groundhog

The derived bias correction factor of 0.82 (0.85-0.91) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 22% (10% - 34%).

4.1.3 Morriston Groundhog 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[53] to determine tube bias as well as checking the accuracy and precision of the diffusion tube measurements. The results can be seen below.

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

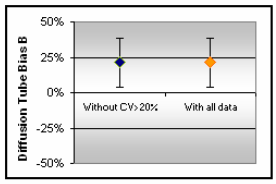
Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	03/01/2007	31/01/2007	45.4	38.8	40.8	42	3.4	8	8.4	46.82	94.53	Good	Good
2	31/01/2007	05/03/2007	48.4	49.4	41.4	46	4.4	9	10.8	55.37	97.72	Good	Good
3	05/03/2007	04/04/2007	40.6	34.2	38.8	38	3.3	9	8.2	36.74	97.25	Good	Good
4	04/04/2007	04/05/2007	39.8	39.1	40.8	40	0.9	2	2.1	35.89	97.33	Good	Good
5	04/05/2007	30/05/2007	31.9	31.6	33.1	32	0.8	2	2.0	21	97.33	Good	Good
6	30/05/2007	04/07/2007	40.3	41.4	42.4	41	1.1	3	2.6	23	88.89	Good	Good
7	04/07/2007	31/07/2007	27.4	29.4	24.2	27	2.6	10	6.5	24	97.68	Good	Good
8	31/07/2007	24/08/2007	35.2	35.1	32.7	34	1.4	4	3.5	25	97.52	Good	Good
9	24/08/2007	02/10/2007	38.4	37.6	39	38	0.7	2	1.7	28	96.38	Good	Good
10	02/10/2007	01/11/2007	50.4	48.5	47	49	1.7	4	4.2	49	97.53	Good	Good
11	01/11/2007	27/11/2007	57.9	51.5	63.5	58	6.0	10	14.9	46.79	97.67	Good	Good
12	27/11/2007	04/01/2008	49.8	51.4	56.3	53	3.4	6	8.4	41.72	97.73	Good	Good
13													
It is necessary to have results for at least two tubes in order to calculate the precision of the measurements										Overall survey -->		Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Morriston
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	0.87 (0.76 - 1.02)
Bias B	15% (-2% - 32%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	96%
Adjusted Tubes Mean:	36 (32 - 42) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.87 (0.76 - 1.02)
Bias B	15% (-2% - 32%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	96%
Adjusted Tubes Mean:	36 (32 - 42) μgm^{-3}



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Bias correction factor 3 – Morriston groundhog

The derived bias correction factor of 0.87 (0.76-1.02) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 15% (-2% - 32%).

4.1.4 Final Swansea Bias Correction factor for 2007

As can be seen from 4.1.1 – 4.1.3 above, there are a range of bias factors that have been determined following the co-location studies undertaken during 2007. These factors range from 0.82 – 0.87.

An enquiry has been made to the Review and Assessment helpdesk as to what factor should be used for Swansea given the range obtained from the tri-location studies mentioned above. The advice received was to use the bias adjustment

factor that was able to be justified – this could either be the mean of the results (0.84) or the worse case (0.87). In light of this advice, the mean bias correction factor of 0.84 will be used, as well as an indication of "worse case" by use of the 0.87 bias factor. It is felt that this approach will provide the best possible view of the likely outcomes.

4.2 UK Non-Automatic (NO_2) Network Sites

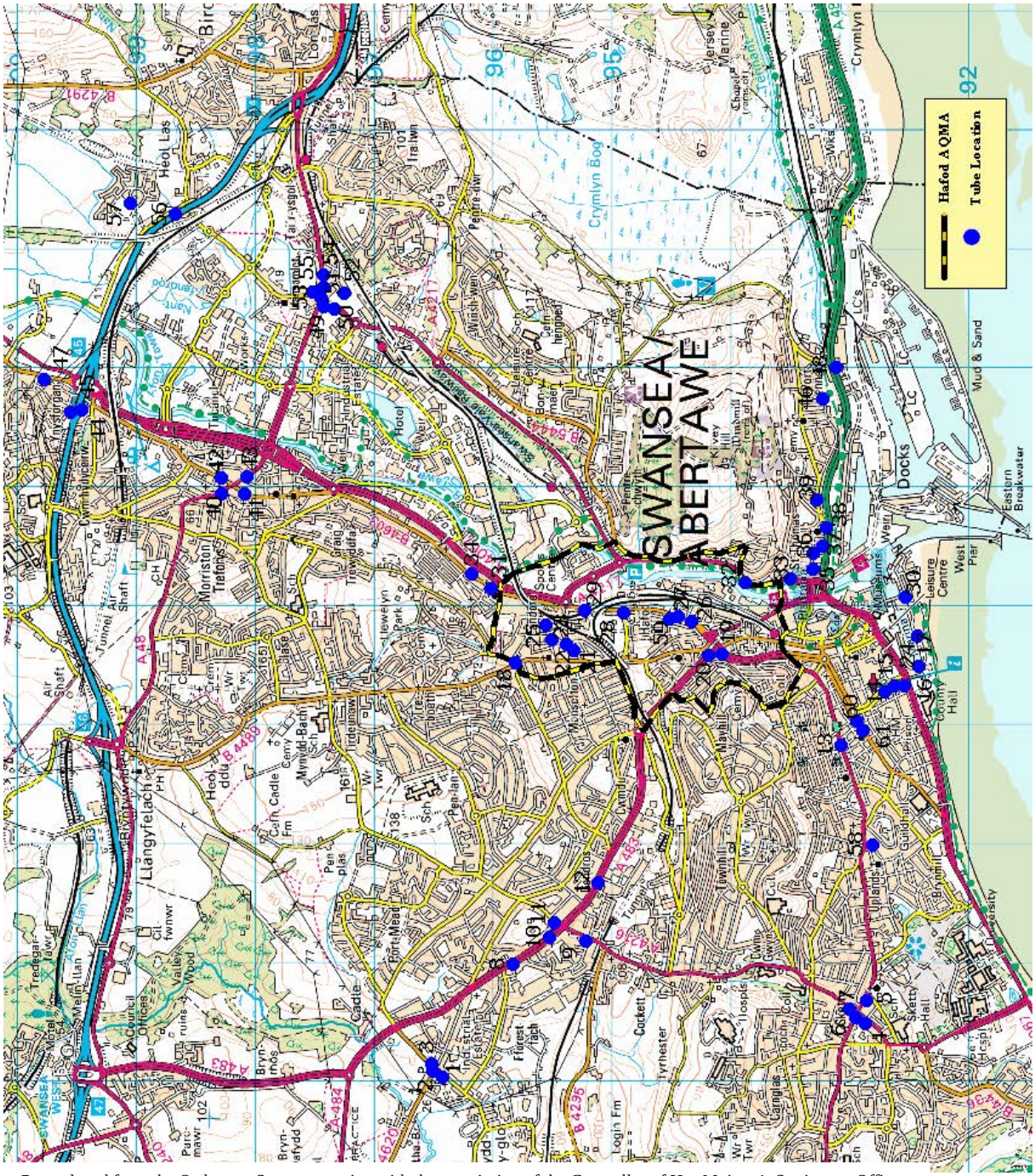
For information, the former UK Network monitoring sites that have previously been reported have been decommissioned following the closure of the UK Non-Automatic network during December 2005: Moorside Road, West Cross (4N); Manselton (6N).

However, the other two sites that provided data to the network have remained operational. These are Hafod Post Office (1N) now referred to as site 59 post 2005 and Uplands (5N) as site 58 post 2005.

4.3 Current Passive Nitrogen Dioxide Diffusion Tube Surveys 2006-2007

The authority commenced a new 61 site diffusion tube survey on the 5th October 2005. This survey followed on from the previous diffusion tube survey work undertaken that has been reported within previous stages of the LAQM process.

Map 7 below indicates the areas where monitoring was undertaken and the extent of the existing Hafod AQMA. All exposure periods operate on a monthly basis.



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Map 7 – *NO_2 Diffusion Tube Survey 2006-2007*

Table 35 lists the monitoring locations and indicates whether the monitoring site lies within the existing Hafod AQMA.

Site	Easting	Northing	Within Hafod AQMA	Location
1	262046	196420	-	12 Ystrad Road, Fforestfach
2	262095	196500	-	1332 Carmarthen Road, Fforestfach
3	262161	196513	-	2 Ffordd Cynore, Fforestfach
4	262497	192857	-	26 Dillwyn road, Sketty
5	262548	192943	-	108 Gower Road, Sketty
6	262612	192995	-	21 Vivian road, Sketty
7	262691	192852	-	15 Gower Road, Sketty
8	262990	195820	-	1034 Carmarthen Road, Fforestfach
9	263190	195205	-	41 Station Road, Fforestfach
10	263219	195513	-	932 Carmarthen Road, Fforestfach
11	263344	195474	-	18 Ravenhill Road, Fforestfach
12	263680	195103	-	747 Carmarthen Road, Gendros
13	264830	193066	-	Brunel Court, Walter Road
14	265285	192696	-	14 Clarence Street
15	265334	192608	-	56 Westway
16	265339	192534	-	136 Osytersmouth Road
17	265496	192408	-	1-7 Arethusa Quay, Marina
18	265526	195807	Yes	6 Cwm Level Road, Landore
19	265597	194061	Yes	49 Dyfatty Street, Dyfatty
20	265594	194175	Yes	30 Carmarthen Road, Dyfatty
21	265634	195316	Yes	33 Plough Road, Landore
22	265682	195374	Yes	114 Pentreharne Road
23	265728	195494	Yes	15 Mysydd Road, Landore
24	265760	192420	-	126-149 Trawler Road, Marina
25	265845	195547	Yes	53 Mysydd Road, Landore
26	265876	194318	Yes	1399 Neath Road, Landore
27	265922	194428	Yes	1379 Neath Road, Landore
28	265949	194891	Yes	119 Neath Road, Landore
29	265973	195222	Yes	5 Morfa Terrace, Landore
30	266080	192516	-	34-41 Trawler Road, Marina
31	266153	196003	-	289 Neath Road, Landore
32	266209	193867	Yes	6 Pentreguinea Road, St.Thomas
33	266236	193488	-	69 Pentreguinea Road, St.Thomas
34	266272	196168	-	1184 Neath Road, Landore
35	266314	193298	-	50 Delhi Street, St.Thomas
36	266455	193300	-	24 Delhi Street, St.Thomas
37	266515	193213	-	2 Sebastopol Street, St.Thomas

Site	Easting	Northing	Within Hafod AQMA	Location
38	266662	193181	-	5 Port Tennant Road, Port Tennant
39	266905	193271	-	69 Port Tennant Road, Port Tennant
40	266951	198278	-	19 Pentrepoeth Road, Morriston
41	266953	198085	-	Fountain Inn, Woodfield Road
42	267084	198274	-	32 Sway Road, Morriston
43	267093	198063	-	17 Clase Road, Morriston
44	267639	199543	-	4 Ian's Walk, Ynysforgan
45	267661	199451	-	52 Glyncollen Drive, Ynysforgan
46	267752	193218	-	63 Wern fawr Road, Port Tennant
47	267908	199773	-	505 Clydach Road, Ynysforgan
48	268011	193101	-	5 Bevans Row, Port Tennant
49	268501	197329	-	34 Nantyffin Road, Llansamlet
50	268530	197419	-	6 Nantyffin Road, Llansamlet
51	268593	197434	-	138 Samlet Road, Llansamlet
52	268643	197245	-	87 Midland Place, Llansamlet
53	268652	197508	-	16 Church Road, Llansamlet
54	268693	197416	-	12 Peniel Green Road, Llansamlet
55	268789	197420	-	38 Peniel Green Road, Llansamlet
56	269306	198661	-	Ynysallan Road, Birchgrove
57	269395	199042	-	18 Coed Fedwen, Birchgrove
58	264000	192800	-	16 Uplands Crescent, Uplands
59	265900	194500	Yes	Hafod Post Office
60	265036	192931	-	10 St.Helens Road
61	264959	192878	-	Pacos St.Helens Road

Table 35 Nitrogen Dioxide Passive Diffusion Tube Monitoring Locations 2006-2007

All passive diffusion tubes were exposed in accordance with the UK NO_2 survey Instruction Manual and were fixed to the front façade of receptor locations i.e. to a down pipe. The exceptions to this are at sites 56 and 58 where lampposts were used and site 45 (outlined below). Annual means from site 58 have been corrected back to façade.

It is possible to use a conservative method to estimate the concentrations from the data presented within table 36 to the façade of the nearest property. Using guidance from http://www.uwe.ac.uk/aqm/review/mfaqroad.html paragraph 7, the

following conservative façade measurements presented within table 36 are obtained by assuming a kerb to façade distance between 2-5m for site 58. At site 56, the lamppost used is close to the entrance to a new housing development along Ynysallen Road (see site 57 for monitoring within this development) and is within 25m of the eastbound carriageways of the M4. This monitoring location is used to assess the impact from the M4 Motorway as it is feasible that additional applications for dwellings could be received for this frontage. Similarly, site 44 Ians Walk is located to the façade of an existing dwelling that is located within 20m of the eastbound exit slip road at junction 45 M4 and 45m from the central reservation. Opposite site 44 on the westbound carriageways of the M4 is site 45. Site 45 is located within 5m of the westbound entrance slip road at junction 45 M4 and within 30m of the central reservation. The sample location is approximately 1m from the side elevation at first floor level, being located on the flat garage roof overlooking the M4.

Data presented below within table 36 represents full calendar years of measurement from this survey i.e. January 2006 – December 2007. Data from October - December 2005 has been held back from any analysis for sake of simplicity of presentation. All results are expressed in $\mu g/m^3$.

Data capture during 2006 (being 66%) for site 59 (Hafod Post Office) falls below the 75% required to form a valid annual mean due to area renewal renovation works underway to the Post Office and adjacent terraced dwellings between August and December 2006. The signal is so strong at this site that it is thought prudent to include the details for sake of completeness. Historical data from this site has always shown exceedences of the annual mean objective. Data capture at sites 60 and 61 commenced in April 2006 and 75% data capture overall was achieved for 2006.

Site	Within AQMA.	Measured NO_2 Annual Mean $\mu g/m^{-3}$ **2006**	Measured NO_2 Annual Mean $\mu g/m^{-3}$ **2007**	Swansea Mean Bias (0.84) Corrected **2006**	Swansea Worse Case Bias (0.87) Corrected **2006**	Swansea Mean Bias (0.84) Corrected **2007**	Swansea Worse Case Bias (0.87) Corrected **2007**
1		29.55	30.7	24.8	25.7	25.8	26.7
2		20.23	20.8	17.0	17.6	17.5	18.1
3		24.53	25.5	20.6	21.3	21.4	22.2
4		38.71	39.0	32.5	33.7	32.8	33.9
5		39.06	40.4	32.8	34.0	33.9	35.1
6		36.70	36.8	30.8	31.9	30.9	32.0
7		58.77	57.5	**49.4**	**51.1**	**48.3**	**50.0**
8		48.50	52.9	**40.7**	**42.2**	**44.4**	**46.0**
9		34.41	34.8	28.9	29.9	29.2	30.3
10		29.46	28.5	24.7	25.6	23.9	24.8
11		46.85	44.9	39.4	**40.8**	37.7	39.1
12		48.03	48.6	**40.3**	**41.8**	**40.8**	**42.3**
13		34.28	36.9	28.8	29.8	31.0	32.1
14		28.98	33.3	24.3	25.2	28.0	29.0
15		29.52	31.8	24.8	25.7	26.7	27.7
16		35.39	39.6	29.7	30.8	33.3	34.5
17		25.73	29.9	21.6	22.4	25.1	26.0
18	Y	49.56	53.4	**41.6**	**43.1**	**44.9**	**46.5**
19	Y	51.57	55.4	**43.3**	**44.9**	**46.5**	**48.2**
20	Y	46.83	47.2	39.3	**40.7**	39.6	**41.1**
21	Y	37.25	37.0	31.3	32.4	31.1	32.2
22	Y	42.11	41.8	35.4	36.6	35.1	36.4
23		37.48	40.1	31.5	32.6	33.7	34.9
24		24.90	27.2	20.9	21.7	22.8	23.7
25	Y	34.01	33.2	28.6	29.6	27.9	28.9
26	Y	50.27	48.4	**42.2**	**43.7**	**40.7**	**42.1**
27	Y	50.05	47.5	**42.0**	**43.5**	39.9	**41.3**
28	Y	32.76	36.3	27.5	28.5	30.5	31.6
29	Y	67.09	67.1	**56.4**	**58.4**	**56.4**	**58.4**
30		25.64	29.0	21.5	22.3	24.4	25.2
31		38.99	37.5	32.8	33.9	31.5	32.6
32	Y	37.52	39.1	31.5	32.6	32.8	34.0
33		37.23	37.5	31.3	32.4	31.5	32.6
34		40.39	41.5	33.9	35.1	34.9	36.1

Site	Within AQMA.	Measured NO_2 Annual Mean $\mu g/m^{-3}$ **2006**	Measured NO_2 Annual Mean $\mu g/m^{-3}$ **2007**	Swansea Mean Bias (0.84) Corrected **2006**	Swansea Worse Case Bias (0.87) Corrected **2006**	Swansea Mean Bias (0.84) Corrected **2007**	Swansea Worse Case Bias (0.87) Corrected **2007**
35		44.80	44.4	37.6	39.0	37.3	38.6
36		37.98	39.1	31.9	33.0	32.8	34.0
37		29.95	30.5	25.2	26.1	25.6	26.5
38		38.74	40.8	32.5	33.7	34.3	35.5
39		31.44	30.6	26.4	27.4	25.7	26.6
40		32.29	34.1	27.1	28.1	28.6	29.7
41		45.58	38.3	38.3	39.7	32.2	33.3
42		32.70	35.9	27.5	28.4	30.2	31.2
43		41.13	40.3	34.5	35.8	33.9	35.1
44		34.35	32.5	28.9	29.9	27.3	28.3
45		39.77	44.8	33.4	34.6	37.6	39.0
46		19.59	19.2	16.5	17.0	16.1	16.7
47		28.00	27.7	23.5	24.4	23.3	24.1
48		28.45	27.9	23.9	24.8	23.4	24.3
49		33.01	34.8	27.7	28.7	29.2	30.3
50		45.33	44.1	38.1	39.4	37.0	38.4
51		37.12	35.2	31.2	32.3	29.6	30.6
52		31.39	24.0	26.4	27.3	20.2	20.9
53		27.28	26.9	22.9	23.7	22.6	23.4
54		44.32	39.4	37.2	38.6	33.1	34.3
55		42.69	41.6	35.9	37.1	34.9	36.2
56		45.26	44.9	38.0	39.4	37.7	39.1
57		18.69	18.3	15.7	16.3	15.4	15.9
58 ••		47.52	47.9	37.9	39.3	38.2	39.6
59	Y	65.31**	69.6	**54.9**	**56.8**	**58.5**	**60.6**
60		42.93*	44.5	36.1	37.3	37.4	38.7
61		44.00*	43.9	37.0	38.3	36.9	38.2

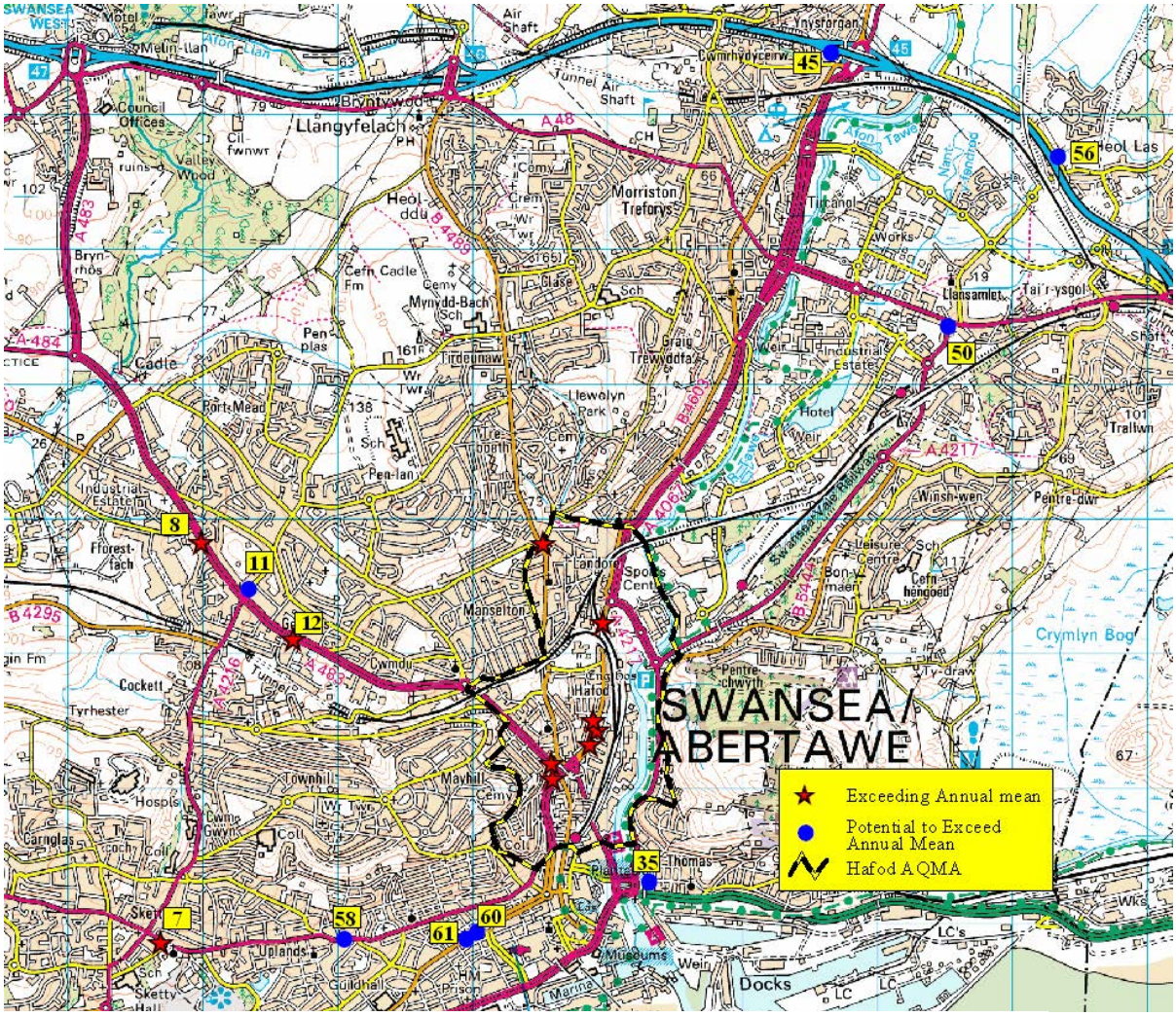
Table36 NO_2 Passive Diffusion Tube Monitoring 2006-2007

** Data Capture 75% for 2006*
*** Data capture 66% for 2006*
••Corrected to façade

Monitoring results for 2006-2007 have identified continued exceedences of the annual mean objective within the existing Hafod Air Quality Management Area. However, monitoring has now highlighted areas outside of the existing Hafod

AQMA that exceed the annual mean objective. These are at site 7 Gower Road, site 8 Carmarthen Road Fforestfach and site 12 Carmarthen Road, Gendros. In addition, if a conservative view is taken in that those sites that return corrected annual mean concentrations within the range 37-40μg/m^{-3} (data highlighted as blue within table 36) and that are outside of the Hafod AQMA are at risk of breaching the annual mean objective then 8 sites require further detailed investigation. These are: site 11 Ravenhill Road Fforestfach, site 35 Delhi Street St.Thomas, site 45 Glyncollen Crescent, Ynysforgan (M4), site 50 Nantyffin Road Llansamlet, site 56 Ynysallan Road, Birchgrove (M4 – precautionary site as no receptors at present), site 58 Uplands Crescent Uplands, and sites 60-61 St Helens Road, City Centre.

A map showing the three sites newly identified as exceeding the annual mean objective, together with the eight now thought to be at risk of potentially exceeding the annual mean objective are shown below within map 8. For sake of completeness, those sites within the existing Hafod AQMA that continue to show exceedence of the annual mean standard are also shown. The extent of the existing Hafod Air Quality Management Area is identified within map 8.



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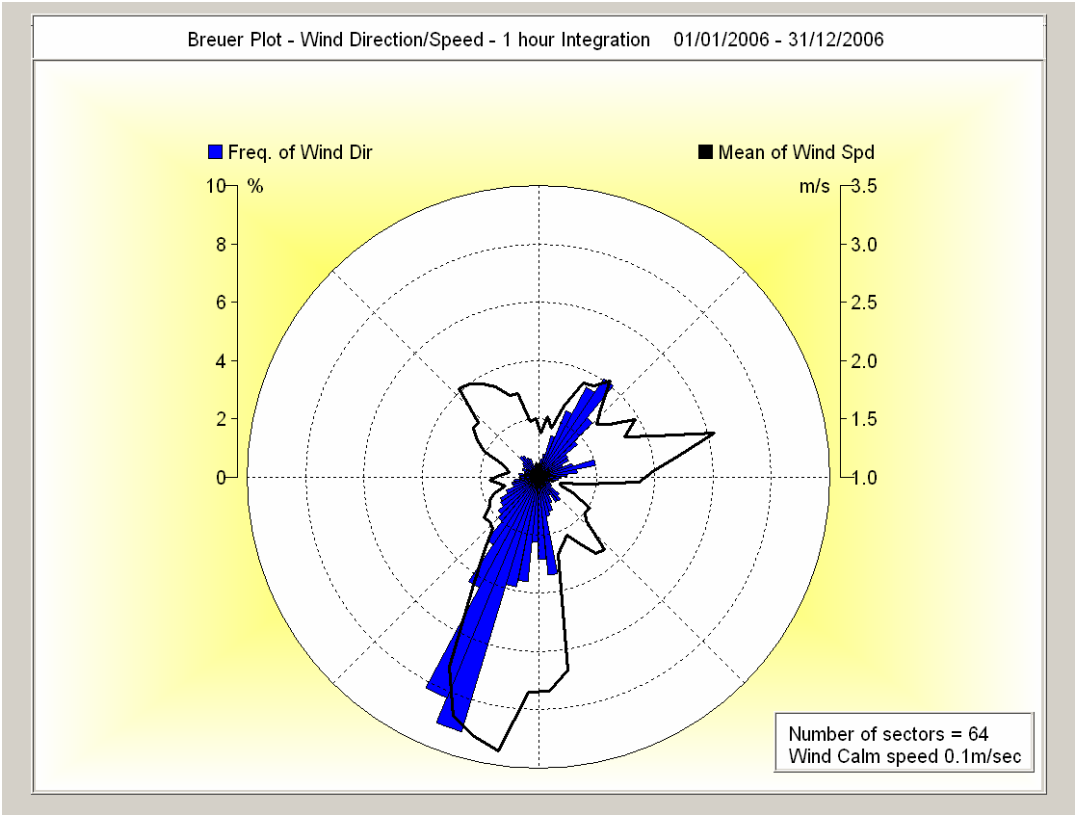
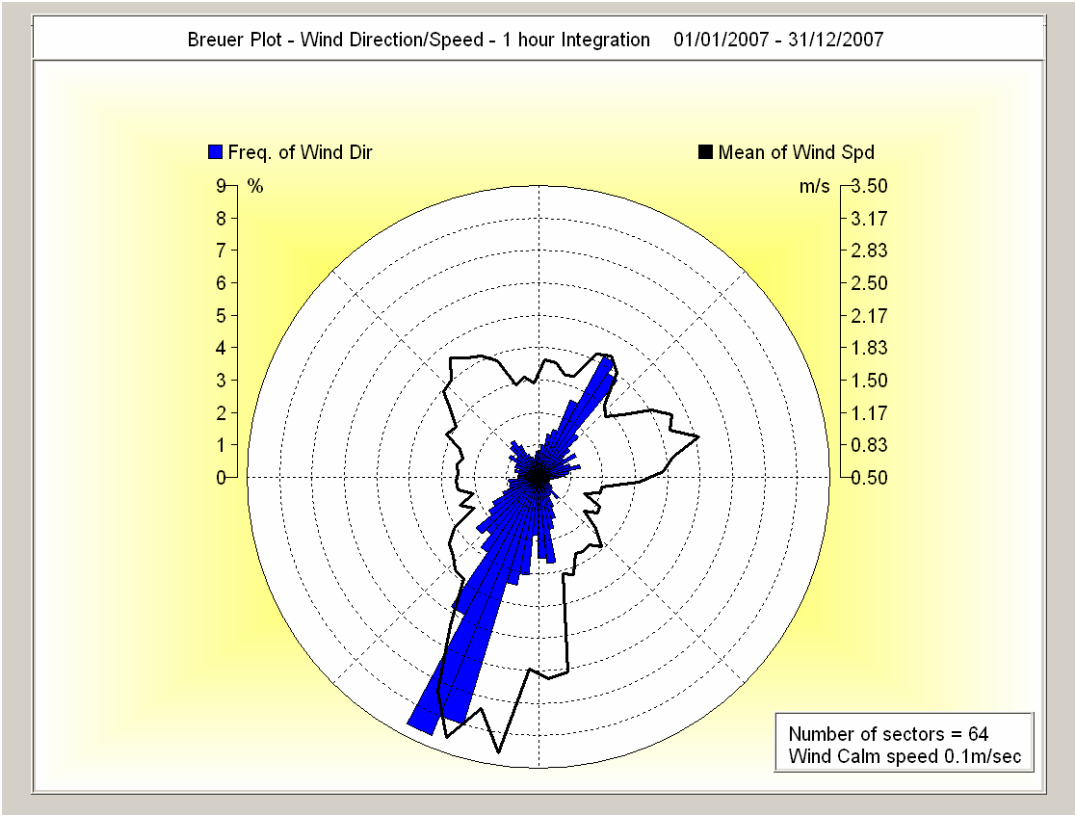
Map 8 Sites Exceeding / Potentially Exceeding NO_2 Annual Mean 2007

Meteorological data has been examined for the period January 2006- December 2007 using data from the Opsis Guildhall station located close to Swansea Bay. Breuer Plots representing each measurement year are given below as Breuer Plot 9 and Breuer Plot 10. Both show a prevalence of south westerly winds. These plots typify the expected meteorological conditions.



Breuer Plot 9 – 2006



Breuer Plot 10 – 2007

The January 2006 update of LAQM.TG(03) indicates that the correction factors provided within the original LAQM.TG(03) guidance (box 6.7 and 6.8 page 6-29) to estimate annual mean concentrations in future years should no longer be used. The revised guidance indicates use of the Year Adjustment Calculator v2.2a (from http://www.airquality.co.uk/archive/laqm/tools/Year_Adjustment_Calculator22a.xls).

Using 2007 as the base year, the ranges of possible projections for 2010 are shown below as table 37. All projections are expressed in μg/m^3.

Site	**Within AQMA.**	Swansea Mean Bias (0.84) Corrected Mean **2007**	Swansea Worse Case Bias (0.87) Corrected Mean **2007**	Swansea Mean Bias (0.84) Projected **2010**	Swansea Worse Case Bias (0.87) Projected **2010**
1		25.8	26.7	23.08	23.89
2		17.5	18.1	15.66	16.19
3		21.4	22.2	19.15	19.86
4		32.8	33.9	29.35	30.33
5		33.9	35.1	30.33	31.40
6		30.9	32.0	27.65	28.63
7		**48.3**	**50.0**	**43.21**	**44.74**
8		**44.4**	**46.0**	39.73	**41.46**
9		29.2	30.3	26.13	27.11
10		23.9	24.8	21.38	22.19
11		37.7	39.1	33.73	34.98
12		**40.8**	**42.3**	36.50	**37.85**
13		31.0	32.1	27.74	28.72
14		28.0	29.0	25.05	25.95
15		26.7	27.7	23.89	24,78
16		33.3	34.5	29.79	30.87
17		25.1	26.0	22.46	23.26
18	Y	**44.9**	**46.5**	**40.17**	**41.60**
19	Y	**46.5**	**48.2**	**41.60**	**43.13**
20	Y	39.6	**41.1**	35.43	36.77
21	Y	31.1	32.2	27.83	28.82
22	Y	35.1	36.4	31.40	32.57
23		33.7	34.9	30.15	31.23
24		22.8	23.7	20.40	21.20
25	Y	27.9	28.9	24.96	25.86

Site	**Within AQMA.**	Swansea Mean Bias (0.84) Corrected Mean **2007**	Swansea Worse Case Bias (0.87) Corrected Mean **2007**	Swansea Mean Bias (0.84) Projected **2010**	Swansea Worse Case Bias (0.87) Projected **2010**
26	Y	**40.7**	**42.1**	36.41	**37.67**
27	Y	39.9	**41.3**	35.70	36.95
28	Y	30.5	31.6	27.29	28.27
29	Y	**56.4**	**58.4**	**50.46**	**52.25**
30		24.4	25.2	21.83	22.55
31		31.5	32.6	28.18	29.17
32	Y	32.8	34.0	29.35	30.42
33		31.5	32.6	28.18	29.17
34		34.9	36.1	31.23	32.30
35		37.3	38.6	33.37	34.54
36		32.8	34.0	29.35	30.42
37		25.6	26.5	22.90	23.71
38		34.3	35.5	30.69	31.76
39		25.7	26.6	22.99	23.8
40		28.6	29.7	25.59	26.57
41		32.2	33.3	28.81	29.79
42		30.2	31.2	27.02	27.92
43		33.9	35.1	30.33	31.40
44		27.3	28.3	24.43	25.32
45		37.6	39.0	33.64	34.89
46		16.1	16.7	14.40	14.94
47		23.3	24.1	20.85	21.56
48		23.4	24.3	20.94	21.74
49		29.2	30.3	26.13	27.11
50		37.0	38.4	33.10	34.36
51		29.6	30.6	26.48	27.38
52		20.2	20.9	18.07	18.70
53		22.6	23.4	20.22	20.94
54		33.1	34.3	29.61	30.69
55		34.9	36.2	31.23	32.39
56		37.7	39.1	33.73	34.98
57		15.4	15.9	13.78	14.23
58		38.2	39.6	34.18	35.43
59	Y	**58.5**	**60.6**	**52.34**	**54.22**
60		37.4	38.7	33.46	34.63
61		36.9	38.2	33.01	34.18

Table 37 Projected Annual Means to 2010 from 2007 measured/corrected data

From the projections made within table 37 above, 6 sites will still remain above the annual mean objective in 2010. Of these, 4 are within the existing Hafod AQMA. It is also thought that a further two sites, one within and one outside of the existing Hafod AQMA would be within the range 37-40μg/m^3 with the potential to exceed the objective level.

As a result of the monitoring undertaken and the future projections made, the authority intends to move to a Detailed Assessment for nitrogen dioxide within the identified areas. The Detailed Assessment will utilise additional passive diffusion tube monitoring and also dispersion modelling techniques to determine the areas to be included within any amendments/modifications made to the boundary of the existing Hafod Air Quality Management Area.

It is not proposed at present to commission any additional real-time chemiluminescent analysers within these areas as part of the detailed assessment due to cost implications and the problems to be overcome with the correct siting of the chemiluminescent analysers. It is unlikely that a single chemiluminescent analyser will be able to accurately assist in the identification of how many dwellings lie within an area of exceedence – this is more than likely to be determined by use of diffusion tubes, supplemented by dispersion modelling. The authority is now in a position to undertake dispersion modelling given the considerable investment in providing the high quality data feeds into any emissions database i.e. meteorological data and real-time traffic flow data.

5 Other Monitoring Works

5.1 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 INCO Europe being located within the authorities 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[54]. 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 38.

[54] *COM 2003 (423)*

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

Table 38- Target Values 4th Daughter Directive - Heavy Metals Monitoring

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

During July 2006, two additional monitoring locations were added: one at Coed-Gwilym Cemetery ❸ upwind of the high level stack release and one at the Morriston Groundhog ❺ some 4.1 kilometres downwind of the stack release point (see section 3.4.1 for site location of the Morriston Groundhog). 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 will continue to fund heavy metals monitoring at this site for the foreseeable future and have contracted NPL to undertake all analysis work.

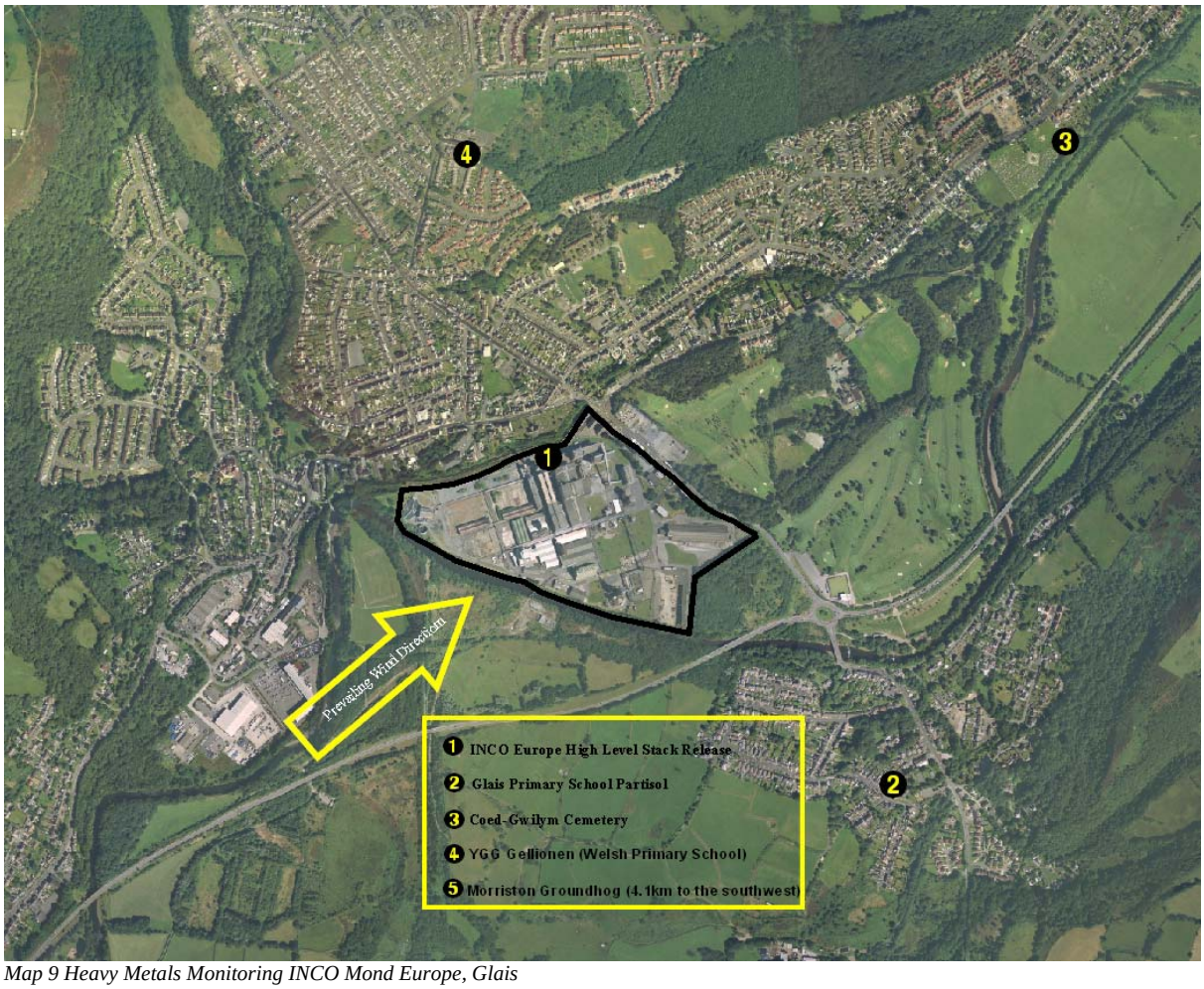
A further site has been established to the north of the high level stack release point during November 2007 at YGG Gellionnen ❹ (Welsh Primary School). The site is located on top of a flat roof within the school complex and has an uninterrupted view down to the refinery complex. This authority will continue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

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

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

All monitoring locations (both UK Network sites and the two Swansea funded sites) have an Industrial Background classification. Data is now being captured covering the four compass points around the high level stack release point.

The location of INCO Europe and the sampling locations can be seen within map 9.



Map 9 Heavy Metals Monitoring INCO Mond Europe, Glais

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

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

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

ICP-MS analysis of the digested solutions took place using at least four gravimetrically-prepared calibration solutions. A QA standard was repeatedly analysed (after every two solutions), and the change in response of the QA standard was mathematically modelled 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[55].

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:

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

[55] 2006 NPL Report-AS 20 (March 2008) Annual Report for 2007 on the UK Heavy Metals Monitoring Network

Nickel results are presented as annual means from 2002-2007 with presentation of monthly means (along with the other metals monitored) and the resulting annual means for 2005-2006 for the Glais Primary School monitoring.

Table 39 details the annual means 2002-2007 with tables 40 and 41 the monthly means (2006-2007) for the Glais Primary School ❷ site. All results are expressed in ng/m^{-3}

Year	Annual Mean ng/m^{-3}	% of target Value (100% = Target Value)
2002	28.91	145
2003	18.14	91
2004	33.83	169
2005	19.62	98
2006	26.13	131
2007	28.04	140

Table 39 Nickel Annual Means Glais Primary School 2002-2007

Glais Primary School												
2006	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	1.14	0.29	0.62	7.43	234	4.79	**30.86**	16.9	0.02	1.65	21.4	2.29
Feb	1.44	0.33	6.90	22.54	668	9.37	**15.76**	21.6	0.00	3.77	37.2	0.23
Mar	0.52	0.19	5.20	2.96	107	2.82	**24.35**	6.2	0.15	2.40	11.3	0.64
April	0.41	0.11	2.98	3.49	82	2.18	**26.86**	5.4	0.01	1.66	13.9	0.25
May	0.72	0.14	3.28	4.62	196	4.69	**18.68**	7.6	0.01	3.00	16.9	0.26
June	0.38	0.20	1.91	5.15	229	6.50	**20.04**	9.3	0.10	2.12	16.6	0.52
July	0.71	0.24	2.12	5.02	274	6.91	**18.98**	12.5	0.00	3.52	16.3	0.17
Aug	0.36	0.14	1.51	3.42	91	2.90	**27.42**	7.5	0.00	0.78	9.0	0.24
Sept	0.39	0.21	6.22	4.43	183	6.22	**18.19**	8.6	0.01	1.13	20.2	0.68
Oct	0.84	0.15	1.97	3.94	100	3.35	**32.60**	9.4	0.00	1.73	15.1	0.63
Nov	2.73	0.34	5.84	10.41	168	3.83	**27.72**	34.5	0.00	0.85	24.8	0.18
Dec	1.39	0.24	3.45	5.34	124	2.61	**52.09**	18.5	0.00	1.51	18.5	0.12
Ann Av.	**0.92**	**0.21**	**3.50**	**6.56**	**205**	**4.68**	**26.13**	**13.2**	**0.03**	**2.01**	**18.4**	**0.52**

Table 40 Glais Primary School Heavy Metals Monitoring 2006

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

Table 41 Glais Primary School Heavy Metals Monitoring 2007

Tables 42 and 43 detail the monthly means that are available for the Coed-Gwilym Cemetery ❸ during 2006 and 2007. All results are expressed in ng/m^{-3}.

Tables 44 and 45 detail the monthly means that are available for the Morriston Groundhog ❺ site during 2006 and 2007. All results are expressed in ng/m^{-3}.

Coed-Gwilym Cemetery												
2006	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Aug	**0.25**	**0.09**	**1.96**	**3.1**	**55**	**2.32**	**31.1**	**6.6**	**<0.01**	**0.61**	**16.0**	**0.30**
Sept	**0.45**	**0.21**	**5.57**	**5.9**	**203**	**5.65**	**66.6**	**9.5**	**<0.01**	**2.05**	**23.6**	**0.40**
Oct	**0.89**	**0.22**	**9.14**	**4.2**	**127**	**4.66**	**76.3**	**12.5**	**<0.01**	**1.51**	**18.7**	**0.62**
Nov	**1.89**	**0.28**	**5.95**	**9.5**	**118**	**3.46**	**49.2**	**26.8**	**<0.01**	**0.56**	**20.5**	**0.29**
Dec	**3.68**	**1.13**	**6.46**	**14.5**	**173**	**4.19**	**141.0**	**31.0**	**<0.01**	**2.98**	**36.9**	**0.07**

Table 42 Heavy Metals Monitoring Coed-Gwilym Cemetery 2006

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

Table 43 Heavy Metals Monitoring Coed-Gwilym Cemetery 2007

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

Morriston Groundhog												
2006	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Aug	**0.26**	**0.15**	**1.03**	**17.6**	**338**	**5.76**	**15.3**	**12.4**	**<0.01**	**0.56**	**24.3**	**0.43**
Sept	**0.57**	**0.24**	**4.45**	**29.0**	**582**	**11.96**	**24.6**	**27.0**	**<0.01**	**2.57**	**48.5**	**0.60**
Oct	**0.91**	**0.26**	**36.6**	**29.6**	**563**	**10.07**	**74.0**	**20.0**	**<0.01**	**1.79**	**28.8**	**0.44**
Nov	**2.90**	**0.61**	**7.59**	**46.2**	**574**	**9.68**	**39.8**	**51.8**	**<0.01**	**0.70**	**39.5**	**0.16**
Dec	**3.81**	**1.23**	**4.88**	**35.2**	**657**	**9.77**	**88.1**	**36.7**	**<0.01**	**2.92**	**57.8**	**0.09**

Table 44 Heavy Metals Monitoring Morriston Groundhog 2006

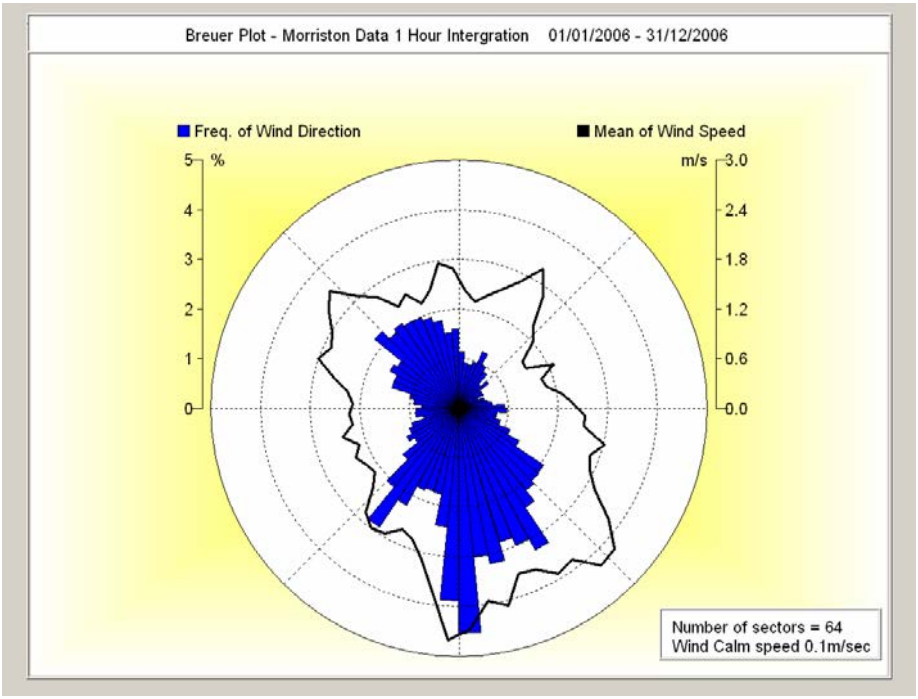
Morriston Groundhog												
2007	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Pt**	**V**	**Zn**	**Hg**
Jan	1.11	0.41	4.31	21.6	399	5.02	14.1	20.7	<0.01	1.08	23.7	0.06
Feb	1.65	0.45	4.49	32.9	848	16.38	22.2	31.2	<0.01	1.83	77.7	0.14
Mar	0.92	0.37	3.74	20.8	524	8.35	18.1	16.2	<0.01	2.15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

Table 45 Heavy Metals Monitoring Morriston Groundhog 2007

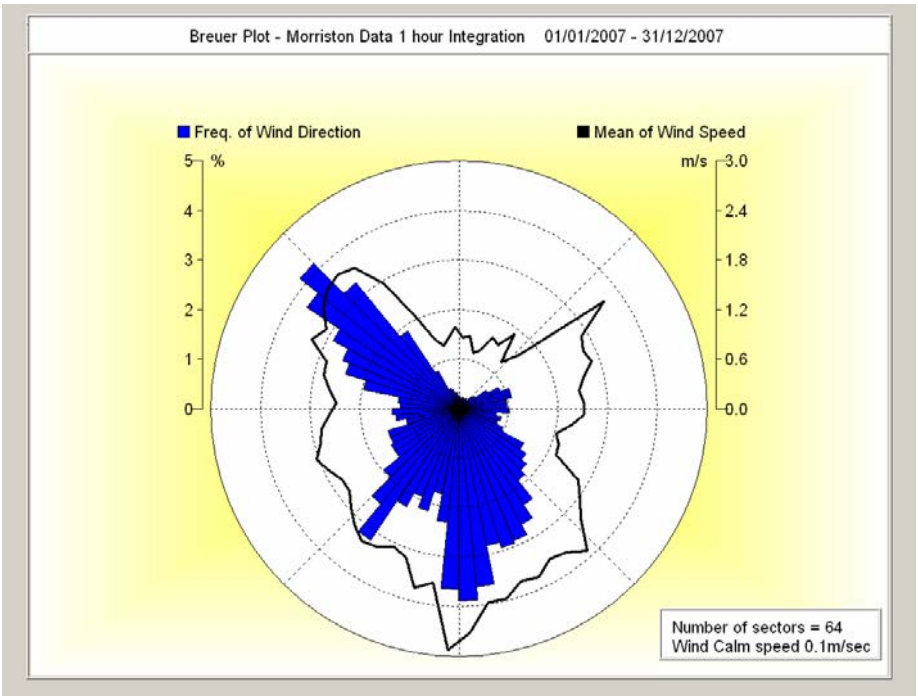
****** The vanadium levels measured during May were mostly extremely high. This is thought to be owing to an instrument fault affecting the first in the series of analytes to be measured, which is vanadium. These values should be treated with caution and should have a very high uncertainty attached to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

As mentioned above, monitoring at the site YGG Gellionnen ❹ (Welsh Primary School) commenced during December 2007. There is little valid data that can be presented for this station at this time so for the sake of clarity, no data is reported here.

Breuer plot 11 below for 2006 shows a prevalence of southerly/south easterly winds. North westerly winds are again noticeable, with unusually, very little influence from the prevailing south westerlies. This plot has been generated using data from the Morriston Groundhog site which itself is located within the lower valley area and thus representative of conditions within the valley area.



Breuer Plot 11 – Meteorological conditions 2006



Breuer Plot 12 – Meteorological conditions 2007

Breuer Plot 12 above for 2007 indicates a prevalence of north-westerly winds together with southerlies. There was very little influence from northerlies during 2007. During periods of northerlies, it would be expected that elevated levels of nickel would be seen at the Morriston ❺ site. During 2007, there were higher concentrations recorded at the Coed-Gwilym Cemetery ❸ site which is located

upwind of the release point which would appear to mirror the meteorological conditions. In addition, elevated levels were also recorded at the Glais Primary School ❷ site during 2007 which is thought attributable to the north westerly conditions also experienced during 2007.

From the annual mean data presented above within tables 39, 40, 41, 43 and 45 it is evident that the Glais Primary School ❷ site recorded nickel concentrations during the period 2002 – 2007 that either marginally fall below the Forth Daughter Directive Target Value (20ng/m^{-3}) or exceed this Target Value. In addition, the newly established site upwind of the release point at Coed-Gwilym Cemetery ❸ also exceeds the Forth Daughter Directive Target Value (20ng/m^{-3}).

The Morriston ❺ site falls marginally fall below the Forth Daughter Directive Target Value (20ng/m^{-3}). However you look at the data, the signal is strong suggesting a dominant consistent local source.

Information to hand would indicate that low-level fugitive emissions are minimal and that the vast majority of release is via the high-level discharge stack. It is not clear whether the stack emissions could generate these data, or, what the contribution from re-suspended historical deposition might be. In order to try and gain an understanding of the historical deposition versus active release debate, the analysis undertaken from the Morriston and Coed-Gwilym Cemetery sites also includes scandium to determine if any significant nickel-scandium relationship exists which would possibly indicate historical deposition being re-suspended. To date, and from the data available, no such relationship can be seen within the data.

During late September 2007, improvements have been made by the operators in that a filter bag system has been installed into the high level stack release point.

Post improvement data is limited at present but any reduction in ambient nickel concentrations will be reported in due course.

It is recommended that monitoring continues at all of the local authority funded sites for the foreseeable future to assess any changes in ambient nickel concentrations.

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.

6 New Local Developments

During the last two to three years, Swansea has seen a substantial amount of interest in development of both green field sites and brown field sites. The catalyst for this upsurge in development has undoubtedly been the DIEN (Department of Innovation Enterprise and Networking – formally the Welsh Development Agency) led redevelopment of the old docklands within Swansea Port that has become known as the SA1 development. This major investment site has seen developers submitting Planning Applications both within the SA1 area and more lately outside of that area but to the main within the influence zone of the SA1 development.

Details of all major projects known of are summarised below as some developments have the potential to impact upon air quality. In the main, these impacts have largely been resolved through the planning process. Some development sites have been completed while others remain either in the early stages of construction or planning processes. These details have been reported within the Updating and Screening Assessment submitted in April 2006 and the Progress Report 2007 but are repeated and updated here where appropriate for the sake of completeness.

6.1 New Retail Developments

6.1.1 Morfa Retail Park

Construction of the Morfa Retail Park commenced during 2003 alongside the construction of a new sports stadium to be used by both Swansea City Football

Club and for the new regional rugby team the Ospreys. Swansea City Football Club will play all of its home games at the stadium with the Ospreys also playing their home fixtures at the venue. The sports stadium development has been named during 2006 as The Liberty Stadium and is located within the boundary of the Hafod Air Quality Management Area (AQMA). The Morfa Retail Park development lies just outside of the Hafod AQMA and map 10 below indicates the extent and location of the development within the lower Swansea Valley.

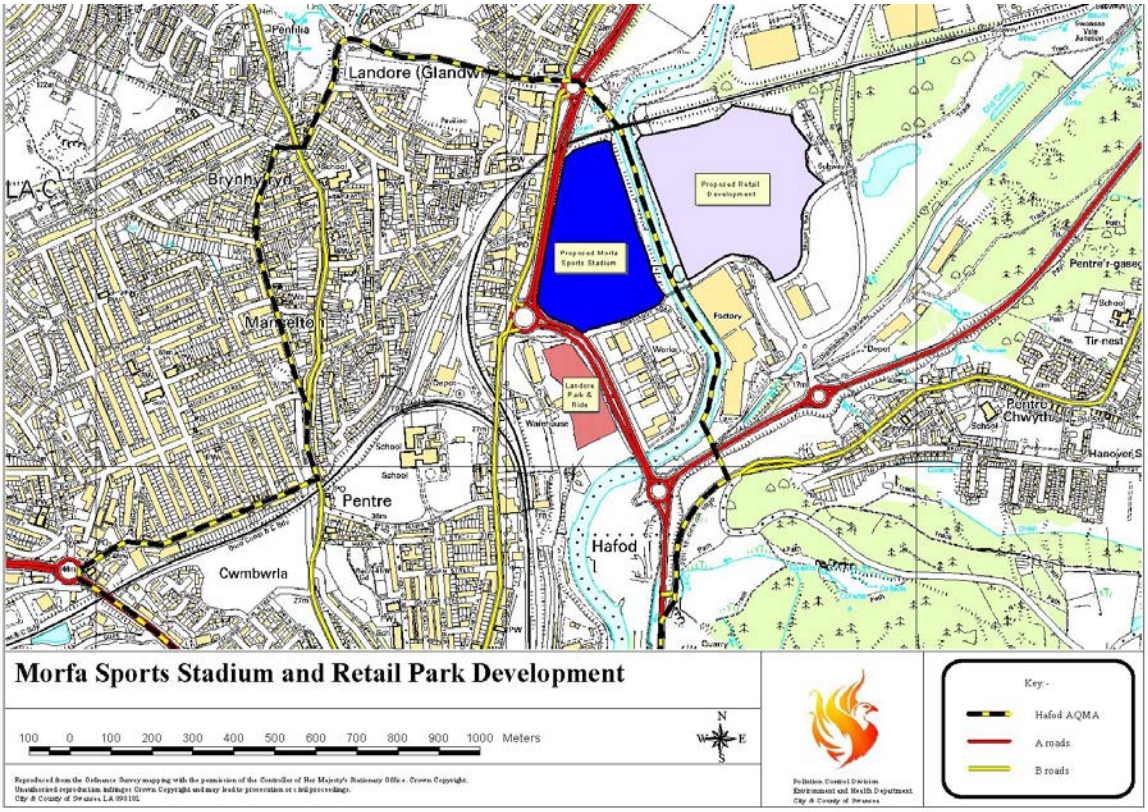
The Morfa Groundhog (see 3.1.1 above) air quality monitoring station is located at Normandy roundabout, adjacent to the development site. This site will provide the data to enable an assessment of any impact upon the lower valley area from the development and the road transport infrastructure of the lower valley area.

The Retail Park opened during late 2004/early 2005 and has seen major UK operators establish premises within the retail park. These operators include a major DIY chain, numerous cloths and sports goods outlets and a major UK food retailer. The vast majority of the remainder of the retail units were occupied during 2005 but whilst one or two remain vacant during the early part of 2007 additional units were under construction.

The sports stadium was completed during June 2005 and hosted its first football game during July 2005 prior to the commencement of the football and rugby season for 2005/2006. The stadium will be in use for the majority of weekends as well as certain weekday evening fixtures for both sport uses.

There are plans to stage major pop concerts and other “outdoor events” at this venue. The first of these events occurred during June 2007 when “The Who”

performed at the Liberty Stadium. In addition, the Retail Park will be open for business until late evening for the majority of the time.



Map 10 - Sports Stadium and Morfa Retail Park Developments

Vehicle by vehicle automatic classification and counting is now ongoing throughout the lower Swansea Valley via a network of GPRS Automatic Traffic Counters. This will provide in time, the data to enable a clearer picture to be obtained of the influence of the road transport network to the lower valley area.

6.1.2 Parc Fforestfach & Pontardulais Road Retail Park

Parc Fforestfach has been constructed over the last couple of years following the reconstruction of a major UK food retailer store and the acquisition of adjoining derelict retail units. The complex now can be considered to straddle two sites - one either side of the busy A483 Pontardulais Road. The complex as a whole

comprises of major UK food retailers, clothing retailers and electrical retailers together with a fast food outlet and other mixed retail units consisting of, amongst other things, a bookstore and chemists.

It has become established as a major "out-of-town" retail attraction for both Swansea residents and further afield. Access to the complex is off the A483 and also via the traffic signal controlled junction at the intersection of the A483 with Ffordd Cynore and Pentregethin Road. Junction 47 of the M4 is approximately one mile to the north of the site. Swansea City centre is located approximately 3 miles to the south of the complex. The location of the developments can be seen below as map 11.

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Map 11 Parc Fforestfach and Pontardulais Road Retail Parks

Traffic congestion at peak times - particularly over the weekends is becoming a concern for local residents. Approximately 230 dwellings have been under construction within the Ffordd Cynore development opposite the delivery access for the Parc Fforestfach Retail Park. This development is wholly accessed at present from the Ffordd Cynore junction to the north west of the retail park. This residential derived traffic also negotiates access either via the signal controlled junction of Ffordd Cynore with the A483 Carmarthen Road or via the signalled controlled junction of Ffordd Cynore with Ystrad Road/Carmarthen Road (old section).

Passive nitrogen dioxide monitoring tubes have been established to the facade of terraced dwellings along Ffordd Cynore (site 3 in section 4.3), Ystrad Road (site 1 in section 4.3) and Carmarthen Road (site 2 in section 4.3). The location and monitoring results from 2006 - 2007 for these sites can be seen within table 36 above. In view of the noticeable congestion within the area at certain periods, the results are surprisingly low. This is not to say that there have been, or will be, breaches of the NO_2 1-hour objective standard but this is thought unlikely given that the annual mean values are below 60$\mu g/m^3$ [56].

PM_{10} is now being monitored along Ffordd Cynore in the vicinity of the Retail Park as the monitoring station that had been ordered has been re-commissioned following the installation of an upgraded flow pump. Difficulties have been experienced with its location and electricity supply etc but the site was finally established following resolution of the equipment problems during the summer of 2007. It is intended to use the laser light-scattering device initially as a screening tool to assess any likely breach of the PM_{10} standards. These measurements will continue for the foreseeable future along with the passive

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

NO_2 diffusion tube work. These measurements have taken on greater significance due to the housing development off Ffordd Cynore. The vast majority of these new dwellings are now in occupation with continued expansive development extending into 2008. The housing development accessed off Ffordd Cynore is outlined below within 6.3.1. Additionally the proposed mixed-use development off Ffordd Cynore (see 6.2.4 below) is adjacent to these developments

6.1.3 Proposed Asda Store, Gorseinon

The application site consists of a vacant parcel of land (2.63 hectares / 6.5 aces) and incorporates the two existing residential properties of 12 and 13 Mill Street and forms part of the Melyn Mynach development site adjacent to the north-east of the Gorseinon District Shopping Centre and Somerfield retail store. The site was previously part of the Mountain Colliery and Gorseinon Tin Plate Works, which was reclaimed in the late 1970's. The site is bounded by the residential development of Cae Glas and Cwrt Rhian to the north; Ty'r Felin doctors surgery and the residential properties in Cecil Road to the west; the Somerfield store to the south and Heol Mynydd to the east. An outline of the proposed site can be seen within map 12 below.

The application seeks full planning permission for the development of a Class A1 retail store with a gross floor space of 5,341 sq m (57,500 sq ft) together with associated car parking (471 spaces) and service delivery area. The net sales area of the store will be 2705 sq m, of which it is proposed that up to 40% (1082 sq m) would be used for the sale of comparison goods and the remainder, convenience goods. The proposal involves the demolition of the residential

properties at 12 and 13 Mill Street. It is proposed to construct a new vehicular access incorporating a roundabout on Heol-y-Mynydd at the eastern end of the site with a separate service yard access at the western end of the site along the existing Somerfield store access. The existing vehicular connection to Cecil Road will remain open. Pedestrian access and crossing points are indicated

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Map 12 Proposed Asda Development, Gorseinon

from Heol-y-Mynydd and across the existing service road. In order to enhance the pedestrian linkages between the proposed store and High Street, Asda have confirmed that they are prepared in principle to negotiate with the Council, a planning obligation under Section 106 of the Town and Country Planning Act 1990 subject to the provision of Circular 13/97 (Planning Obligations) being satisfied. The precise detail of the contribution would need to be negotiated. In

addition, Asda have agreed to off-site highway improvement works (which include the provision of pedestrian crossings to facilitate improved access to the town centre) amounting to a contribution of £175,000. The application indicates that the proposed store would employ 300 people as a result of the proposed development.

The planning application was accompanied by a Retail Assessment, Transport Assessment, Design Statement, Landscaping Appraisal, Air Quality Assessment, Phase 2 Geo-environmental Investigation and an Environmental Noise Survey Report.

The proposal was subject to a screening opinion under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 prior to the submission of the planning application to assess the requirement for an Environmental Impact Assessment (E.I.A.) to accompany the application. It was concluded that the proposed development would be unlikely to raise any significant environmental issues of more than of local importance, and that the scale of the store would not exceed the tolerances within the E.I.A. Circular (02/99) which indicates that an EIA is more likely to be required for proposals to redevelop land on a greater scale if the site is greater than 5 hectares or would involve more than 10,000m^2 of new commercial floor space. It was therefore considered that an Environmental Impact Assessment was not required.

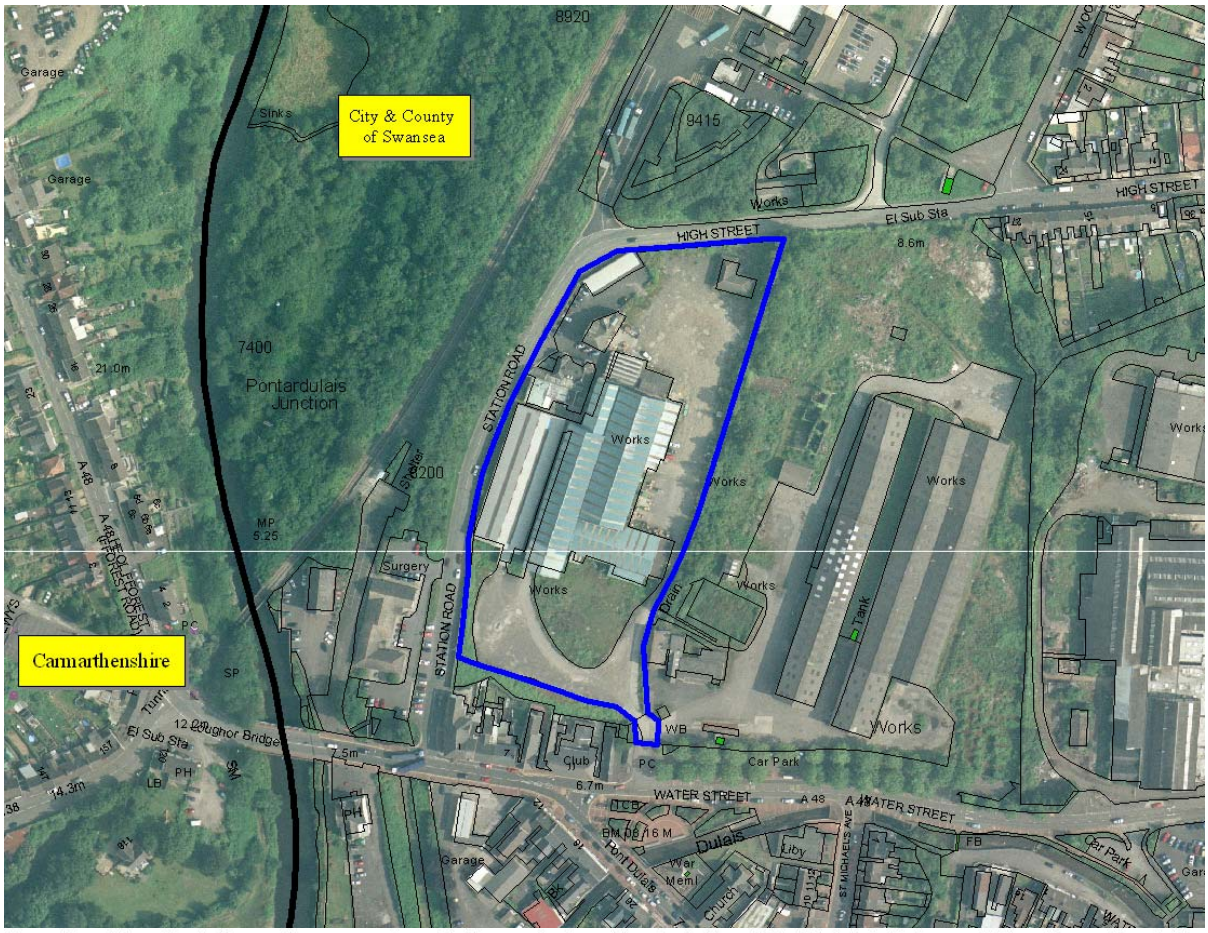
The application was refused during 2007 for the following reason "The application fails to adequately demonstrate the need for the size and type of store proposed at this location and that the development would not have an unacceptable adverse impact upon the Gorseinon Shopping Centre as a whole and the potential for enhanced shopping facilities within the broader catchment

area." As such, the development fails to accord with Structure Plan Policies S2 and S4, Southern Lliw Valley Local Plan Policies S1, S3 and S9, Draft Swansea Unitary Plan Policies SP6, EC4 and EC5 and the adopted Parc Melin Mynach Development Brief.

The applicant has submitted an appeal against the authority's decision to refuse permission with the appeal hearing scheduled to be heard during May 2008.

6.1.4 Proposed Tesco Store, Pontardulais

The proposed development involves the demolition of the existing buildings on the Former Clayton Works Site, Station Road, Pontardulais, and the construction of a Tesco Retail Store which would provide a total floor space of 4,517 sq. metres (48,622 sq.ft.) with associated parking (325 spaces) and the formation of a new vehicular access off Station Road with deliveries from High Street. Map 13 below outlines the development site.



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Map 13 Tesco Development Site, Pontardulais

The application site is currently occupied by David Mathews Ltd. who operate an aluminium works on the site. The aluminium works operations have been scaled down over the last few years and there is limited production on the site. The site is bounded to the west by Station Road, with High Street forming the northern boundary. The eastern boundary of the site was formerly occupied by the industrial buildings of Morgan Rees and Teddington Bellows, however, both sites are currently being redeveloped for residential development by Persimmon Homes (see 6.3.7 below). The site is within walking distance of the town centre and also is well located in relation to the town's railway station and there are also bus stop facilities located along Water Street. The site is therefore a relatively accessible, brownfield edge of centre location.

The planning application was accompanied by a Retail Assessment, Transport Assessment, Landscape Supporting Statement, Design Statement, Ecological Assessment and Flood Risk Assessment. The Retail Assessment has been updated following the retail audit by CgMs Consultants requesting that the assessment was conducted on a "goods" rather than a "business" basis. It also re-examines the relevant issues in the context of national and local policy guidance and assesses the potential trading consequences and benefits associated with the proposed store. A Consultant's desktop study report in relation to noise from the proposed development was submitted during the processing of the application.

The Retail Assessment (RA) states that the proposal is to provide a modern main (bulk) food store designed to meet the existing and growing needs of Pontardulais and its surrounding catchment area. The RA indicates that the proposed store will provide a broad range of convenience products accounting to 1,554 sq. m (16,729 sq.ft.) or 62.2% of the retail sales area. The store will also provide a range of comparison goods accounting to 886 sq. m (9,539 sq.ft.) or 37.8%, typically including health and beauty products, pet foods, videos/CDs and small items of homeware. However, the RA does confirm that the proposed Tesco store will not include a cafeteria; pharmacy; opticians; post office; or dry cleaners. It is submitted that the absence of the above services within the proposed store coupled with the provision of a pedestrian link will encourage Tesco shoppers to undertake linked shopping trips to Pontardulais town centre. It is argued that the linked shopping trips would deliver spin-off economic benefits for existing town centre businesses, encouraging the revitalization of the town centre and ensuring the scheme's physical and economic integration with the town centre. In order to better integrate the proposed store to the town centre, and to improve the existing town centre, Tesco have offered a Unilateral

Undertaking to pay £70,000 and £250,000 to fund a pedestrian link and town centre improvement works respectively.

It is indicated that the store's 325 space car park will provide additional short term public parking in close proximity to the town centre and additionally, would serve the doctor's surgery on Station Road, where parking frequently spills on to the road. A car park Management Strategy document has been submitted, which includes a two hour waiting limit, in order to control usage of the store car park by customers. The existing boundary wall along Station Road will be largely retained, but may need to be rebuilt using stone.

It is also indicated that the construction of the proposed store would allow the relocation of the existing industrial occupier of the site, David Mathews Ltd., to more suitable premises, thereby enabling them to operate in purpose built premises and secure the future of their business. The existing buildings on the site are in poor condition and the demolition of the existing buildings would present an opportunity to improve the visual appearance of the area. The proposal would therefore safeguard the existing employment of the current occupier, whilst it is stated that the proposed Tesco store will provide an opportunity of delivering up to 280 jobs.

The proposal was subject to a screening opinion under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 prior to the submission of the planning application to assess the requirement for an Environmental Impact Assessment (E.I.A.) to accompany the application. It was concluded that the proposed development would be unlikely to raise any significant environmental issues more than of local importance, and that the scale of the store would not exceed the tolerances within the E.I.A. Circular (02/99) which indicates that an EIA is more likely to be required for

proposals to redevelop land on a greater scale if the site is greater than 5 hectares or would involve more than 10,000 m^2 of new commercial floor space. It was therefore considered that an Environmental Impact Assessment was not required.

A recommendation to refuse the application has been made, for the following reason**: "**The application fails to adequately demonstrate the need for the size and type of store proposed at this location and that the development would not have an unacceptable adverse impact upon the Pontardulais Shopping Centre as a whole and the potential for enhanced shopping facilities within the broader catchment area, and that a sequentially preferable site is not available. As such the development fails to accord with Structure Plan Policies S2 and S4, Southern Lliw Valley Local Plan Policies S1, S3 and S9, Draft Swansea Unitary Plan Policies SP6, EC4 and EC5". Further updates will be provided dependant upon the applicant submitting an appeal within subsequent reporting

6.2 Mixed Use Developments

6.2.1 SA1 Development

The SA1 Development is located alongside the River Tawe and the Prince of Wales Dock and covers an area of approximately 40 acres. The proposed development lies approximately 450 metres south of, and outside of, the Hafod AQMA. The site extends from the eastern bank of the River Tawe 1.2 Km eastwards. The A483-Fabian way forms its northern boundary. The A483 is one of the principal routes into and out of Swansea and connects to junction 42 of

the M4. The eastern boundary of the site extends to the Port Tennant district of Swansea.

To the south and east the site is surrounded by the existing dock's complex. The Swansea-Cork Ferry operates from a berth to the south of this development. The River Tawe Barrage is also located close to this development and the Maritime Quarter is located to the west of the development.

Existing businesses that are traditionally associated with docks i.e. sand dredging and building supplies will be relocated to existing derelict plots elsewhere within the docks complex.

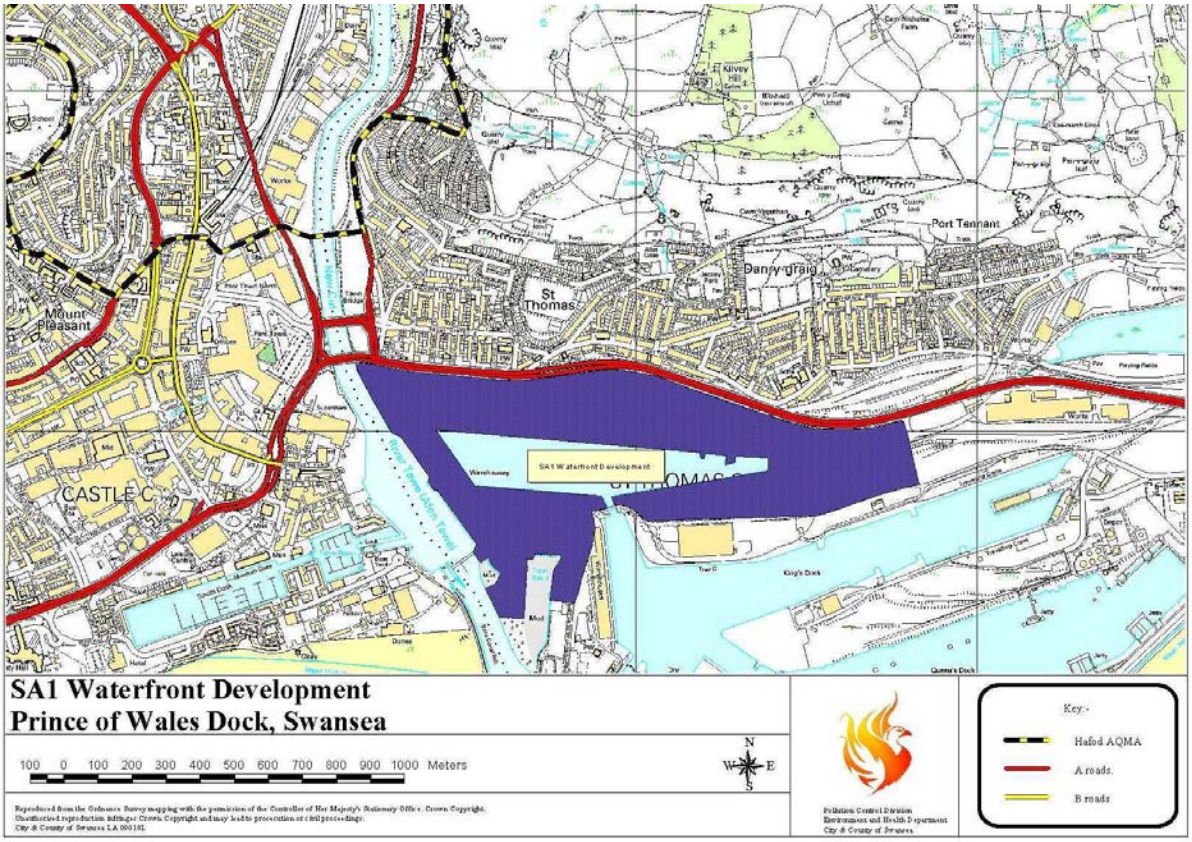
The SA1 Development is proposed as a mixed-use development combining residential and commercial development. The development will extend the waterfront along both banks of the River Tawe. Development works have been divided into zones A-F and will be undertaken in four phases running from 2002 to 2017. Phase 1 began during late 2002 with extensive redevelopment works taking place during 2005-2006. Some elements of the scheme were available for occupation during the late summer of 2005.

The Environmental Statement submitted concludes that the results of the Design Manual for roads and Bridges (DMRB) screening assessment indicate that no exceedences of air quality standards at sensitive sites closest to the A483 and the Quay Parade bridges are predicted. Assessments undertaken for future traffic flows (2005-2017) and traffic directly associated with the development indicate that both nearby and existing residents along with new residents are unlikely to experience a significant deterioration in air quality with all objectives being met in both 2005 and 2017. The Environmental Statement states that whilst traffic flows are not disputed to show an increase as a result of the development, any effect from this increase in traffic flows and resultant emissions will be

mitigated by technological improvements in emissions management. However, recent EIA submissions based on detailed modelling for the most recently released phases within the development are starting to contradict this view. Modelling projected to 2010 is indicating that the whole of the SA1 development and surrounding existing residential areas will fail the as yet provisional PM_{10} annual mean standard.

A new traffic signal controlled access road into the development site was completed during March/April of 2006 at the junction of the main A483 Fabian Way and Port Tennant Road. The development site will also be capable of being access by the existing "docks entrance" at Quay Parade Bridges.

The location and extent of the development is indicated within map 14 below.



Map 14 - SA1 Development Site

6.2.2 Tawe Vale Development Site

The Tawe Vale development lies to the north-east of Swansea, approximately 5 miles from the City Centre and approximately 2 miles from the northern most boundary of the Hafod AQMA. The site as a whole covers 190 hectares of what was originally urban fringe land, of mixed use ranging from improved agricultural land to derelict “brown field” sites. An Environmental Statement was submitted in May 1993.

The overall proposal is for a mixture of housing, business, industry and leisure uses. Proposals have been made to provide for up to 1800 new homes on approximately 132 acres of the site. The housing is intended to provide clusters of villages separated by landscaped areas. A range of housing types will be provided but as yet the precise mix and distribution of private and social housing has yet to be finalised. Residential land parcels are to be sold to interested developers and, given the large-scale provision of housing land at this site the development of the overall housing provision will take place in a phased manner over a long term. Construction of one “village” commenced in late 2001/2002 with the homes being occupied during early 2003. Further extensive housing developments were undertaken during 2003 -2007 with the majority of these dwellings, also now fully occupied.

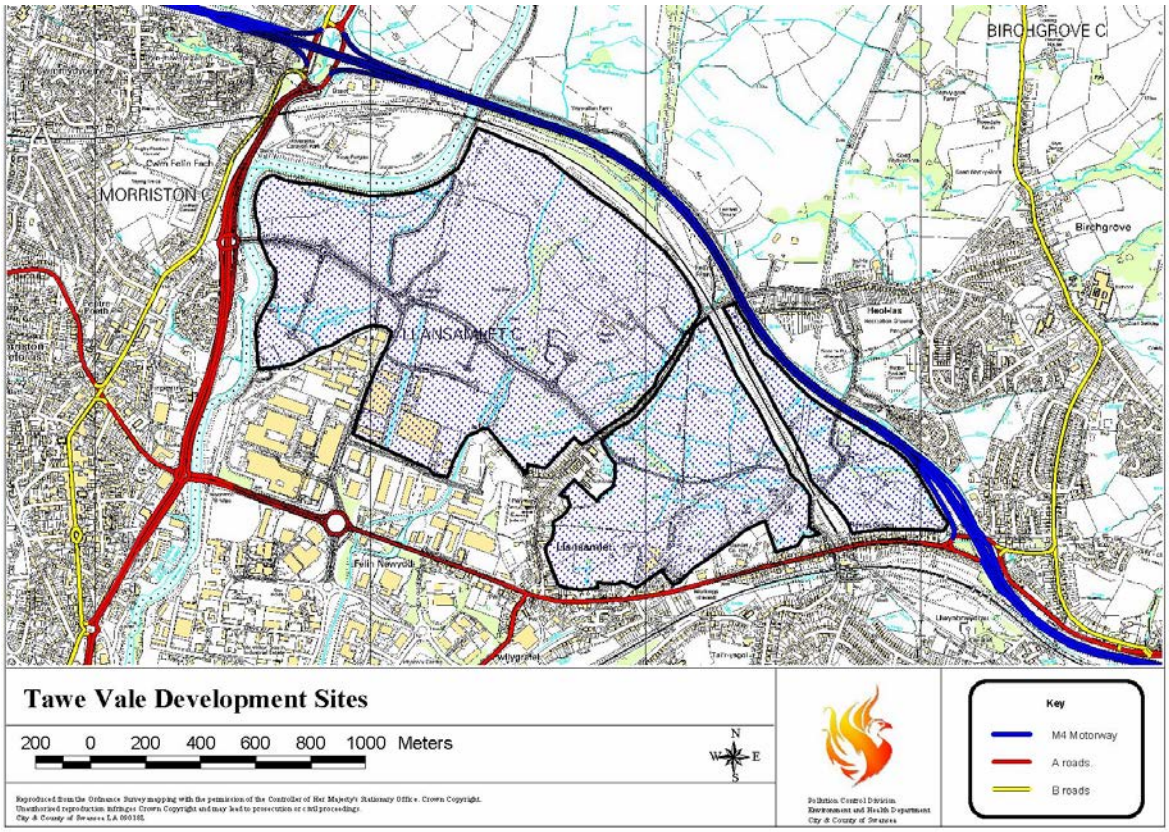
Employment provision is made for at approximately 100 acres. As with the housing proposals, the employment sites have been divided into discrete parcels, each of which is proposed to be situated within a landscaped setting. A mix of employment uses is envisaged, within a high quality business park.

The main leisure provision is via a golf course and recreational use of the designed open spaces will be encouraged through the extension of the footpath

and cycle networks along the River Tawe. The golf course development has yet to commence.

The Environmental Statement identified problems with the overall road network that existed with heavy congestion on the A4067 and A48 at peak times. Works have been undertaken during the last several years to improve the A4067 with the construction of an underpass at the Wychtree roundabout intersection with improvements to the A48 also being made. The development has seen the provision of a new dual-carriageway access from the A4067 and a single lane access from Church Road, Llansamlet. The M4 motorway runs from east to west around the eastern and northern boundaries of the site. Access can be gained indirectly from junctions 44 and 45 of the M4.

The development site overall will see the continued development of all the provisions that make up the overall scheme over the next several years. The extent of the development site as a whole can be seen in map 15.



Map 15 - Tawe Vale Development

6.2.3 Seagate and Ferrara Quay, Trawler Road, Maritime Quarter.

This mixed use application was granted full planning on the 10th March 2005 and comprises:

Ferrara Quay

- A twenty nine storey tower with retail/leisure use (Class A1/D2) at ground floor, restaurant (Class A3) on the top floor and 124 residential uses throughout the interim levels (Ferrara Tower);
- One six storey block with ground floor commercial uses (retail Class A1/A3, leisure use Class D2 and Office Class B1) and 20 residential units above (Ferrara Block A);
- One part six storey/part ten storey block with ground floor commercial (retail Class A1/A3, leisure Class D2 and office Class B1) and 41 residential units above (Ferrara Block B);

Seagate

- One six storey block with 47 residential units with ground floor commercial unit (office Class B1) (Seagate Block A);
- One part seven/part nine storey block with 41 residential units (Seagate Block B);
- Two nine storey towers providing 18 residential units (Seagate Tower 1 and 2);

Plus

- Two hundred and thirty four undercroft car parking spaces (78 spaces at Ferrara Quay and 156 spaces at Seagate);
- Refurbishment of existing Camona Drive multi-storey car park to provide 67 allocated;
- Associated areas of open space, landscaping, pedestrian routes and infrastructure.

The application site in the main comprises two distinct areas separated by Trawler Road in the Swansea Maritime Quarter. The seafront area (Seagate) measures approximately 0.35 hectares and has a southern frontage boundary onto the established seafront promenade and a northern boundary to Trawler Road. The site is currently vacant and predominantly level and grassed. The land is approximately 2m above Trawler Road level and slightly elevated above the promenade. The dockside area (Ferrara Quay) measures approximately 0.27 hectares and has an extensive northern frontage to the dockside walkway. The ground is level and the southern boundary adjoins Trawler Road. Ferrara Quay is currently in use as a pay and display surface car park.

A further element of the site is the Camona Drive multi-storey car park, which is an existing 120 space facility of four mezzanine floors located on the southern side of Trawler Road, to the east of the Seagate site. The upper two floors comprise 38 public car parking spaces and 15 spaces allocated to local residents. The remaining 67 lower car parking spaces are currently cordoned off and are unused. It is proposed as part of the scheme to introduce lighting, CCTV and generally upgrade the lower floors. The number of car parking spaces will not change; however, 59 of the unused spaces would be used by occupants of

Seagate and Ferrara Quay, with the remaining 8 spaces used by the commercial units.

The main element of the proposal involves the introduction of high density mixed use development on the Seagate and Ferrara Quay sites. This is predominately residential, adding a further 291 apartments to the existing complement of living accommodation at the Maritime Quarter. This is made up from 138 two-bedroom apartments, 11 three-bedroom apartments, 12 three-bedroom penthouse apartments, 124 one-bedroom apartments and 6 one-bedroom penthouse apartments. Added to this are commercial uses totalling 2,500 square metres, positioned at key locations on the ground floor as well as in the top two levels of the tower. The majority of the car parking (234 spaces) would be accommodated within the basement and semi-basement levels beneath both halves of the site.

The strategy for the development is based upon the use of three distinct architectural forms: -

- The most significant of these is the high-rise tower of 29 storeys at the western end of the Ferrara Quay site, which would measure 90m in height by 40.5m in width. Its elliptical plan derived from the sweep of Trawler Road is carried through its full height resulting in a blade-like form. The tower is positioned so that its curved form 'hugs' the side of the road. It is oriented with its narrow ends facing due east and west and its broadsides facing due south and north. Particular attention has been paid to the design of the uppermost storeys that would accommodate a restaurant. The roof of the tower is raised above two storeys of glass and inclined towards the east. Otherwise, the materials employed on the elevations are intended to reinforce the tower's smooth curved planes. The composition is based on a series of

bold verticals such as the multiple stacked balconies and slender rendered panels designed to disguise the tower's apparent width.

- In addition to the main tower, four smaller towers are proposed; three nine storey towers measuring 28m in height and 11m in width aligned alongside the promenade on the Seagate site and one ten storey tower, measuring 31m in height and 11m in width, at the north east corner of the Ferrara Quay site at the end of the six storey Ferrara Block B. The Seagate towers would enclose semi private gardens at regular spacing thereby permitting views into and out of the development through the gaps. These towers are slender in proportion and intended to provide a distinctive, albeit less imposing frontage to the promenade.

- The remainder of proposed development comprises predominantly 6 storey blocks known as Ferrara Blocks A and B and Seagate Blocks A and B. These are intended to be the 'background' architecture that unify the development and create an urban structure that provides enclosure and continuity to the Trawler Road and dockside frontages. The blocks would also frame two new public spaces: Ferrara Square next to Trawler Road and Ferrara Quayside, next to the dock. Additionally the design of these blocks are intended to establish an aesthetic rapport with the warehouse inspired render and brick architecture of the existing Maritime Quarter which are of similar scale and materials.

Turning to the treatment of the public realm around the buildings, it is proposed that the promenade would be integrated with the site where it would border the development by the introduction of a broad raised plinth designed to bring pedestrians closer to the level of the semi-private 'Seagate Gardens'. A series of interweaving ramps and steps are proposed to link the western end of the

promenade to Trawler Road, whilst a link between the promenade and Trawler Road and the dock edge is proposed along the western side of Camona Drive. On the opposite side of Trawler Road, Ferrara Square is intended to act as the hub at the centre of the development with further routes linking to the dock edge. Because of the semi-basement car park, the level of the two linked squares at this location is raised above Trawler Road and the dock edge, consequently a number of ramps and steps are proposed. The dock edge walk would be linked to the development at four separate locations.

In view of the scale of the proposed development, it has been necessary to analyse the potential changes it may cause to wind speeds, especially at pavement level. The results have identified the need for the positioning of additional artificial and natural screening at strategic locations throughout the development to mitigate the effects of worse case scenario wind speeds. Although the precise design of the wind mitigation measures are not yet finalised, it is likely they would include trees and sail-like screens within both squares on the Ferrara Quay site, transparent screens positioned at both ends of the north-south link between Ferrara Blocks A and B and Camona Drive with canopies around the base of Ferrara Tower and Ferrara Block A.

It is proposed that the development be constructed on a phased basis as follows:

- Phase 1: Seagate Block B
- Phase 2: Seagate Block A
- Phase 3: Seagate Tower 1
- Phase 4: Seagate Tower 2
- Phase 5: Ferrara Block A
- Phase 6: Ferrara Block B

- Phase 7: Ferrara Tower
- Phase 8: External Works

Phases 1 - 7 would commence construction at the same time although it is envisaged that occupation of these phases will occur in the order listed above. Phase 8, external works, would be developed as an integral part of each development phase.

The Seagate element of the development site commenced construction works during June 2006 with works progressing during 2007. The remaining developments also commenced works during 2007. Map 16 below indicates the extent and location of the development.

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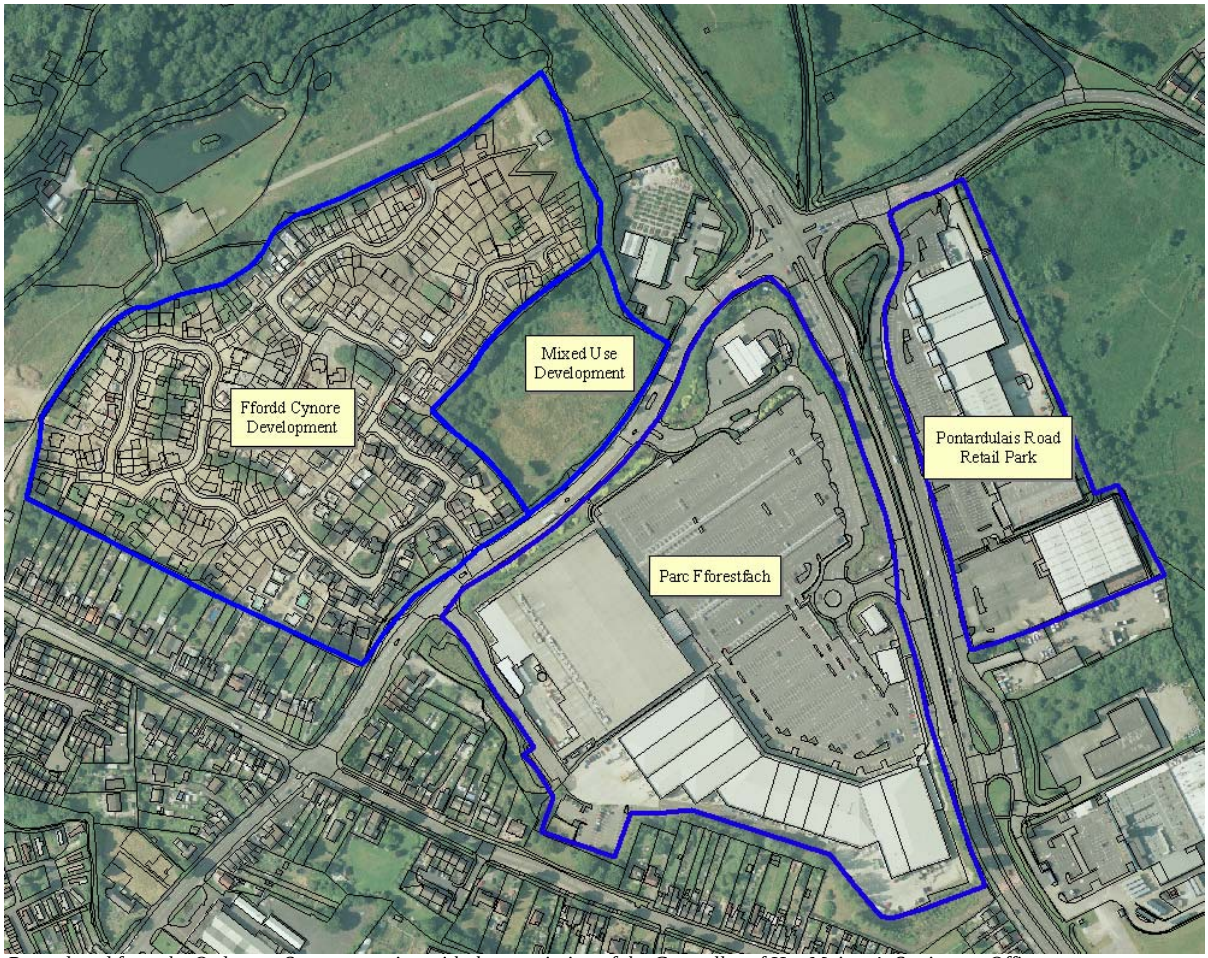
Map 16 - Seagate and Ferrara Quay Development, Trawler Road, Maritime Quarter

6.2.4 Ffordd Cynore Development, Fforestfach

A formal Planning Application has not been received as yet for the proposed mixed use development on the site outlined within map 17 below. However, it is anticipated that any application will seek to include residential dwellings, along with a hotel/pub/restaurant. This section should be read in conjunction with sections 6.1.2 (Parc Fforestfach) and section 6.3.1 (Ffordd Cynore Development) which are located adjacent to the proposed site.



Map 17 - Ffordd Cynore Mixed Use Development, Fforestfach

6.2.5 Swansea Point (Spontex Site), Marina

This development is taking place on a brown field site formally occupied by sponge manufacturers Spontex. Planning approval was given in 2004 for a mixed-use housing and commercial development. Works are currently in progress with the vast majority of the site now developed. Residential occupation of those dwellings that have been completed commenced during 2007.

The proposal is for a dense urban development that would reflect the character of the adjacent area and the aspirations of the City and County of Swansea's Development Brief. The buildings would define the edge of the streets, which would in turn create a series of spaces that connects the residents and visitors into the pedestrian network of Swansea Marina and across the River Tawe into the new Swansea Waterfront development. To meet the demands of providing an active public frontage on the street and private residential areas, the design concept illustrates how the buildings set along the street frontages, would create private courtyard areas for amenity and vehicular access. In this way all the residential car parking would be provided within the courtyards with public car parking provided along the promenade and next to the mixed use area.

The focal point of the development would be The Point, a 10 storey landmark building on Harbour View Square next to the River Tawe and harbour entrance. The proposed location of The Point is at the termination of the seafront promenade and Trawler Road; it would be the natural destination for the main pedestrian routes and a significant landmark on the Swansea skyline.

The proposed Atlantic Square would provide a new public place, focused on the attractive barrage area and the new pedestrian link across the river. Within the Square would be provided a wide range of A3/leisure and support activities to enliven the public realm for all those living and working in the area.
The continuation of the seafront promenade is an integral part of Swansea Point. The promenade will extend along the whole southern frontage of the site, next to the dunes and around the eastern side next to River Tawe before joining the public area next to the barrage. It would also provide access to the two main pedestrian routes across the site, which connects into Swansea Marina.

The proposed land uses illustrates in indicative form the proposed layout of the development. The majority of the site has been identified as being appropriate for residential development in the form of townhouses and apartments. It is proposed that the site has the capacity to accommodate some 600 units in total. These would be laid out along the street frontages with private spaces located within the residential courtyards. Dual access is promoted for all properties onto the street and courtyard.

The mixed-use component of the scheme would be predominantly sited on the northeast of the site next to the River Tawe and Maritime Quarter. Atlantic Square forms the focal point of the mixed use development with 440m^2 of A3/leisure use on the north side of Atlantic Square, 480m^2 of A3/leisure use on the south side of Atlantic Square and a further 480m^2 of A3/leisure use on the ground floor of the hotel building next to Atlantic Square. In addition, 300 m^2 of commercial use is located on the ground floor of the block overlooking the Maritime Quarter. This will be used to provide accommodation for the Sea Scouts, who would need new accommodation when their existing building on Pilot Wharf Quay is demolished to make way for Atlantic Square to connect onto the barrage area.

A 3 star 60-bed hotel is proposed, that would cover 2,400m^2 on 6 floors above the ground floor A3/leisure use. 1,440m^2 of work units are also provided above the ground floor leisure facility on the south of Atlantic Square.
The car park to serve the leisure development in Atlantic Square and the public parking required for these uses would be provided in the multi-level car park adjacent to the new development. A waterfront A3/leisure use would also be located next to the public car park on Harbour View Square. This would provide 700m^2 of space on 2 storeys and 25 car-parking spaces dedicated to the leisure use. A 500m^2 play area is proposed next to the leisure use.

In addition three new public places are proposed, comprising:

- Crescent Park – a 0.3 ha green amenity area in the centre of the development and the crossroads for many of the pedestrian routes;

- Atlantic Square –the heart of the mixed use development with the building frontages providing a dynamic shape to the square opening out onto the river and barrage; and

- Harbour View Square –the termination of the seafront and riverfront promenades. The square would accommodate a number of different functions including a turning area for buses, public car parking, leisure use with car park and 500m^2 play area, together with car parking to serve the adjacent Point 10-storey residential development.

The proposed spaces would accommodate the pedestrian, cycle and vehicle movements into and through the site. Trawler Road would continue on a new alignment through the scheme to terminate at a new roundabout next to the promenade and new public car park at Harbour View Square. Trawler Road

would also provide access to the multi-level public car park next to Atlantic Square. Further public car parking is proposed to be located on the west of the site at the end of Slipway Road.

The network of pedestrian routes in Swansea Marina, are continued through the development to connect to each other and onto the promenade. The seafront promenade would be designed to accommodate the train/people carrier that the City & County of Swansea will be providing at a later date. A new bus turning area would be provided in Harbour View Square at the termination of Trawler Road and a series of bus stops provided along the highway. It is also proposed that the main pedestrian/cycle routes within Swansea Point would form strategic connections to other parts of the city centre. There is also scope for the development to include offsite improvements next to the Boat yard, to open up the pedestrian link across Trawler Road and the provision of a pedestrian bridge across the lock of Swansea Marina.

Access and egress from this development will be via Trawler Road which itself is accessed from the A4067 Oystermouth Road located to the west of the development. Also using Trawler Road as an access/egress will be the developments outlined within section 6.2.3 above **(**Seagate and Ferrara Quay, Trawler Road, Maritime Quarter).

The southern boundary of the Hafod AQMA is approximately 1000 metres north of the development. Immediately to the east of the development and across the River Tawe is the SA1 development site.

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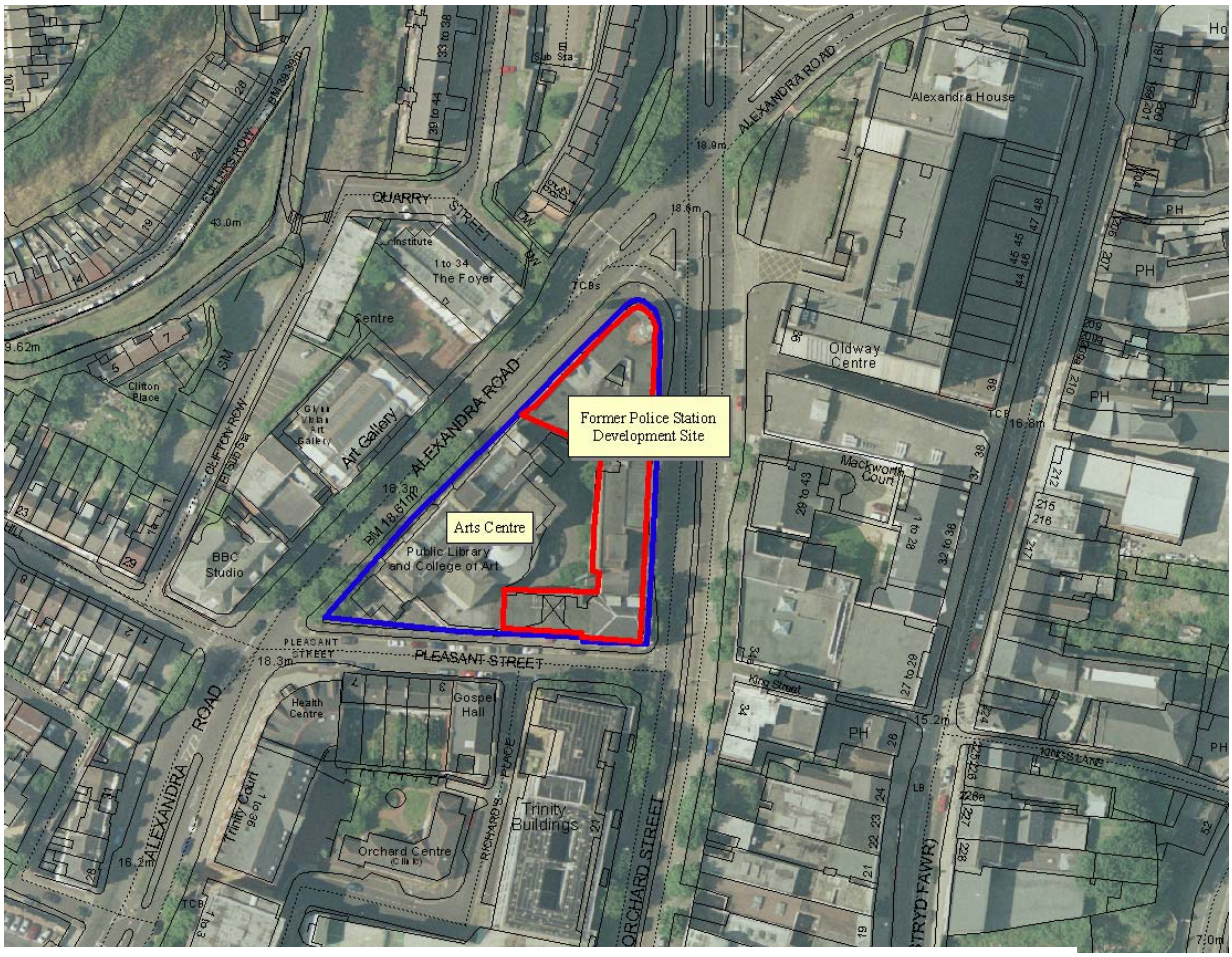
Map 18 - Swansea Point Development

6.2.6 Former Swansea Central Police Station, Alexandra Road / Arts centre/ Restaurant

The former Swansea Central Police Station now lies within the revamped one way traffic system introduced as part of the Swansea Metro scheme (see 6.7.4 below). The site lies at the junction of 3 traffic signal controlled junctions and at peak times traffic can be seen queuing down the new one-way system along Orchard Street and Alexandra Road. Traffic can join Orchard Street to the southern boundary of the development again by way of a traffic signal controlled junction. Queuing traffic can at peak times surround the development site on all three sides. The impact of this in terms of air quality has yet to be

assessed as monitoring is impossible at the moment due to the constraints imposed by the construction activities. An outline of the whole development site can be seen shown in blue within map 19 below with the former Police Station outlined in red.



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Map 19 Former Swansea Central Police Station Development

The application seeks planning permission for the construction of 4th storey roof extension to Orchard Street and Alexandra Road elevations, construction of 3rd storey roof extension to Pleasant Street elevations, erection of courtyard sub-station, addition of solar panels to roof of former cell block, landscaping to internal courtyard area and change of use of former police station to restaurant

(Class A3), offices (Class B1) and arts studio/workshop (Class D1) at ground floor level; arts studio/hall (Class D1) and offices/board room (Class B1) and 27 student accommodation units with associated kitchen diner facilities at first floor level; arts studio/offices (Class D1/B1) and 29 student accommodation units with associated kitchen diner facilities at second floor level and 24 student accommodation units with kitchen/diner facilities at 3rd floor level.

Internally on the ground floor the proposed redevelopment seeks to provide an Arts Centre of studio and exhibition space for artists with its principal entrance being from Alexandra Road, opposite the Glynn Vivian Art Gallery along with a restaurant with aspects to Orchard Street and the new internal public courtyard. Ancillary office space is also proposed at the ground floor. The mix of uses and configuration of entrances and access to the courtyard is intended to reflect the aspirations for revitalising the block as a cultural centre to the city, generating necessary level of street life to animate the site and benefit/compliment the activities of the surrounding locality. The student accommodation is proposed on three floors above ground floor with the principal entrance on Alexandra Road.

No suitable on-street parking facilities are available for residential use and there is no proposal to introduce such facilities. No parking permits will be made available for residents. Whilst the development was completed during 2007, occupation is yet to take place.

6.3 Housing Developments

There are a number of developments that are either underway, have just gained Planning approval or are within the initial stages of the Planning Approval process. The major developments are listed below.

6.3.1 Ffordd Cynore Development, Fforestfach

The application for the construction of 230 dwellings on the former Brynau-Duon Farm on behalf of 3 developers was originally refused planning permission on the 16th January 2003. The reason for refusal was: "The development by virtue of traffic generation would exacerbate existing traffic congestion in the vicinity of Parc Fforestfach to the detriment of the safe and free flow of traffic in the area". However, the applicants appealed against the authorities decision and approval for the development was given upon appeal.

Construction works commenced during the early summer months of 2004 and a limited number of dwellings were occupied during the early months of 2005. Additional works are now complete and the vast majority of completed dwellings have now been occupied during 2007. Construction of additional dwellings remains in progress. The extent of the development can be seen within map 20 below.

Access and egress to the development site is via a junction on Ffordd Cynore. This junction is within approximately 170 meters of the main traffic signal controlled junction leading into Parc Fforestfach and within 330 meters of the signal controlled junction of Ffordd Cynore with the A483 Pontardulais Road.

To the west of the site access and within approximately 130 meters is the signal-controlled junction with Ystrad Road and Carmarthen Road.

Map 20 -Ffordd Cynore Development, Fforestfach

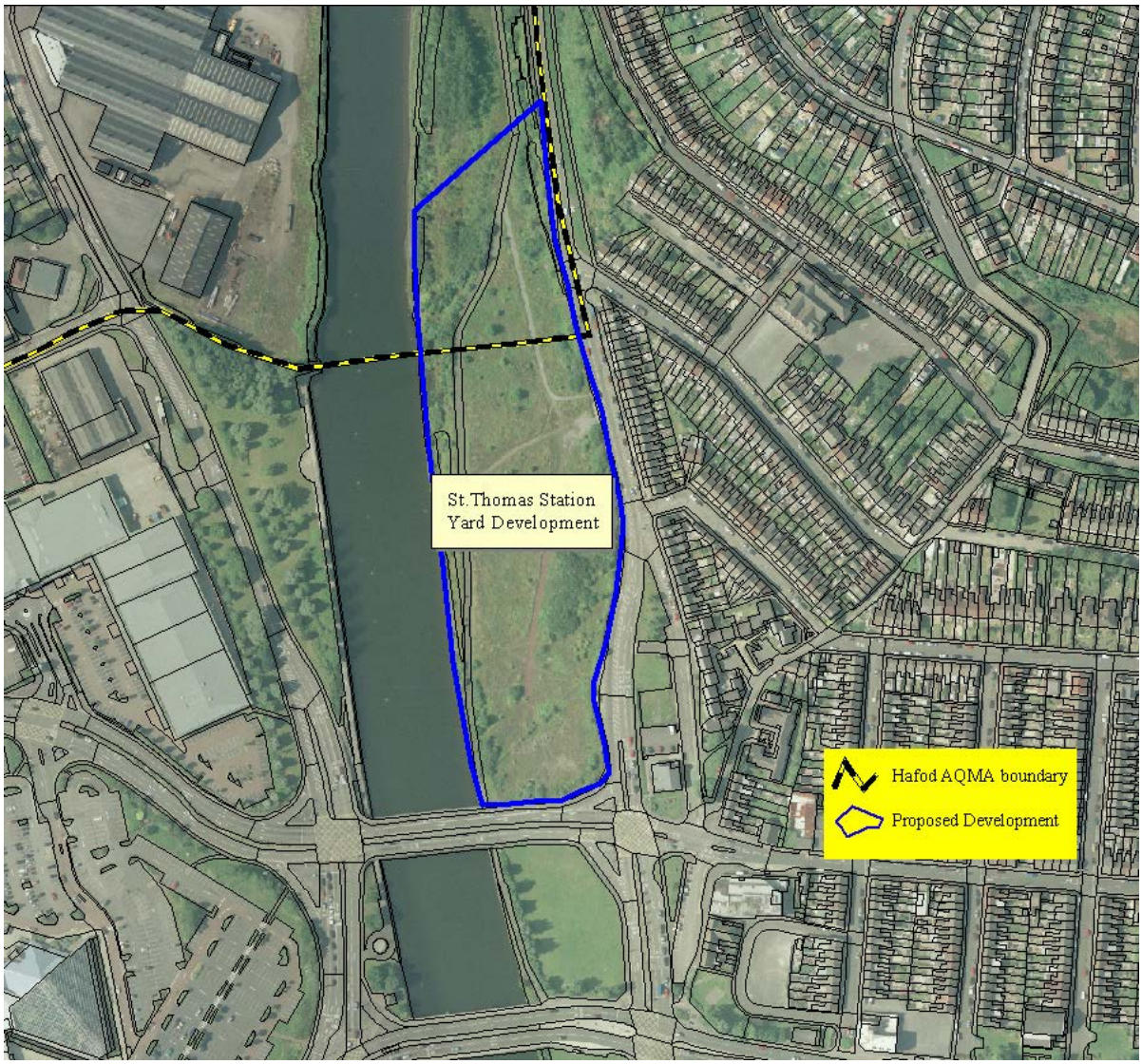
6.3.2 St.Thomas Riverside Development

Outline planning consent was approved on the 14th July 2003 for a hotel and residential development. The residential development comprises of 50 combination three/four storey townhouses, 169 apartments in six, 5.5 storey pavilions, one 4.5 storey pavilion and one block rising from four storeys to 7.5 along with associated car parking. Landscaping and infrastructure requirements will also be undertaken.

The majority of the site is located on a former railway station yard that has been contaminated through its former use.

The site itself lies part within the Hafod AQMA, with the majority of the site lying just outside the boundary of the Hafod AQMA. Pentreguinea Road is subject to heavy congestion during peak times and will be affected by any re routing of traffic through the lower valley routes and more importantly by the existing Quay Parade bridges. Attention will be given to the access and egress from this site and whether this will compound the existing congestion.

An application for formal planning consent was received during 2005 but was rejected due to the intensity of the development. A modified scheme will be resubmitted shortly to include an element of social housing as a result of the appeal process. The WAG Planning Panel are yet to issue its formal decision.



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Map 21 - St Thomas Riverside Development (Former Station Yard Site)

6.3.3 Bryngwyn Steelworks Site

The 13 hectare (about 32 acres) Corus Plant at Bryngwyn closed in June, 2001 and an outline application for the comprehensive redevelopment of this "brown field" site was received. The former industrial site is bordered to the west by the residential properties of West Street and Libanus Road together with the Gorseinon Business Park, with more housing to the north along Lime Street. The eastern boundary is bordered by the Afon Lliw with the Mardy Industrial Estate

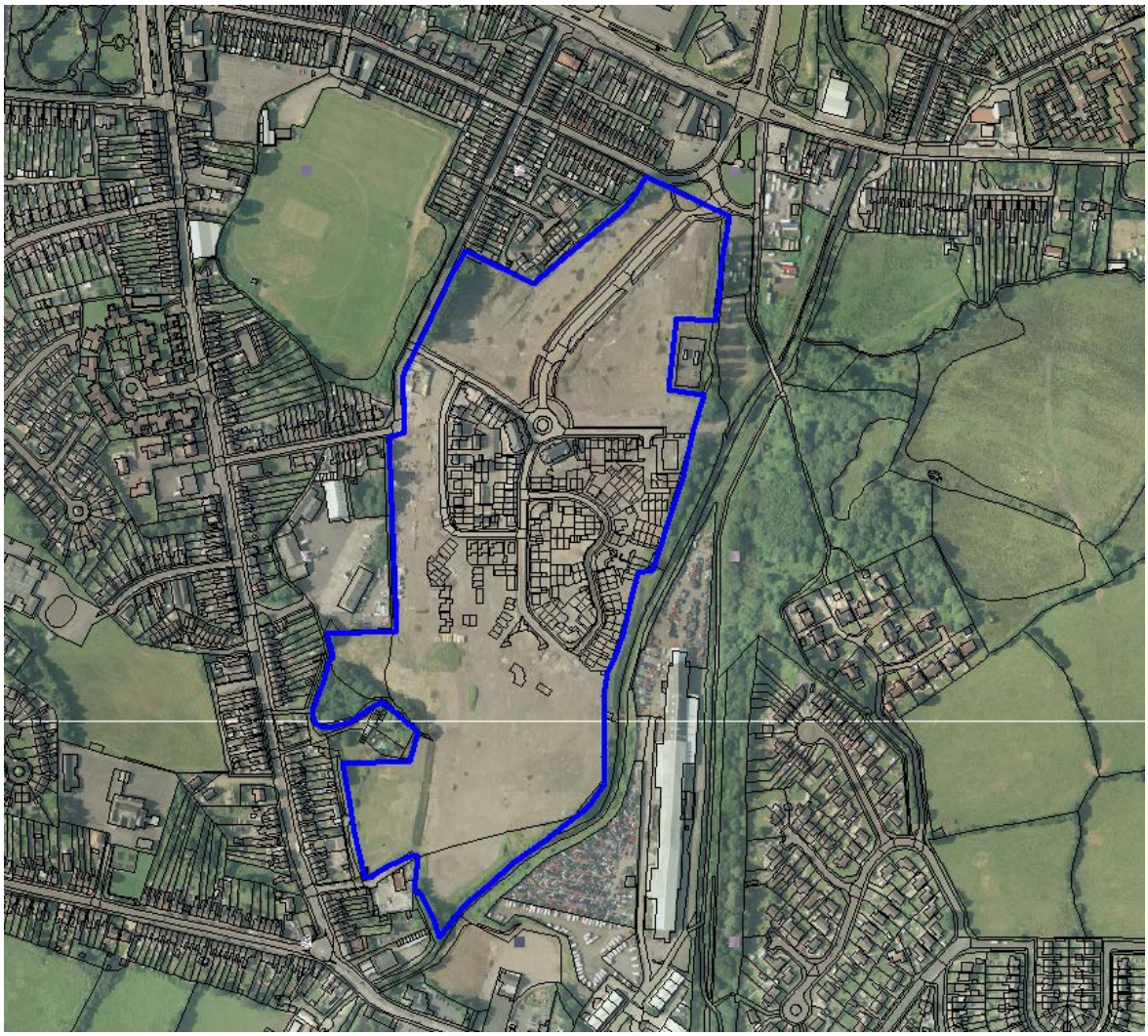
on the eastern banks of the river. The centre of Gorseinon lies approx. 500 metres to the north west of the site.

Outline planning permission was approved on the 9th December 2003.

The outline application was for a mixed use redevelopment comprising residential development, a community enterprise centre and economic development. The application was accompanied by an illustrative land use plan, which provides a draft allocation of 21 acres of residential land, 6.4 acres of economic development and 4.5 acres for the community development facilities. The applicants (Corus) sought a valid planning permission to dispose of the site to a developer, who would then carry out the demolition of the buildings and the site remediation and preparation, in advance of the site's redevelopment.

A reserved matter approval for the construction of residential development of 376 units (reserved matters approval pursuant to outline planning permission 2003/1241 granted 9th December 2003) was approved during August 2004. A further reserved matters application for the construction of residential development of 359 units was approved during November 2004.

Works are now complete with the vast majority of the dwellings beeing occupied during 2007. Some community based schemes remain to be completed but the vast majority of construction works are complete.



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Map 22 - Former Bryngwyn Steelworks Development Site

6.3.4 Former Marcroft Engineering Site, Port Tennant

The 4.6 hectare site at the former Marcroft Engineering Works, Port Tennant has been derelict for some time and an outline application has been made for the comprehensive redevelopment of this "brown field" site. The former industrial site is bordered to the west by the residential properties of Wern Terrace, and to the east, by the Crymlyn Bog Site of Special Scientific Interest (SSSI). The south-eastern boundary of the site is bounded by the main access road to the Tir John landfill site located approx. 250 metres to the east. The former Marcroft

Engineering Works buildings consist of two large disused workshops, a series of temporary 'portacabins' and associated peripheral facilities such as outbuildings, areas of hard standings, cranes, as well as fuel and chemical storage tanks. Whilst the application was initially submitted for outline consent it is indicated that access would be obtained to the north of the site from Danygraig Road/Tir John North Road. However, it is indicated that site access for construction traffic, particularly HGV's, could be obtained from the Tir John landfill site access to the south, which would reduce the impacts to local residents located along Danygraig Road.

The applicants submitted a detailed application for the residential development of the whole site, which has now been approved. The applicants sought a valid outline planning permission to establish the principal of the redevelopment of the site for residential purposes which would see the construction of 232 units with the formation of a new access road off Danygraig Road. This justified the demolition of the buildings and ancillary structures on the site and to commence the site remediation and preparation, in advance of the site's redevelopment. The development site is to be split into 3 phases with different developers undertaking construction within each phase.

Phase 1 to the north of the site commenced during 2007 and works are ongoing. Development of phase 2 is envisaged to commence during 2008.

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Map 23 - Former Marcroft Engineering Development Site

6.3.5 Pearl Building City Centre

Pearl Assurance House overlooks the Kingsway and the new one way system within the city centre introduced as part of the Swansea Metro scheme (see 6.7.4 below) and consists of a three storey building with retail units at ground floor. The application was accompanied by a Design Statement. Planning permission has been given for the conversion of the first and second floor levels from office and retail storage space together with the construction of a three storey rear extension and the addition of a third floor to provide 42 self contained flats (Class C3), and other external alterations. Map 24 below outlines the

development site. Please note that the roundabout has been removed as part of the Metro scheme and one way system introduced during 2006.

Map 24 Pearl Building Development Site, Kingsway,Swansea.

The development site overlooks the former location of the Swansea AURN air quality station on Princess Way which can be seen within map 24. This station was itself relocated during late 2006 due to the demolition and redevelopment of the David Evans buildings complex to the east of the station. Traffic flows have radically altered since the introduction of the one way system and the façade of this building will in all likelihood form part of the diffusion tube network operated by the authority once the development is completed.

Policy H5 of the Swansea Local Plan Review No.1 presumes in favour of the conversion of vacant or underused upper floor space above commercial properties for residential purposes subject to satisfactory access and parking arrangements (where appropriate), detailed design considerations and the relationship with and impact upon adjacent uses. The proposed change of use of the upper floors will result in the reuse of a large area of redundant floor space. Its conversion to a residential use will make a valuable contribution to the city's housing stock as well as securing a diversity of uses. It is therefore considered that the change of use of the upper floors of this building complies with policy H5 of the Swansea Local Plan Review No.1.

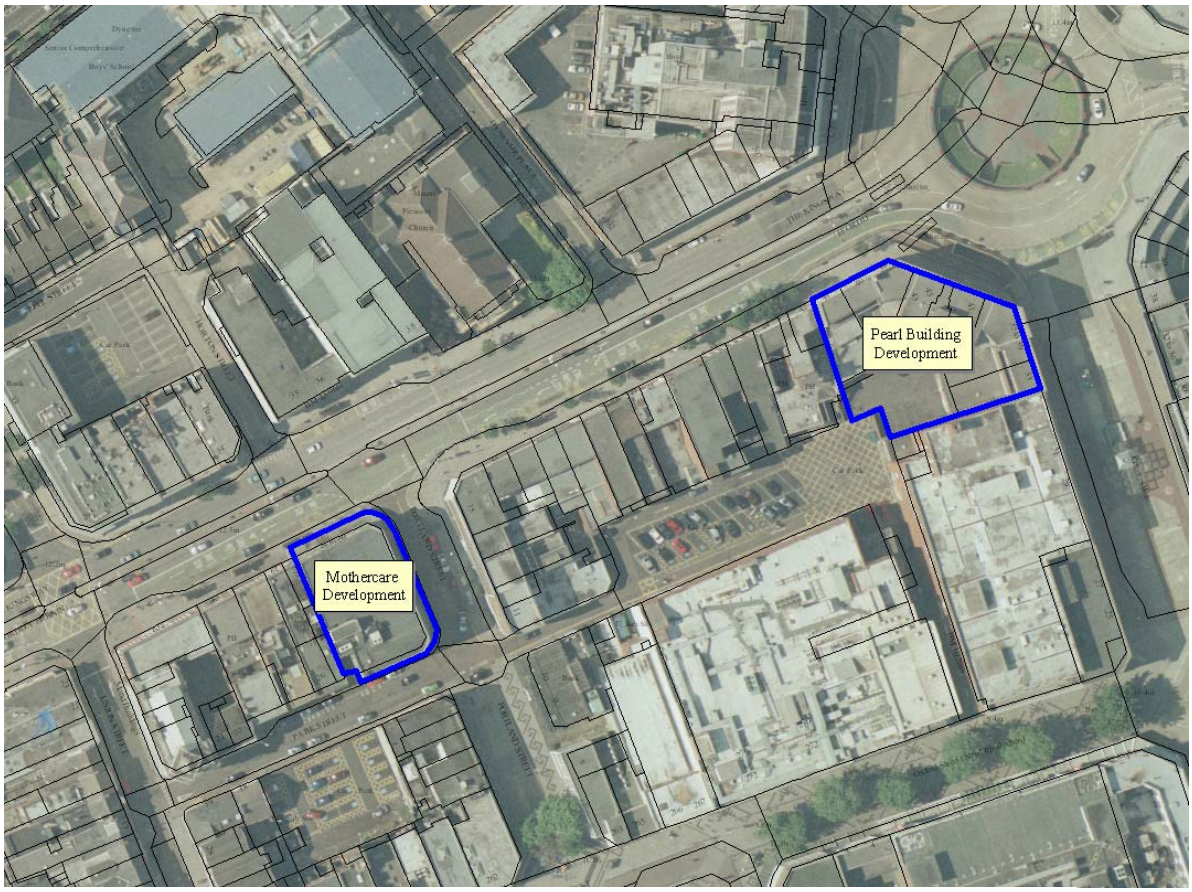
It is proposed to retain the existing ground floor entrance on The Kingsway and to enhance the internal lobby area by providing an internal level access and the provision of a lift. The retention of the existing entrance is important for aesthetic reasons but also from a Community Safety perspective. The entrance will serve the whole of the development, providing secure access and lead to a stair and lift serving all floors. The basic layout of the first, second and third floors apartments would consist of a single aspect either looking over The Kingsway or the rear elevation and are situated either side of a central circulation spine.

There are currently 10 parking spaces provided within the rear service yard and it is proposed that this provision will be reduced to 8 spaces. The loss of spaces is due to the creation of a new electrical sub-station and a refuse area. However, the application property is located within the City Centre core area where off street parking facilities are not required for residential development. Additionally, a bicycle store (14 spaces) is indicated in the basement. The Head of Engineering and Transportation raised no objection to the proposal but recommends that a Travel Plan is implemented prior to the occupation of the

residential units, having regard to the nature of the development in terms of its restricted parking facilities.

6.3.6 Former Mothercare Building, Portland Street

The Mothercare building occupies a prominent location at the junction of Portland Street with The Kingsway and consists of a four storey building with a basement area. Mothercare previously retailed from the ground and first floor levels but is now vacant. Planning permission has been given for the conversion of the first, second and third floor levels from retail and retail storage space to provide 39 self contained one bedroomed flats (Class C3), together with various external alterations. Map 25 outlines the development site.



Map 25 Former Mothercare Building Development, Portland Street

The development site overlooks the new city centre one way system and Metro scheme (see 6.7.4 below) along the Kingsway. Traffic flows have radically altered since the introduction of the one way system and the façade of this building will in all likelihood form part of the diffusion tube network operated by the authority once the development is completed.

Policy H5 of the Swansea Local Plan Review No.1 presumes in favour of the conversion of vacant or underused upper floor space above commercial properties for residential purposes subject to satisfactory access and parking arrangements (where appropriate), detailed design considerations and the relationship with and impact upon adjacent uses. The proposed change of use of the upper floors will result in the reuse of a large area of existing vacant floor space. Its conversion to a residential use will make a valuable contribution to the city's housing stock as well as securing a diversity of uses. It is therefore considered that the change of use of the upper floors of this building complies with policy H5 of the Swansea Local Plan Review No.1.

The building is unable to provide any off-street car parking space. However, the application property is located within the City Centre core area where off street parking facilities are not required for residential development. Additionally, a bicycle store is indicated in the basement. The Head of Engineering and Transportation raised no objection to the proposal but recommended that cycle storage stands facilities together with wheeling ramps are installed.

6.3.7 Persimmon Homes Development, Pontardulais

The application sought reserved matters approval for the comprehensive residential redevelopment of the "brownfield" site of the former Clayton and

Teilo Works which were granted outline planning permission on 15th June, 2005 and 5th December, respectively. The former industrial site is adjacent to the residential properties in Water Street and Tyn-y Bonau Road and abuts the David Matthews industrial site to the west, which is subject to a current application (now refused) for the redevelopment of a Tesco retail store (see 6.1.4 above). The centre of Pontardulais lies approx. 150 metres to the south west of the site. Map 26 outlines the development site.

Map 26 Persimmon Homes Development, Pontardulais

Previous outline and reserved matters applications have been the subject of screening opinions under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 to assess the requirement for an Environmental Impact Assessment (EIA) to accompany the

applications. Whilst it was concluded that the potential impact from the development would be significant on the environment by way of its size and location, in terms of the nature of the development the proposal would remove an industrial use from the residential area. The site is not considered to be located within an environmentally sensitive area and the redevelopment proposal will not breach the threshold figure of 5 hectares or 1000 dwellings contained in Annex A of DETR Circular 02/99. Having regard to the nature and scale of the proposed development, the proposal is unlikely to raise any significant environmental issues of more than local importance and therefore an Environmental Impact Assessment was not required for the proposed development.

This current application seeks the joint residential redevelopment of both Clayton and Teilo Work's sites with a residential layout comprising a total of 220 residential units, consisting of 121 dwellings and 99 residential apartments. The dwellings would consist predominantly of two storey three and four bedroomed detached, semi-detached and terraced properties with a proportion (28) of three storey and two and a half storey (18) townhouses. The residential apartments would be accommodated within 8 three storey blocks within the development with a small proportion (6) of flats situated above garage blocks. The vehicular access would be obtained from Water Street and High Street allowing for a linked access through the site with a 'Village Green' area in the centre of the layout which would provide a focal point for the development.

The new development aims to create an attractive and interesting 'people friendly' environment where cars are not allowed to dominate the street scene, whilst integrating the layout with the surrounding area and community. The principles that drive the proposal are: -

- a comprehensive approach to both former industrial sites;

- a public open space within development linked to surrounding areas;
- the incorporation of a pedestrian/cycle movement framework within and linking beyond the development; and
- a landscape strategy that supports the concept and utilises existing natural features.

The layout is based upon a loose grid of streets that connect with the existing street pattern at two locations: to the north from High Street and to the south from Water Street, where vehicular accesses to the site are proposed. In addition to this there are pedestrian/cycle connections with Ty'n y Bonnau Road to the east and Water Street at the southwest corner of the site. There is an area of public open space at the heart of the development, which consists of a 40m x 32m 'village green' laid out in a formal rectangular pattern partially surrounded by trees, and overlooked on four sides by residential frontages. At the centre of the development the green provides an obvious focus for the development.

Vehicular access will be obtained from a new junction off Water Street and a further new access is proposed off High Street. Visibility at both access points is acceptable and within the recommended guidelines. The site layout plan in the main indicates a conventional estate road layout with standard carriageway width and footways on both sides. Standard methodology was used to assess the traffic generation of the development and the affect of this additional traffic on the surrounding highway network, and this was covered in detail under the Transport Assessment submitted with the outline consent. The affect of development traffic on 8 local junctions was previously assessed. This encompassed all junctions on the one-way system through that part of Pontardulais. All junctions tested indicated that there will be no adverse affect on the ability of the junctions to accommodate the additional traffic movements and all junctions in the test should operate satisfactorily.

The application site is suitably located for access by all modes. There are bus stops within a short distance of the site to an adequate bus service and footways are present for pedestrian access. In addition to the vehicular accesses there are two pedestrian/cycle accesses shown, one to the east and one to the west, the vehicle accesses are to the north and south of the site.

Whilst the bus frequency in the locality is acceptable, improvements to facilities at and on the approach to the adjacent bus terminus are required. The improvements will become more crucial as a result of this proposal if the travel mode of future occupiers is to be influenced. This residential development will strengthen the need for improvements to be implemented before the development is fully occupied and to that end will require the applicant to pay a sum of money in order that these improvements can be implemented. The monies have been secured to the sum of £35,000 under a section 106 agreement drafted under the outline consent.

Parking facilities have been provided through the site, in a mixture of parking courts, driveways and garages and would be provided in accordance with Council's adopted parking guidelines. Parking is predominately contained to the side or rear of the properties to reduce the visual impact. Cycle stores have also been provided for the residents within the proposed apartment blocks.

The internal road layout has been designed in accordance with the Highway Authority guidelines with the grid pattern of the road network reflecting the urban character of the site and provides access to a series of private drives and courtyards. The main road network is characterised by properties fronting directly onto the street. Served off the main network are a series of home-zones and private drives. The development proposal has been agreed in principle at outline stage and the Head of Transportation & Engineering accepted the

conclusions of the TIA which accompanied the Outline Planning Permission which indicated that the proposed development would not have a detrimental impact upon the operation of the existing highway network and will not adversely effect local highway safety conditions and therefore raises no highway objection.

Broadly speaking the proposed layout is a logical approach to the site which will help to create a sense of place and community. The network of alternative routes within the site and beyond for vehicles, cyclists and pedestrians will encourage walking and maximise pedestrian activity and community interaction on the street. The layout based on perimeter blocks ensures public fronts and private backs where streetscenes are mainly addressed by attractive active frontages. This is also inherently more secure as there are higher levels of natural surveillance and in most cases a clear definition between public and private ownership. The layout incorporates a combination of railings and dwarf wall/ railings for the front boundary treatments which will provide appropriate public/private definition by utilising an architectural device that is widely seen in the established parts of Pontardulais.

Approval has now been given and demolition/construction works commenced late 2006 and are now well advanced with a limited number of the dwellings being occupied during 2007.

6.4 The Tawe Riverside Development Corridor

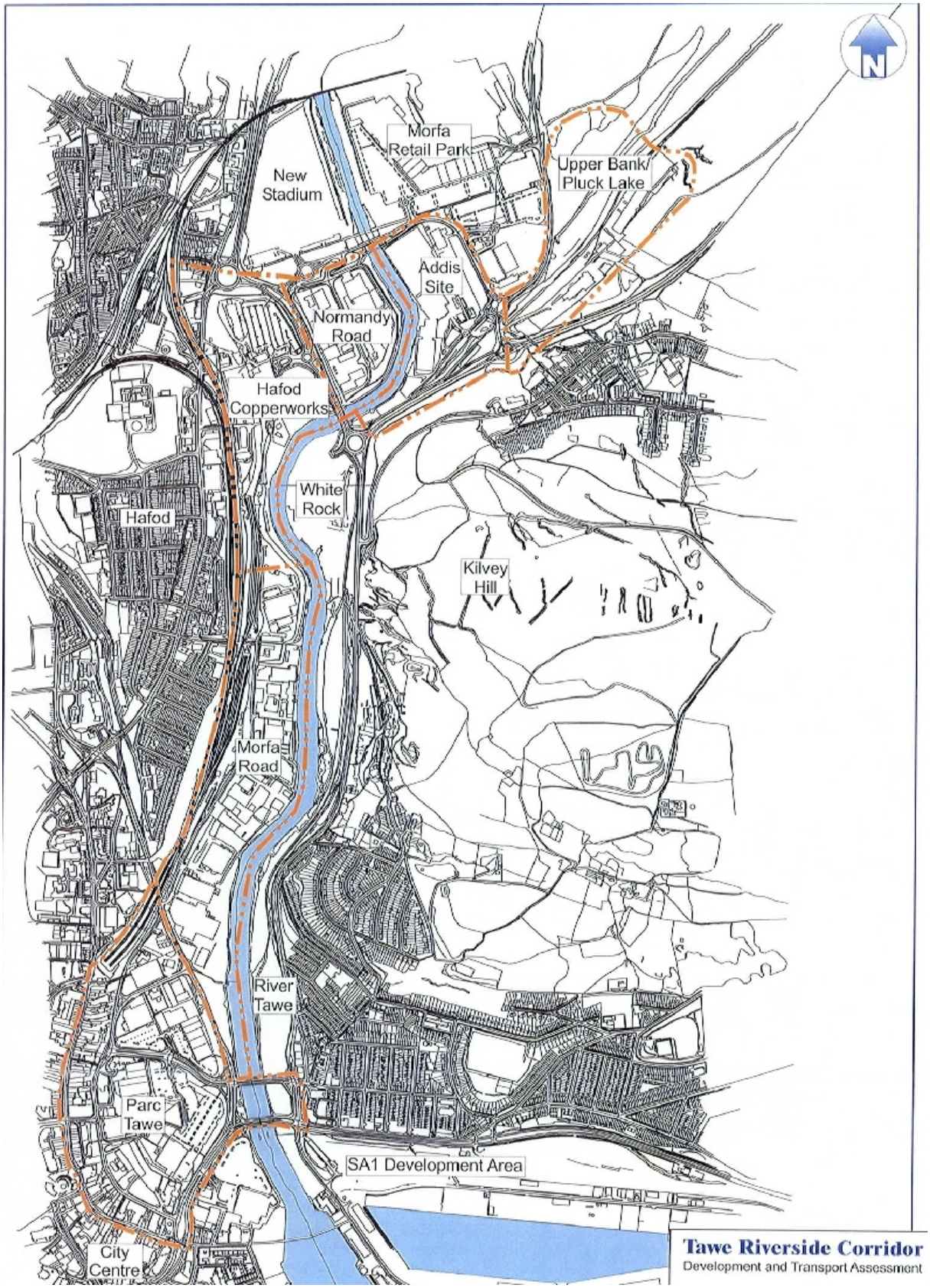
Proposals for the Tawe Riverside Development span a large area of former derelict industrial land and currently occupied commercial sites from Quay Parade Bridges up to, and beyond the new Liberty Stadium and Morfa Retail

Park area of the lower Swansea Valley. The proposals include some housing development sites as well as mixed use sites. All details relating to this development corridor are identified and discussed here as to split the developments as is the case in 6.1 - 6.3 above may detract from the overall scale of the proposals and significance that the authority is placing on the regeneration of the lower Swansea Valley/Tawe Riverside area. The development area can be seen within map 27 below[57]. The Morfa Road and Hafod Copperworks proposals fall within the existing Hafod Air Quality Management Area.

The River Tawe Corridor provides a series of distinct locations linked by the river and its rich industrial past. The Tawe forms part of the Swansea Waterfront concept, which is of national importance. The concept seeks to integrate the City Centre, Maritime Quarter, SA1 and the River Tawe corridor to allow the creation of a high density, mixed use, modern core for the City. The riverside corridor area provides the next significant opportunity to create a new place in the City for living, working and visiting, capitalising on the heritage importance of the area, which is a key theme linking the development of the area, and the potential of the river for visual interest, leisure and recreation. The Tawe Corridor provides a new sector of the city between the Waterfront and City Centre and links the modern developments at Morfa to the City Centre.

These proposals have the potential to impact significantly on air quality both within the existing Hafod Air Quality Management Area and outside. An internal working group has been established in order that discussions can take place on how the air quality issues raised can be addressed as air quality objections have already been tabled in respect to certain parts of the masterplan.

[57] Tawe Riverside Corridor Study Development and Transport Assessment Final Report June 2006 Hyder Consulting



Map 27 Tawe Riverside Development Corridor

The Corridor is of immense importance in terms of its industrial past. The development area comprises the western edge of the former Hafod and Morfa Copperworks, which merged in 1924 and were acquired by Yorkshire Imperial Metals in 1957, and are therefore widely known as the YIM site. It lies on the west bank of the River Tawe, bounded to the west by the Swansea Canal, which was established in 1794-8 to open up the coal trade from the head of the Swansea Valley. Its presence encouraged the establishment of other industries, such as Hafod and Morfa Copperworks. No longer profitable by 1902, it became disused and finally closed in 1931. It was infilled, both naturally and deliberately, and was complete by the 1970s. Sections higher up the valley, at Clydach and Pontardawe, were still "wet" in 1988. In 2002, a study was undertaken by Atkins Consultants on the restoration of the Swansea and Neath-Tennant Canals. This developed a range of proposals for restoration, although it was not proposed to restore the canal within the development area to a working waterway given that significant sections are no longer in place.

Hafod Copperworks was established in 1810, the adjoining Morfa Works dating from 1828. At its peak in the mid 19th century, Hafod was the largest copperworks in the world, with the greatest output. Morfa's output followed closely behind and between them, the 13 copperworks in the Lower Swansea Valley accounted for 90% of the world's copper production.

The two works merged in 1924 and were acquired as Yorkshire Imperial Metals in 1957. Copper working ceased in 1980 and the site was acquired by (then) Swansea City Council. Much of it was cleared. The A4067/A4217 Cross Valley Link Road was carried through the centre of the site in the early 1990s, and light industrial units established in the eastern half. In the 2000s, part of the site was occupied by the Landore Park-and-ride scheme.

To the south of these copperworks, between Morfa Road and the River Tawe, were a number of other industries. These were largely established in the 19th century although the Cambria Pottery, at the south end of the development area, dates from 1720. It was disused by 1868 and has now gone. This area lay between the Swansea Canal and the River Tawe and was a natural site for a series of coal wharves, and wet- and dry-docks. Other industries developed in this area during the 19th century including a foundry, a nickel-cobalt works and a phosphate works. Many of them had closed by the earlier 20th century. The canal, wharves and docks were progressively disused and infilled during the 20th century, and much redevelopment took place, mainly comprising light industrial units. An area to the south, between Morfa Road and the River Tawe, during the 19th century, was the site of a number of subsidiary industries including two large and important potteries, in addition to the coal wharves and dry docks that served the port of Swansea.

The area is of crucial importance to the later history and development of Swansea. The Hafod and Morfa Works, two 19th century copperworks were, during the mid 19th century, the largest in the world, with the greatest output. Hundreds were employed in these industries, and housed in purpose-built densely packed back-to-back terraced housing - notably, the Hafod area.

The area is also an important feature of the urban landscape. It is one of the very few assemblages of 18th-19th century industrial buildings that survive in Swansea. There are 11 listed buildings within the development area, and two Scheduled Ancient Monuments, alongside the incomplete remains of a large number of other structures and features.

The structural remains within the development area are not limited to listed buildings and Scheduled Ancient Monuments. There are the remains of further

former structures, and former surfaces, which together increase the Group Value of the site. The extensive use of local building stone (Pennant sandstone), and indigenous copper slag blocks, are an important contribution to the 'sense of place'. The geometry of the area and its relationship with the Swansea Canal and the river, is also important, and is still well preserved.

The protection of the surviving remains is seen as "the last chance" to preserve and interpret the industrial copper heritage of Swansea.

6.4.1 Summary of Area Strategies

The strategies for the development and regeneration of the parts of the development area are in summary:

Morfa Distributor Road

- The introduction of a new road between the A4067 (Hafod Site) to the Strand and New Cut Road (Morfa Road site) to have a "distributor route" function to serve development in the area, enabling maximum development opportunities with minimum environmental impact, particularly on industrial heritage;

Morfa Road Area

- Altering the balance of uses in the Morfa Road area from light and heavy industry and dereliction, which ignores the river frontage, to a high quality mixed area of residential, commercial and light industrial uses. The development would thus capitalise

on the superb riverside setting, the proximity of the area to the City Centre and waterfront and also celebrate and interpret the heritage of the area.

Hafod Copperworks Area

- An integrated, mixed use development of Hafod Copperworks, which:
- preserves heritage structures, interprets industrial history and finds new uses for heritage buildings, to ensure the heritage importance of the area is fully celebrated;
- capitalises on the stunning waterfront location and strategic proximity to the stadium by the introduction of a hotel and restaurant/ bar/ café uses, bringing economic vitality back to the river frontage by day and evening;
- provides for water transport links and recreation, in particular a ferry stop to enable the site to be linked to the Swansea Waterfront and the National Museum;
- provides for park and ride links to the City Centre; and
- provides a high quality living environment with strengthened links to the existing Hafod community.

Normandy Road Industrial Estate

- The retention of Normandy Road Industrial Estate as a location for employment and industry, whilst visually enhancing the site, reducing the visual impact on adjacent land uses and investing in improvements to properties to raise the quality of the estate.

Addis Site

- The redevelopment of the Addis site for residential uses as the next stage in forming a truly mixed use and high quality part of the riverside – with leisure, retail, industrial and residential uses, whilst respecting the heritage importance of the site. Development of this site commenced during 2006 with the former factory units being demolished and the site remediated. Construction works commenced late 2006/early 2007

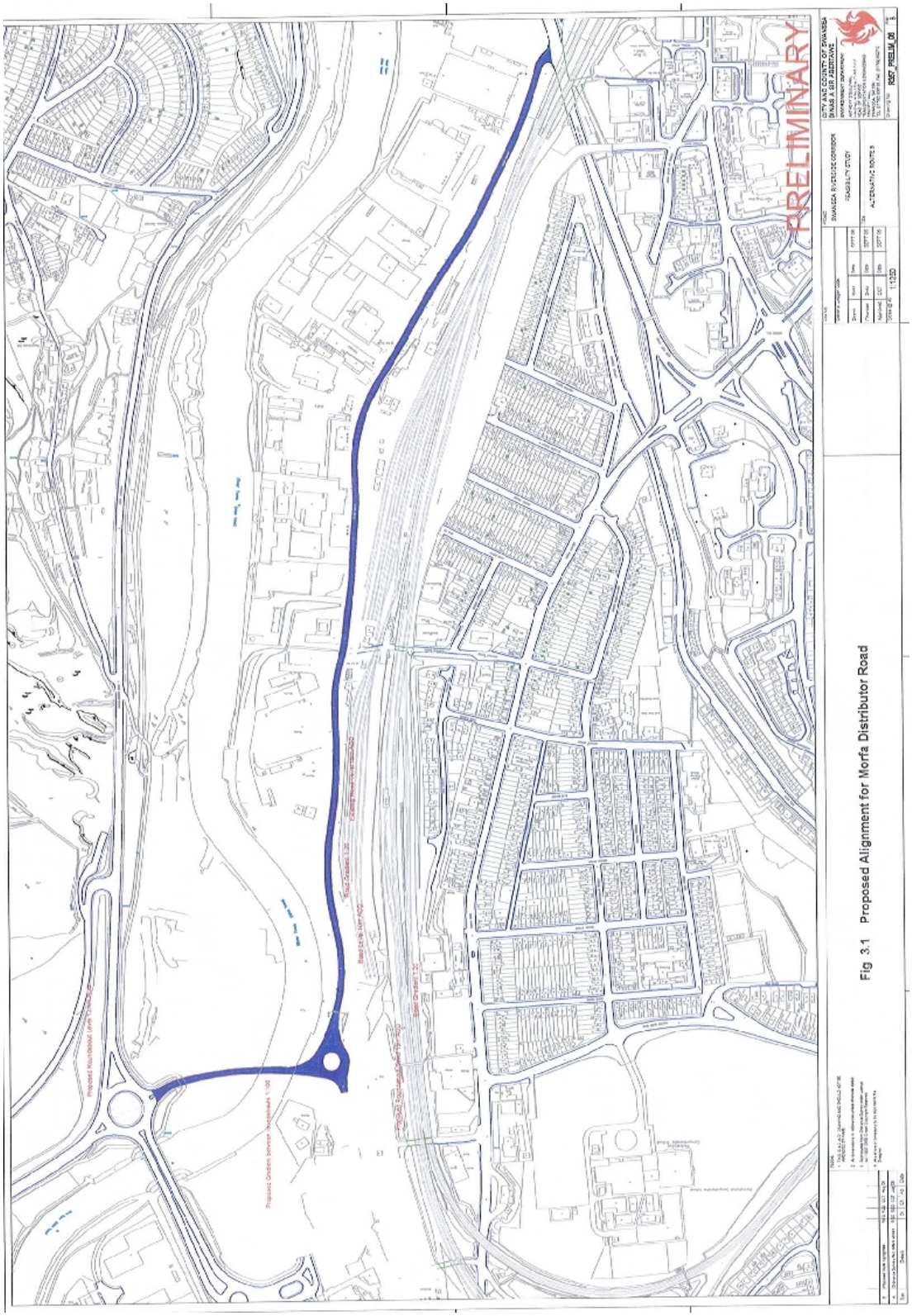
Upper Bank/ Pluck Lake

- Encouraging a compatible mix of land uses to regenerate the Upper Bank site, removing the current areas of dereliction and contributing to the regeneration of the wider area;
- Accommodating the objectives and future plans of the Swansea Vale Railway Company and recognising the heritage value of the site; and
- Recognising the amenity importance of Pluck Lake and Kilvey Woodland, whilst bringing selective development into the area to improve the attractiveness of the site.

6.4.2 Morfa Distributor Road

The City and County of Swansea is proposing to introduce a new road from the vicinity of the existing junction between the B4603 and A4067 (Hafod Site) to the Strand and New Cut Road (Morfa Road site). It is intended that the road would have a "distributor route" function aiming to serve development in the

area. Map 28 below shows the Distributor Road preliminary proposals which have now been modified during 2007/2008.



Map 28 Morfa Distributor Road Preliminary Alignment Proposals

An alignment for a route directly southwards through the Hafod Copperworks Site has been included and protected within the Swansea development plans as far back as 1992. The route is shown in the Deposit Draft Unitary Development Plan (October 2006).

Alternatives to this route have been investigated by the Highway Authority as part of the development proposals. This is to ensure that the route chosen enables maximum development opportunities in the Hafod/ Morfa Road area with minimum environmental impact, particularly on industrial heritage, as well as providing the distributor road.

An option of a crossing of the river from White Rock was proposed and is detailed within map 28 above. However, funding for the required new river crossing bridge could not be secured, rendering this option impracticable. This preliminary route was considered to have less impact on the heritage of the Hafod Copperworks Site and enable more coherent development of the Hafod Site. The two options of the protected route and a White Rock alignment were presented to CADW, who have expressed the preliminary view (in a letter dated 31 March 2006) that: *"Of the two options being considered, CADW would support Option 2 (White Rock), which goes some way towards respecting the integrity of the Hafod-Morfa site and its relationship with the Swansea Canal and associated features".*

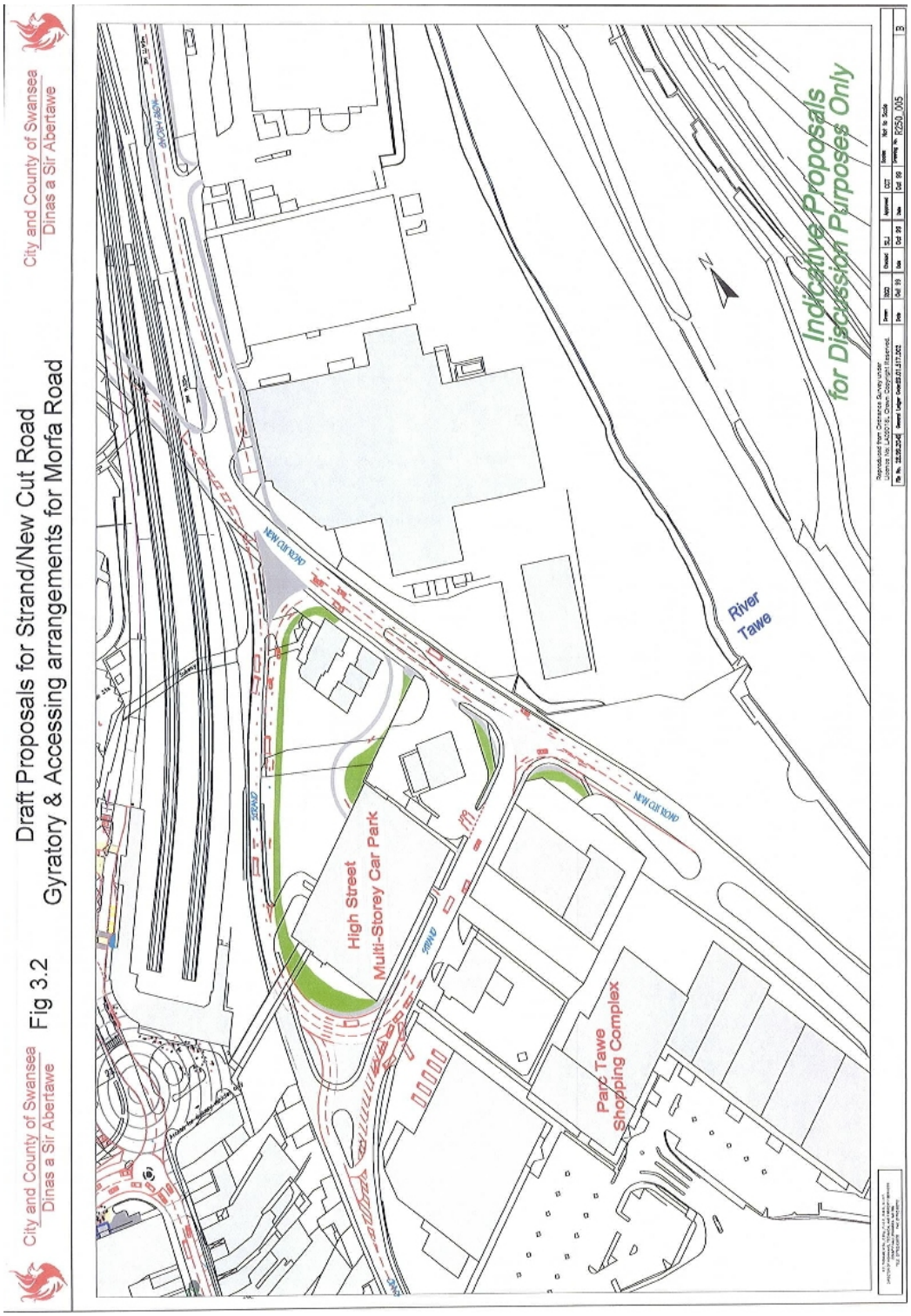
However, the new proposed alignment for the distributor route is now to modify the roundabout serving the Landore Park and Ride site with the construction of a short access link to join up with the existing Morfa Road by the Bernard Hastie site. This proposal will negate the requirement of a river crossing. Discussions have taken place with CADW who appreciate the difficulties experienced.

Tentative approval for this proposal have been secured from CADW subject to detailed archaeological investigatory works being undertaken as the proposed route crosses the structures defining the old canal walls. Whilst any works would cause loss of archaeological features, a pragmatic approach has been taken by CADW in that should the proposed developments along the corridor not take place, then contributions for the renovation of the existing buildings would not be forthcoming. These existing above ground structures have important historical associations with the heavy metals industrial past of Swansea and will be lost for future generations should definitive restoration works not take place within the next decade due to their existing dilapidated condition.

It is anticipated that any Distributor Road could accommodate bus services, subject to the provision of a new service along the route.

It is envisaged that the link under the railway from Maliphant Street would become for pedestrian and cyclists only, and be enhanced. This could include painting or cladding of the underside of the bridge in a light colour, a shared surface for cyclists and pedestrians which also allows emergency access, new signing and lighting.

At the southern end of the proposed Distributor Road, works are also proposed on New Cut Road and The Strand. These works would involve the provision of a gyratory carriageway layout (as previously proposed in Transport Grant Applications). The draft gyratory layout is illustrated below in map 29.



Map 29 Draft New Cut Gyratory Layout

In summary, it involves a gyratory whereby traffic from the Distributor Road would only be able to travel left onto New Cut Road and would enter Morfa Distributor Road only from The Strand. The intention is to minimise traffic

queuing and delays at the southern end of the route and also thereby manage levels of air pollution.

6.4.3 Morfa Road Area

Morfa Road presents a significant opportunity for redevelopment, capitalising on the riverside setting, the proximity of the area to the City Centre and waterfront and also to celebrate and interpret the heritage of the area.

The strategy for the regeneration of the area is to alter the balance of uses from light and heavy industry and dereliction, which ignores the river frontage, to a high quality mixed area of residential, commercial and light industrial uses.

While the land uses provide the framework for development, it is envisaged that the City and County of Swansea will take a flexible view of the use of each site, taking into account any changes in the market situation and the aspirations of land owners. Thus in the longer term, should market conditions change, the majority of the sites in the area may be redeveloped for housing and this is also considered to be acceptable.

The strategy is to be achieved through the provision of a master plan that sets the framework for investment by the private and public sector in the area and is shown within map 30 below.

Map 30 - Morfa Road Area Master Plan

The overall design concept is for:

- a mixed use development of individual sites according to land ownerships;
- the prime focus of each development site being orientated towards the river;
- a network of routes for pedestrians focussed on the riverside walkway/ cycleway with links through the sites at key locations to Morfa Road;
- a secondary focus to development sites to the centre of each site, giving a more intimate scale to the living environment. The central parts of site would be the location for any community facilities and local open space;
- traffic access from Morfa Distributor Road into each site. Within the sites, residential development in accordance with the 'Home Zone' principle of shared pedestrian and vehicular surface, designed for a speed of 10 mph.

The master plan incorporates the following elements:

- An upgraded Morfa Road to a distributor road standard, linking from the north between the Hastie Site and the railway. The road link is proposed to have a limited number of junctions, the locations for which have been chosen to enable phased development in accordance with the various land ownerships.
- A riverside walkway and cycle route of minimum width of 6 metres. This would provide continuous access from Parc Tawe through to the Hafod Site. A footpath is in place for the majority of the route at present, with the exception of the Swansea

Industrial Components site. Moreover it is currently impassable in places due to overgrowth and there is no barrier to protect users along the river edge.

- The provision of a new pedestrian and cycle bridge across the Tawe between the areas of open space south of the Unit Superheaters site, across to the St Thomas Station Site. This, together with a similar facility shown for the Hafod Site, would enable use of both sides of the river bank, connecting to the National Cycle Route on the east bank and link the Morfa Road area to the St Thomas community;
- Mixed-use development of the sites including approximately 360 homes, enhancement and some new development of light industrial uses and trade counter uses; retention of the Dragon Arts Centre facility and approximately 23,000 m^2 of office space. Specifically:
  - Residential development of the Unit Superheaters, Swansea City Highways Depot and Hastie site (7.3 ha, approximately 360 dwellings at a density of 50/ha);
  - Light industrial uses or trading counter uses on the Bevan and Gladeborough sites, involving a mix of enhancement of existing buildings and new development (2.7 ha, approximately 13,500 m^2 of industrial/ trading space);
  - Office development of the former dairy site, average of three storeys (1.55 ha, approximately 23,250 m^2 gross floor area);
  - Retention of the Dragon Arts Centre facility;

- Light industrial uses on the Swansea Industrial Components site, possibly comprising a single large factory unit of 5,500 m^2/ 60,000 sq ft; and
- Retention of light industrial units on the GLT Exports site.

The master plan also illustrates the potential for an element of local needs convenience shopping, open space, and a public house/ café making up part of the overall development as illustrated.

6.4.4 Hafod Copperworks Site

The Hafod Copperworks Site or Yorkshire Imperial Metals (Y.I.M.) Site is a site of international importance in industrial history and has the potential to help tell the story of Swansea's development over the past three hundred years, provide a place for public enjoyment of the riverside, and a new place for living and working.

The site has lain largely vacant for several decades however, the industrial monuments are deteriorating and certain buildings are at serious risk of loss. The site is the last opportunity to preserve and interpret the City's industrial history.

The strategy for Hafod Copperworks is for an integrated, mixed use development which:

- preserves heritage structures, interprets industrial history and finds new uses for heritage buildings;

- capitalises on the waterfront location and strategic proximity to the stadium by the introduction of a hotel and restaurant/ bar/ café uses, bringing economic vitality back to the river frontage by day and evening;
- provides for water transport links and recreation, in particular a ferry stop to enable the site to be linked to the Swansea Waterfront and the National Museum;
- provides for park and ride links to the City Centre; and
- provide a high quality living environment with strengthened links to the existing Hafod community.

The strategy is to be achieved through the master plan that sets the framework for development of the site. The overall design concept for the Hafod Copperworks site aims to:

- create a stimulating contrast between the dispersed historic buildings and structures and contemporary architecture and activities, all set in a consistent landscape theme;
- exploit the riverfront and differences in level to create memorable views and a sense of drama;
- establish a pattern of mixed uses which will help create vitality, day and evening, particularly on the waterfront;
- organise linkages into and through the site which will be convenient, safe and secure;
- maximise the development potential of the key riverside site; and
- minimise the potential impact of the railway.

A master plan has been developed for the Hafod site, based on the proposed route of the distributor road with the crossing from White Rock and can be seen below in map 31.

Map 31 Hafod Copperworks Development Site

The main elements are:

- a new river crossing for traffic with an alongside pedestrian and cycle route, from White Rock to a roundabout junction south of the Musgrove Engine House;
- an extension to the existing park and ride scheme (300 additional spaces);
- Mixed use waterfront development – a mixed development of apartments, hotel and public house/ restaurant;
- High density housing on two sites either side of the former canal route (approximately 100 units);
- Restoration of the canal as a landscape and heritage feature with a walk along the route;
- Creation of a public space on the river front, giving setting to the Engine Houses and a location for a river ferry stop;
- Continuous walking and cycling route from the footbridge south along the riverfront;
- The consolidation and re-use of the listed buildings and Scheduled Monument within the site:
    - Further development of the Museum Stores for public access, with car parking and pedestrian routes from Neath Road;
    - Consolidation and refurbishment of the Laboratory and Canteen Buildings for commercial use, such as eating and drinking;

- Consolidation and interpretation of the Musgrove Engine House for public access; and
- Commercial uses in the Vivian Engine House.

The master plan sets out the potential form of development, but within the framework there is some flexibility to respond to demands for other uses. In particular, there may be potential demand for alternative uses, such as:

- Student and potential key worker accommodation;
- A residential care home;
- Social low cost and specialist housing, including older person accommodation, family accommodation and special needs bungalows;

A new doctor's surgery/medical centre to replace one surgery potentially requiring relocation in the Hafod.

6.4.5 Normandy Road Industrial Estate

Normandy Road is an industrial estate lying to the east of the Hafod Site and the south of the Liberty Stadium and Morfa Retail Park. It is almost fully developed and bounded by the river on the eastern boundary, the A4217 to the west and stadium to the north. The estate is occupied predominately by industrial premises, with the exception of the Territorial Army premises and a three-storey office block. The estate is visually prominent in an area, which has seen considerable recent development.

It is considered that the industrial estate serves an important function in providing premises close to the city centre, and it would neither be desirable or easily achievable (given the large number of occupiers and leases with the local authority) to comprehensively redevelop the estate. The buildings are however relatively dated and the estate could benefit from selective redevelopment and refurbishment. The location of the industrial estate is shown below as map 32.

Map32 Normandy Road Industrial Estate

The site is not proposed for comprehensive redevelopment and therefore the proposals involve a package of environmental improvements rather than a master plan for the site. The strategy for the future of Normandy Road is therefore to:

- Retain the site as a location for employment and industry;
- Visually enhance the site and reduce the visual impact on adjacent land uses;

6.4.6 Addis Development Site

The Addis site occupies a strategic location adjacent to the Morfa Retail Park. The site was formally occupied by the Addis factory, which produced plastic household goods. It was acquired by PMG Developments Ltd who sought planning permission for the redevelopment of the site for residential uses. The redevelopment of the site for residential will be the next stage in forming a truly mixed use and high quality part of the riverside – with leisure, retail, industrial and residential uses, whilst respecting the heritage importance of the site (notably the listed industrial building and Bascule bridge)

A planning application was submitted in January 2006 by Holder Matthias Architects for the redevelopment of the site with construction of 564 residential units including:

- 8 no five storey blocks of 296 residential apartments along the riverside;
- 146 apartments in 2 and 3 storey blocks;

- 122 terraced 2 and 3 storey dwellings; and
- retention of the listed building in the centre of the waterfront area, with future uses to be determined.

The application includes for access, car parking (including under croft), landscaping, open space and infrastructure works including a new riverside cycle path/ walkway.

The overall design concept is to develop a strong river frontage with blocks of apartments and a new riverside walkway and cycleway, graduating eastwards to lower rise two and three storey town houses and terraces. The development uses the principles of a home zone, with access within the site as shared surface between pedestrians and vehicles. The housing design has the majority of properties fronting directly onto the street with gardens to the rear in courtyards/ enclosed spaces. Images of what the development may look like are included as Figures 1 and 2.[58] The Master plan for the site produced for the application is included as map 33.

Figure 1

Figure 2

[58] Images courtesy of Hyder Consulting Final Report Tawe Riverside Corridor June 2006

Works commenced during late 2006/early 2007 with the five story blocks closest to the A4217 (blocks E, F, G and H). During late 2007 the first of these blocks were occupied. Development continues with further areas of the site now being cleared in preparation for construction of the other dwellings.

Map 33 Addis Development Site

6.4.7 Upper Bank/Pluck Lake

Upper Bank represents one of the few predominantly underused sites in the area occupying a key location overlooking the redeveloped area of Liberty Stadium and Morfa Retail Park. The opportunity now exists to regenerate the site, connecting to the key development land and transport links in the area, whilst promoting a mix of different land uses.

The last remaining section of the Swansea Vale Railway runs through the centre of the site and is occupied by the Swansea Vale Railway Society. The Society has a vision to create a Railway Heritage Centre. The majority of the Upper Bank site is however in a state of considerable dereliction. The adjacent Pluck Lake area is an important amenity area and ecological resource.

The strategy for the future development of the site is to:

- encourage a compatible mix of land uses to regenerate the site, removing the current areas of dereliction and contributing to the regeneration of the wider area;
- accommodate the objectives and future plans of the Swansea Vale Railway Company and recognise the heritage value of the site;
- recognise the amenity importance of Pluck Lake and Kilvey Woodland, whilst bringing selective development into the area to improve the attractiveness of the site;

The overall design concept for the Upper Bank/ Pluck Lake site aims to:

- maximise the commercial development potential of the site;
- exploit the differences in level to provide attractive views out from the site to the west;
- establish a pattern of viable mixed uses which will create an attractive living environment and complement the regeneration of the wider area;
- enhance the role of the site in telling the story of Swansea's industrial heritage;
- improve linkages to the Pentrechwyth community and the Kilvey Community Woodland.

The master plan for the site is illustrated in map 40 below and includes:

- A new access westwards from a proposed roundabout junction on Nantong Way;
- A mix of affordable and general housing, totalling approximately 125 units;
- A roundabout junction providing access into the housing areas and railway heritage area;
- Relocation of the Railway Society operations with provision to enable future phases of development of a heritage centre; and
- Potential development site for a hotel south of Pluck Lake

The master plan as proposed would release a significant parcel of brownfield land for housing development. The area of housing land identified on the plan would amount to 3.19 hectares.

The site is proposed to include a small food store (approximately 10,000 sq ft) and associated parking, serving the immediate local area and offering a different product to the Morrison's superstore within the retail park.

The site would be sensitively integrated with the adjacent rail land and the amenity of the future occupiers will be safeguarded from any of the potential impacts of the rail activity by close attention to a green buffer between the two.

Map 34 Upper Bank/Pluck Lake Development Site

The master plan includes the provision of an area to safeguard the future operations and expansion of the Railway Society site. The proposal includes the recommendation that the site redevelopment includes for implementation of Phase 1 works (by negotiation between the Railway Society and City and County of Swansea) to enable the Railway Society to continue their current operations of upgrading the remaining section of the Swansea Vale Railway and restoring the locomotives and rolling stock within a covered modern industrial unit. The proposals would also enable the Society to fully explore the feasibility of establishing a shuttle service between the two terminals at Upper Bank. This will require basic facilities at either terminal, but will help to establish a revenue stream for the Society and the impetus to progress subsequent phases.

6.4.8 Proposed New Leisure Facility incorporating Snow Ski Facility, Water Park and Hotels.

The site extends to approx. 27 hectares in total and comprises of two main parcels sub-divided by Nantong Way with approx. 7 hectares located at the former dry ski slope site to the west of Nantong Way and approx. 20 hectares comprising Pluck Lake and the associated woodland area located to the east of Nantong Way. The majority of the proposals for the site east of Nantong Way are outlined above within 6.4.7 and can be seen within map 40. It is indicated that the submitted site area is indicative at this stage and may be refined prior to the submission of a planning application. The site is bounded to the north by the main Swansea / Paddington railway line and Llansamlet Industrial Estate, and the former dry ski slope is situated to the rear of the Morfa Retail Park, with the Swansea Vale Railway Line (Upper Bank) located to the south – east. An indicative map of the development (west of Nantong Way) is given below as map 35.

The proposal is to develop a comprehensive new leisure resort focussed around the existing redundant dry ski slope. The project would involve the following:

West of Nantong Way:

- the redevelopment of the existing ski-slope into an Indoor Snow Centre / Ski Facility
- Fitness / Health Facility
- Skateboard / BMX Park
- Bike Hire and Associated Bike Trails

East of Nantong Way:

- 120 bed Budget Hotel and associated Restaurant
- 3 / 4 Star 150 bed Family Hotel and Conference Centre
- 37 No. Lakeside Chalets
- Extension of Pluck Lake to be used for Rowing / Fishing / Boating Activities
- Boating and Fishing Club

Map 35 Indicative outline of proposed Ski Centre development site

It is indicated that the proposed development is intended to create a multi leisure attraction including the indoor real snow and ski facility, fitness / health club, skateboard / bike facility and boating / fishing activities, which will promote a sustainable tourism / leisure facility.

6.5 New Landfill Developments

There have been no new landfill development sites within the authority. Indeed, as the Environment Agency had refused to issue a Permit for the operations carried out at Tir John Landfill Site, Port Tennant, the operations undertaken had ceased during 2004. The Local Authority Waste Disposal Company (Swansea Waste Disposal Company) appealed this decision and the Permit was subsequently granted. The amount of HGV traffic using the access and haul roads has therefore been minimal from April 2004. It is anticipated that landfill operations will recommence during 2008 following completion of remedial works to the site but this planned reopening is still subject to change.

The Civic Amenity site has reopened for some time.

6.6 New Mineral Extraction Developments

There have been no new operations or applications for mineral extraction within the authorities' area during 2006 or 2007.

6.7 New Road Schemes

6.7.1 Fabian Way

Fabian Way has seen the construction of a junction to serve the new SA1 development access road around the Port Tennant Road junction with the A483 Fabian Way. This junction is controlled via traffic signals and is approximately 450 meters from the existing traffic signal controlled junction to the old dock entrance and Quay Parade Bridges. To the east of the new SA1 junction and approximately 1100 meters away, is the traffic signal controlled junction that regulates access at the new main docks entrance and the Fabian way Park and Ride site.

The construction of a new dedicated express bus route into the city centre from the Fabian Way Park and Ride site has also been completed during 2007. Phase 1 of the express bus route crossed over the A483 Fabian Way at the site of an old railway bridge, which has now been removed. This crossing has been replaced with a "sail-bridge" during 2007. The express bus route then runs parallel at ground level, adjacent to and parallel with the inbound carriageway of the A483 to Quay Parade Bridges. At this point the service has no option but to join the main inbound carriageway across Quay Parade Bridges leading into the city centre.

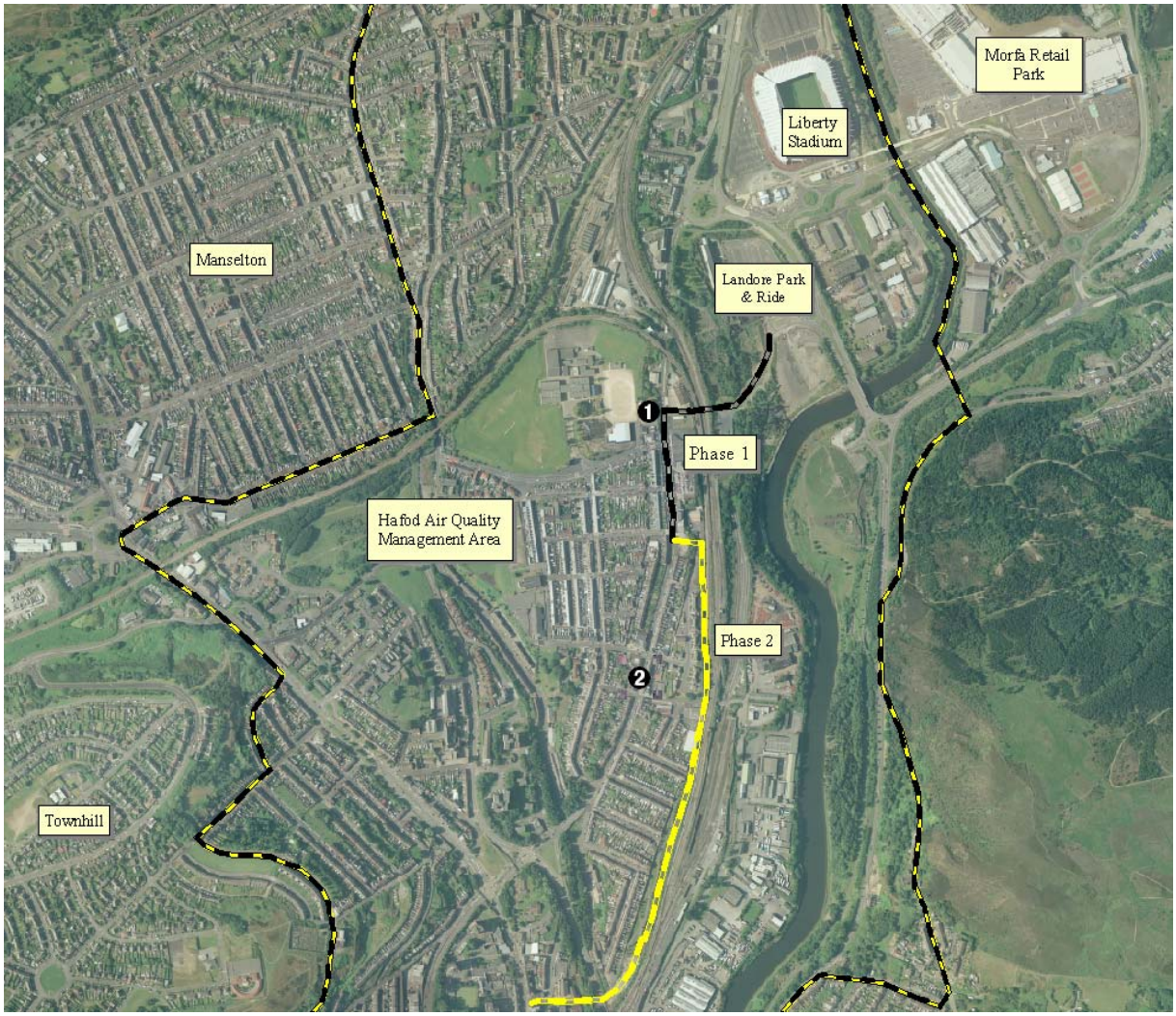
Further phases of the Fabian Way Express Bus Route will see it extended into the city centre.

6.7.2 Landore Park & Ride Express Bus Route

Phase 1 of the Landore Park & Ride Express Bus Route was completed along a section of Neath Road, Hafod late 2004 / early 2005. The existing provision has seen a link provided from the Park & Ride site at Landore through a parcel of derelict land up to a traffic control point ❶on the B4603 Neath Road at the commencement of the bus lane itself - see Map 36. This traffic control point is traffic signal controlled and activated when a Park & Ride bus approaches. Initially, a cycle time of 140 seconds in the am peak and 115 seconds in the pm peak was proposed that would allow three phases of green for southbound Neath Road traffic, but just one phase of green for the Park & Ride site. This cycle time would result in an amber/red phase lasting about 20-30 seconds followed by a green phase lasting 20-25 seconds. Northbound traffic would be halted once every cycle for about 16 seconds, to allow traffic from the Park & Ride site to exit (provision has to be made for access into and from the Landore Social Club off this link road). The consultants employed, modelled the effects of these cycles and it was found that significant queues would be formed equivalent to around 85-110 seconds per vehicle in the am and pm peaks respectively.
If the above were accepted, this would require modifications to the junction of Pentremawr Road and Neath Road to prevent long queues forming due to traffic turning right at this junction. It was decided therefore to remove the existing mini-roundabout and make Neath Road the priority route with a dedicated right turn lane.

Discussions remain ongoing over the exact method of operation of this traffic control point from an air quality perspective. Local knowledge indicates that queues will quickly form towards Normandy roundabout and Morfa Terrace. What is in doubt is the actual extent of these queues and the knock-on effect in

the real world. One avenue being explored is allowing the lights to remain on green phase except when activated by the express bus route, thus minimising delays and stationary traffic. Southbound traffic may well be discouraged from using Neath Road as a southbound route anyway by the proposed road-narrowing ❷ of lower sections of Neath Road as recommended by the Hafod Integrated Transport Study and included as part of the Action Plan.



Map 36 - Landore Park & Ride Express Bus Route Phase 1

As a long term goal, it may be desirable to actively use this point as a delaying tactic during periods where pollution is forecast to be high along Neath Road, to intentionally make Neath Road less attractive as a through route. The outcome achieved would however be a fine balancing act between improving conditions

within the Neath Road corridor and possibly worsening conditions along Morfa Terrace and Normandy roundabout.

From this control point, the express bus route has been constructed parallel to the existing B4603 Neath Road. Neath Road from this point effectively becomes 3 lanes with the main carriageway being reduced to 6 meters width. Phase 1 of the express bus route stopped outside the junction of Neath Road with Bowen Street. At present, buses merge onto the existing Neath Road again via a traffic signal controlled junction. Phase 2 (was expected to commence September 2005 but did not commence until April 2008) of the express bus route will see the route extended behind terraced housing along Neath Road to High Street Railway station. Buses using the route southwards into the city centre will not travel inbound along the more congested section of Neath Road. Buses making the return journey to Landore Park & Ride site will access Neath Road at the priority junction at Bowen Street. Buses will use the existing carriageway up to the access junction to the Park & Ride site mentioned above where they will activate the traffic signals to receive a priority right turn.

6.7.3 Morfa Distributor Road

This proposal is outlined in detail as part of the Tawe Riverside Development Corridor above. Details can be found within section 6.4.2 above.

6.7.4 Swansea Metro Scheme

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

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

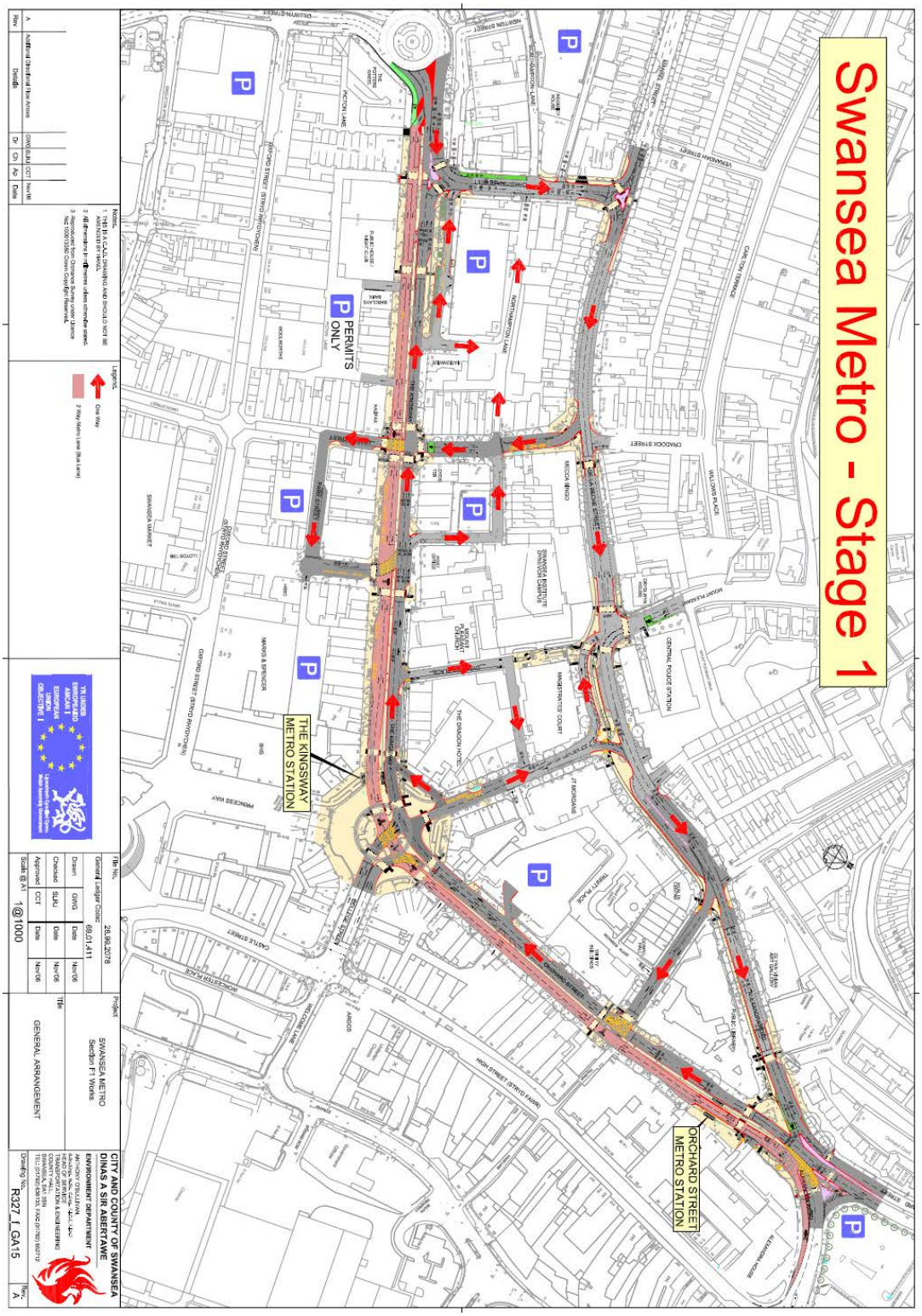
- Morriston Hospital,
- Woodfield Street, Morriston
- High Street Station,
- Kingsway,
- the new Quadrant Interchange (see Action Point 5 in section 7 below)
- County Hall,
- University and Singleton hospital.

Priority will be provided at key locations, including:

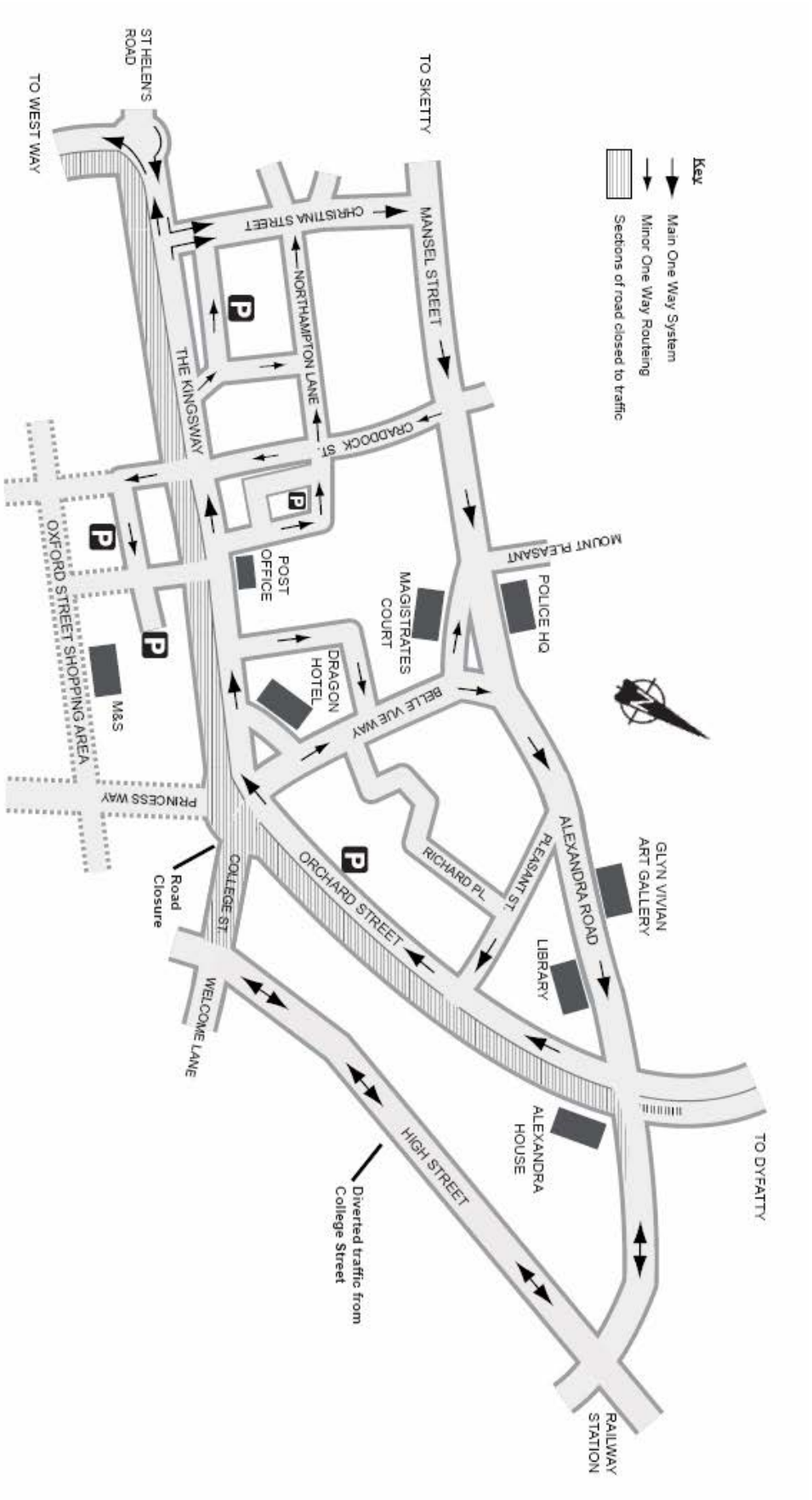
- Martin Street roundabout,
- Cwm Level roundabout,
- Normandy Road roundabout,
- the proposed Landore Express Route
- and in the City Centre, with the detailed design being carried out in-house

In order to enable the Swansea Metro to run, considerable works to the existing road network are required. Some of these works required at Cwm level and Normandy Road roundabouts lie within the existing Hafod Air Quality Management Area. Details at these key interchanges are still to be finalised and will be included in subsequent reporting.

The first phase of these works started within the Kingsway area of the city centre during the summer months of 2006. Plans of the works completed as part of phase 1 can be seen below as maps 37 and 38.

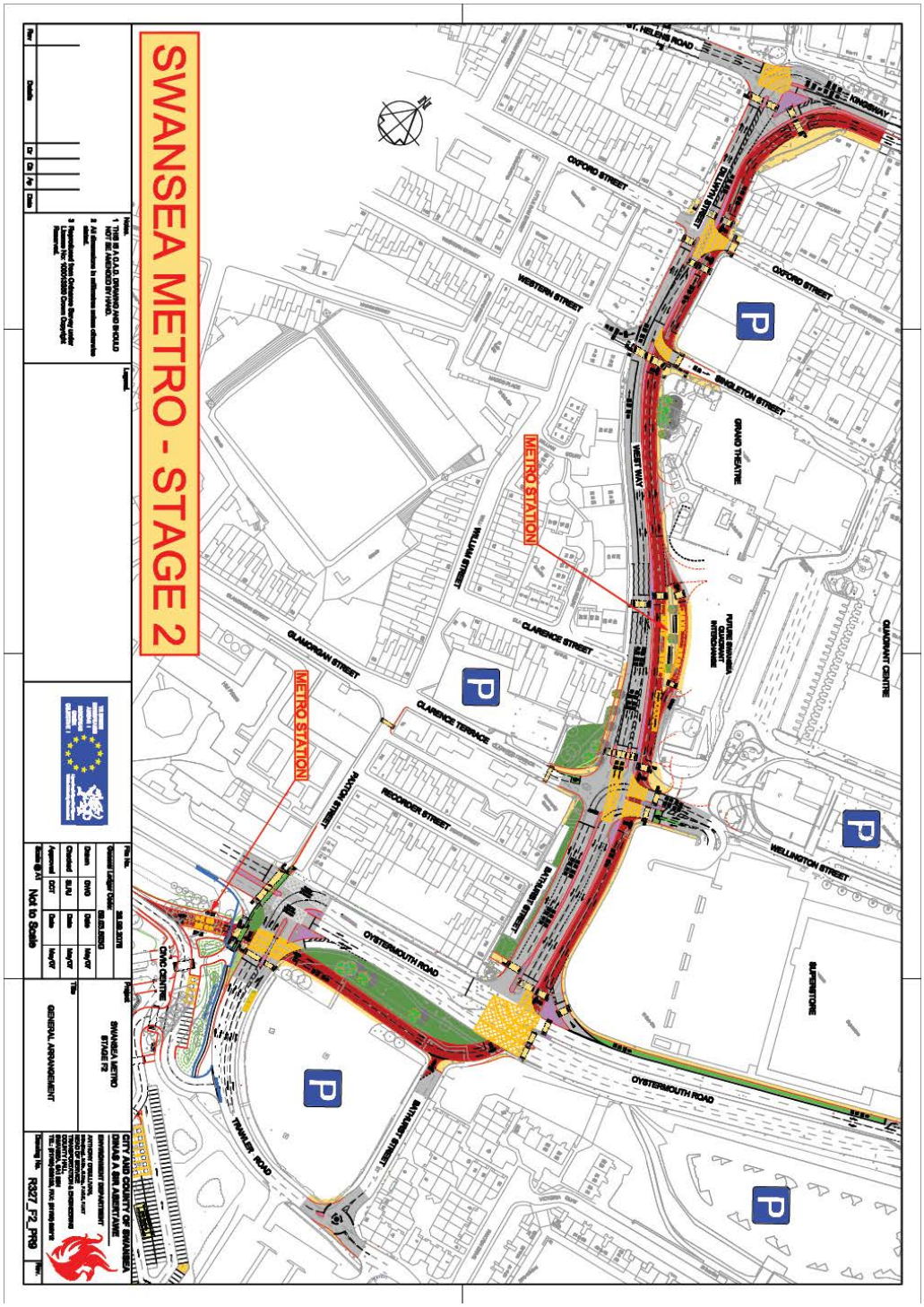


Map 37 – Swansea Metro Phase 1



Map 38 Swansea Metro Phase 1

Phase 2 of the Metro scheme (see map 39) commenced during July 2007 and to extend the provision from the Kingsway down along Westway, linking into the Quadrant Transport Interchange (see Action Point 5 in section 7 below) and to the new Civic Centre on Oystermouth Road. Phase 2 remains ongoing with an expected completion date during May/June 2008.



Map 39 – Phase 2 Swansea Metro Project

6.8 New Permitted Processes [IPPC and LAPC]

There has been one new A2 processes established within the boundary of the authority during 2006 with an application being received in October 2006. The details are repeated from the Progress Report 2007 as the permit has been issued during 2007.

The site is situated in the north east of Swansea on the Winch Wen Industrial Estate and is operated by Ethnic Cuisine Ltd. Its location can be seen within Map 40.

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Map 40 Location of Ethnic Cuisine Ltd

The nearest receptors are commercial premises to the west of the site and residential dwellings east of the site. The main features of the installation are as follows:

The proposed food waste treatment system is designed to treat all food wastes and other suitable wastes produced on site as described in the application. The treatment process converts the waste into bio-fuel, which is thermally treated in a bio-mass burner, with the heat generated being fed to a boiler to produce steam for use in the factory. The system is modular with the main components consisting of the bio-fuel converter, a bio-fuel silo, the bio-mass burner, a boiler to recover heat from the hot flue gases and a cyclone. The main environmental issues arising from the installation are emissions of combustion gases, the control of odour from the bio-mass converter, the discharge of liquid effluent and the disposal of residual solid waste.

The Waste Incineration (England and Wales) Regulations 2002 (SI 2002 No. 2980) (The WI Regulations) and the [Pollution Prevention and Control (Waste Incineration Directive) (England and Wales) Direction 2002] [The Environmental Protection (Waste Incineration Directive) (Wales) Direction 2002] together implement the requirements of the Waste Incineration Directive (Directive EC 2000/76/EC) on the Incineration of Waste.

The installation regulated under this Permit contains a new Waste Incineration Installation (as defined in the WI Regulations) in which the incineration of waste in a co-incineration plant is carried out. Conditions delivering the corresponding requirements of the relevant articles of the Waste Incineration Directive have been incorporated into the Permit.

6.8.1 Proposed Biomass Boiler Swansea Docks

An application has been made for planning permission for a medium sized Biomass Power Station in Swansea docks. The plant would occupy the land between the under used Kings and Queens Dock. Timber would be shipped in (from Canada with some locally sourced) and the power/heat connections would be local.

Discussions are continuing with the Environment Agency and Countryside Council for Wales as whilst effects on compliance are limited, there is a Special Area of Conservation which is sensitive to nitrogen deposits fairly close downwind of the stack. A detailed review will be undertaken, but some key parameters are still unknown.

7 Action Plan Progress

The authority submitted its Action plan in relation to the Hafod Air Quality Management Area in December 2004. Delays were incurred in the formulation of the plan due to the extensive planning and consultation works that were thought vital to delivering a workable plan.

The Action Plan detailed 10 action points to be taken forward by the authority. Progress against each of these action points are briefly discussed below:

- **Action Point 1 - Traffic Management measures on Neath Road**

  The majority of measures identified for this action point depend upon funding being made available to undertake the recommendations of the Integrated Hafod Transport Study. Some identified action points have been completed and have been undertaken as part of phase 1 works in relation to the Landore Park & Ride Express Bus Route scheme. Items completed as part of this scheme include:

  - Provision of some bus stops and shelters
  - Gateway treatment to entrance to Neath Road from the Normandy Road roundabout
  - Creation of traffic control point

  All other identified action points within the Action Plan remain outstanding at present. The recommendations of the Hafod Integrated Transport Study are to be phased in after the renewals program being undertaken along Neath Road as part of the Hafod Renewals Program. This program is undertaking

complete renovation of both domestic and commercial properties within the Hafod. At present, major works by the renewals program are scheduled for two sections of Neath Road. As these works entail extensive building works taking over part of the footway/highway with scaffolding, skips etc. it has been decided to undertake the Hafod Integrated Transport Study works after the renovation works are complete, as to do so earlier would result in the damage of any finished surfaces.

Renewal works are to be undertaken in two phases on two separate blocks of properties along Neath Road. The first phase has undertaken works at 1364 - 1391 Neath Road, and between 15 - 52 Neath Road. Further properties are due to commence renovation works during late 2007 to the block of terraced dwellings that house the Opsis DOAS Receiver open path measurements. This unfortunately will result in another break in the dataset for this station.

It may be a further 2-3 years before the Transport Study recommendations are complete. The Action Plan initially indicated a target of December 2005.

- **Action Point 2 - Park and Ride provision**

Provision of Park & Ride is seen as a fundamental element of Swansea's Transportation Strategy. Significant progress has been made in respect to this action point:

- Landore and Port Tennant Park and Ride sites are now fully operational.
- Fforestfach Park & Ride was opened during November/December 2006 and works are now complete with the site becoming fully operational during February 2008. Map 41 below shows the location on the A483 Carmarthen Road.

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Map 41 Location of Fforestfach Park and Ride Site

Patronage statistics for 2005-2007 show yet another increase in usage of the park and ride provisions provided by the authority.

Table 46 shows patronage figures for all 3 sites during 2005-2007.

Site	Total Spaces	2005	2006	2007
Landore	550	122,105	138,692	137,825
Fabian Way	550	86,407	111,878	122,530
Fforestfach	449		4,982	43,880

Table 46 Park & Ride Patronage Figures 2005-2007

- Phase 1 of the dedicated express bus route serving the Landore Park and Ride site has been completed. Phase 2 was due to commence during September 2005 but did not commence until April 2008.
- The construction of a new dedicated express bus route into the city centre from the Fabian Way Park and Ride site has been completed during 2007/early 2008. Phase 1 of the express bus route crossed over the A483 Fabian Way at the site of an old railway bridge, which has now been removed. This crossing has been replaced with a "sail-bridge" during 2007. The express bus route then runs parallel at ground level, adjacent to and parallel with the inbound carriageway of the A483 to Quay Parade Bridges.
- There are proposals for the provision of a fourth park and ride site to serve the west of the city including the Gower. These plans are at a very early stage with identification of and acquisition of land now taking place.

  All other identified action points within the Action Plan remain outstanding and were not complete by the indicated target of December 2005.

- **Action Point 3 - Improved Bus Provision**

The action points contained within the Action Plan were to the main being achieved upon submission of the Action Plan. However, in order to continue to achieve these aims, the authority continues to:

- Use its revenue budget to ensure that most areas have at least a minimum level of service.

- Make use of the National Assembly's Bus Subsidy Grant to ensure breaks in service are kept to a minimum
- Promote bus priority routes
- Fund a local concessionary bus fares scheme for certain categories of people
- Provide free unlimited bus travel within the authorities area for elderly people

The identified action points within the Action Plan are being achieved now but ongoing provision remains desirable.

- **Action Point 4 - Bus Corridor Enhancements**

Progress made to date includes:

- Transport Grant funded improvements to A48 Bus priority Demonstration Corridor completed during early 2005
- Bus priority proposals for Neath Road being reviewed. Works have commenced for a new concept Metro service linking Morriston Hospital with the city centre and Singleton Hospital (see 6.7.4 above) . The aim is to provide advantages of modern tram at modest costs. Envisaged that the service will use the Landore express bus route, thereby avoiding much of Neath Road and that bus priority will be introduced at key junctions along the route.
- Variable Message displays installed along a number of trial routes to improve dissemination of travel information to passengers.
- Accessibility to bus services for residents who are disabled or who suffer from limited mobility increased, following Transport Grant funding to

raise kerb levels along with the provision of road markings and bus clearway orders at bus stops.

- Bus shelters upgraded on a number of routes

The identified action points within the Action Plan are being achieved now but ongoing provision and enhancements remain desirable.

- **Action Point 5 - Enhancements of Bus and Rail Stations**

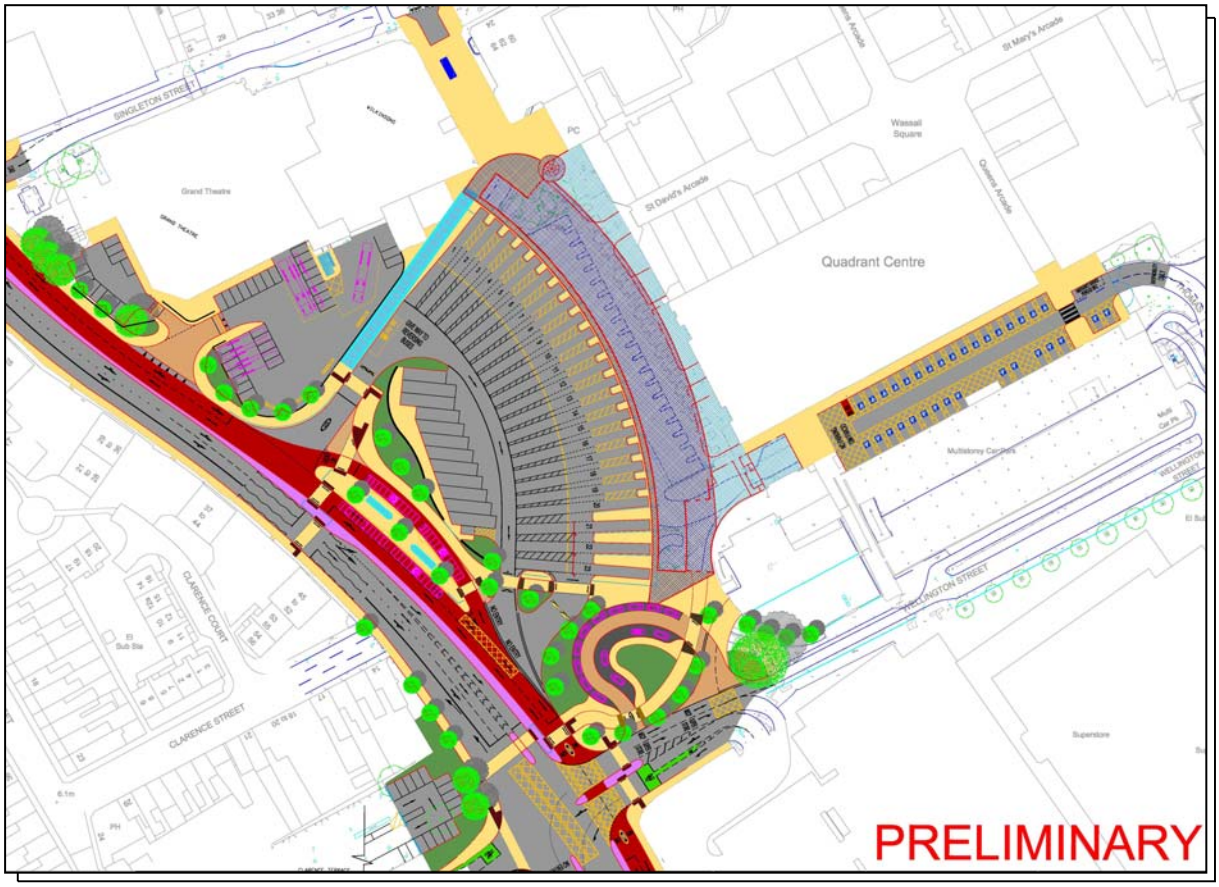
Progress made to date include:

- Swansea High Street Transport Interchange was completed during March 2004. Funded through a combination of Transport Grant and Objective 1 funding, this scheme has provided improved access to the railway station by bus, taxi, and on foot, together with a new public realm, improved security and improved parking facilities.
- Discussion ongoing with network rail and Arriva Trains Wales on how to improve passenger facilities at the station itself.

Quadrant Transport Interchange

The City and County of Swansea has prepared a scheme to replace the existing Quadrant bus station with a modern Transport Interchange to cater for both buses and coaches, including Swansea Metro vehicles, on a larger footprint. The Quadrant Interchange scheme has been accepted for Transport Grant funding by the Welsh Assembly Government. The current bus station is outdated in terms of passenger convenience, comfort and security. The Council's aspiration is 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. However, delays have been encountered with not only procedures involving the compulsory purchase of land but also with ensuring the necessary funding is fully in place prior to commencement of works. Map 42 indicates the provisional scheme with artists impressions of the façade given below.



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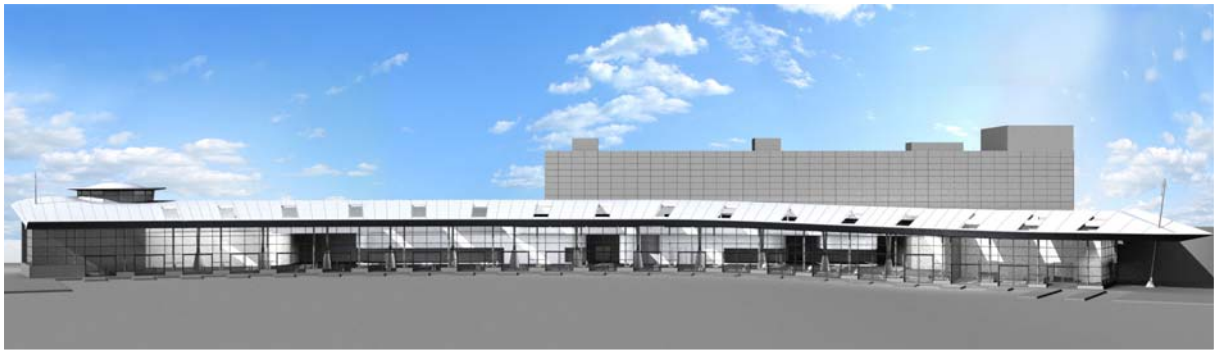
Map 42 Provisional Quadrant Transport Interchange off Westway, Sswansea.



Outline of scheme

The main components of the scheme comprised the following elements:

- 20 bus bays,
- 3 coach stands
- 2 Swansea Metro “stations” on Westway.
- 12 lay-over spaces
- Modern coach station facility to serve the long distance services,
- Enhanced passenger concourse with support facilities.
- Safe access to and from West Way
- New staff and office facilities
- Travel Shop (Information/ticket sales area.)
- Shopmobility Facility. In the Garden Street tunnel area
- Associated Retail Units.
- Enhanced links into the Quadrant shopping area.
- Improved access to the Grand Theatre and Wilkinson’s service areas

- Taxi rank for 9 vehicles
- Short stay parking for 5 cars (Passenger pick-up) adjacent to the coach area
- Passenger drop-off area

Programme

The authority had hoped to start construction of the Quadrant Interchange scheme in early 2007-08. However the Transport Grant allocation for the current year falls short of the bid. Moreover the Welsh Assembly Government has indicated that there should be a 20% private sector contribution. Meetings have taken place with Welsh Assembly Government officials and First Group to explain the scheme in detail and explore funding opportunities. First Group has indicated that they may be able to make a contribution.

The authority has written to the Welsh Assembly Government suggesting that the scheme could start in late 2007-08 and be spread over three financial years.

- **Action Point 6 - Safe Routes to School**

Safe Routes to School has been delivered in Swansea for the last 6 years with numerous schemes undertaken.

- Currently, Safe Routes to school schemes have been developed at:
    - Clydach,
    - Brynhyfryd,
    - Pennard,
    - Birchgrove.
    - Gowerton Comprehensive and its Primary feeder schools

- Penllergaer
- Whitestone Primary

Schemes are currently underway at:

- Oystermouth Primary
- Newton Primary

The aim again, is to encourage more pupils to walk and cycle to school through improved facilities, the introduction of traffic calming measures, together with complementary educational work and road safety training.

The focus of this work with schools is now based on the development of school travel plans. These have previously been prepared for YGG Bryniago (Pontardulais), Penllergaer Primary, Penyrheol Primary (Gorseinon), Whitestone Primary (West Cross), Oystermouth Primary and Newton Primary. In addition, travel plans are in the process of development for Manselton Primary, Plasmarl Primary, Crws Primary, Cwmbwrla Primary, Hafod Primary, Pentrepoeth Juniors, Bishopston Primary, Knelston Primary, Mayals Primary, Sketty Primary. These travel plans will provide the basis for both infrastructure and educational work over the next two years

- **Action Point 7 - Vehicle Emissions Testing**

No additional progress has been made with respect to this action point. However, the equipment is being kept serviced and calibrated. The primary reasons for the lack of progress are:

- No funding for Policing costs
- Lack of staff resources due to the labour intensive nature of the work.
- The Welsh Assembly Government fund for this purpose was not offered to the City & County of Swansea.

- **Action Point 8 Quay Parade Bridges Improvements**

- Feasibility studies remain ongoing as to how total capacity at the bridges can be increased. The initial intention of providing a signal controlled gyratory scheme has now been discounted due to the assessment that it would have a significant and unacceptable negative impact on local traffic and some bus services. The feasibility works are currently looking at the recalibration of the traffic signals at the bridges together with those along Quay Parade/Victoria Road/Oystermouth Road. The aim however remains the same - to make more effective use of the existing highway network. Parallel options for extending bus priority across Quay Parade to Oystermouth Road are still being investigated.

- An air quality monitoring station along Pentreguinea Road has been established with measurements commencing during September 2005. The system measures the pollutants nitrogen dioxide, sulphur dioxide, ozone, benzene, toluene and xylene along a 280-meter open path. The system comprises of a transmitter and a receiver. The transmitter shines a xenon lamp along the path length to the receiver module where the light is focused and transmitted down a fibre optic cable and into a spectra analyser where the measurements take place. The system is now providing spatial data over the 280-meter path length.

Photo 1 - St Thomas DOAS Transmitter

Photo 2 - St Thomas DOAS Receiver Station

- **Action Point 9 - City & County of Swansea Vehicle Fleet**

Improvements are ongoing within the fleet of vehicles operated by the authority. With 40% of the potential green fleet vehicles converted to L.P.G., other bespoke solutions have been implemented to assist in managing down the environmental impact of a 750 vehicle fleet operation within the Council's area. These include,

- A robust time based maintenance and inspection regime that specifies oil and filter changes twice a year
- A rolling 5 year programme of vehicle renewals to consolidate technological advancements within the fleet
- Detailed consultation with users on specifications to ensure maximised utility for the supplied vehicle
- A replacement component strategy that " builds in " disposal and recycling requirements for tyres, oils, batteries, cleaning products, asbestos free linings etc
- Active use of Energy Savings Trust grants for dual fuel vehicle provision that totals in excess of £120,000 to date
- Establishing a refuelling site within our primary operational depot for L.P.G. vehicles, in partnership with Flogas, and extending the use of this

facility to other dual fuel users such as the D.V.L.A., taxi associations, local businesses and private individuals.

- Specifying Eminox Continuous Regenerating Particle traps (CRTs) and Euro 3 compliant engines on new heavy commercial vehicles
- Retrospectively fitting CRTs to existing ordered vehicles and applying for the Wales Assembly Government grants in support of this
- Introduction of Low Sulphur diesel to the Council's fuel stocks

The authority actively enforces a "good neighbour "approach in terms of the Council's driver conduct, vehicle operations and parking arrangements.

- **Action Point 10: Traffic Management Systems with Air Quality Monitoring Feedback.**

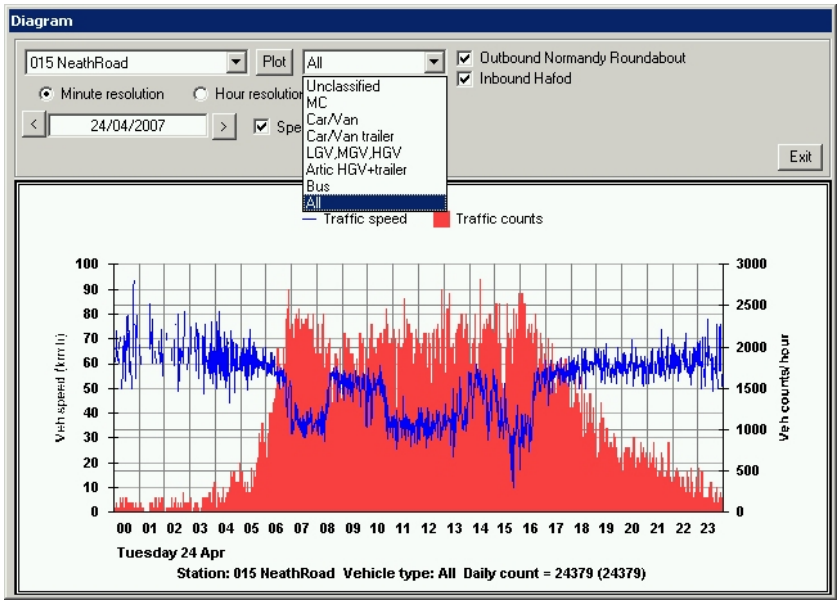
Considerable efforts are being made to ensure that all data feeds into the system under development operate reliably. The major data feeds are:

- Vehicle by Vehicle Traffic flow
- Ambient Air Quality Monitoring data
- Meteorological forecast

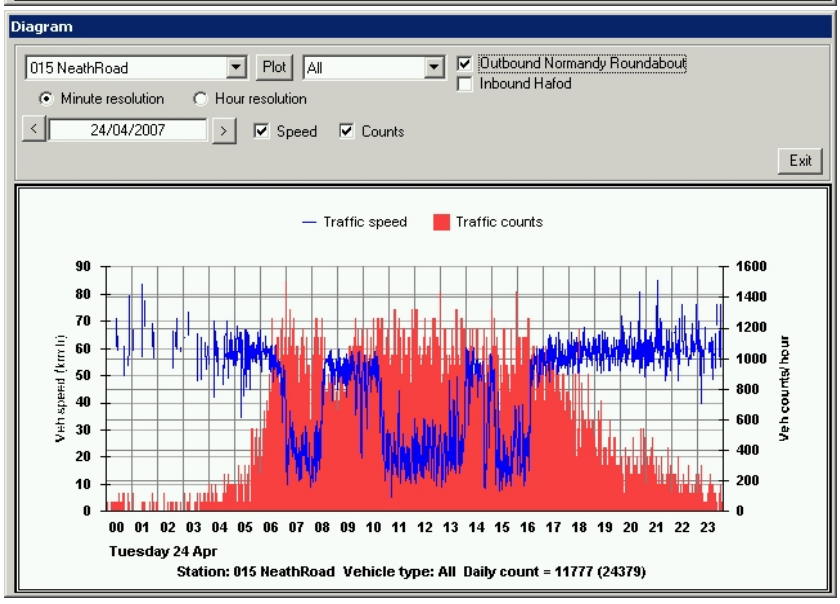
A total of 44 GPRS vehicle by vehicle (VbV) automatic traffic counters have been installed and commissioned and data quality is being assessed - see map 43 below for the location of the existing 44 GPRS traffic counters. Additional temporary surveys are underway within "local streets" for a period of one week to establish basic flow information.

The GPRS automatic traffic counters transmit data to an FTP server every 5 minutes. The vehicle by vehicle data is compiled into 1 minute integration and stored within databases linked to the emissions database (EDB). An example of the information that is now available to both the models and for dissemination to local radio media traffic bulletins (i.e. detection of congestion forming) is given below.

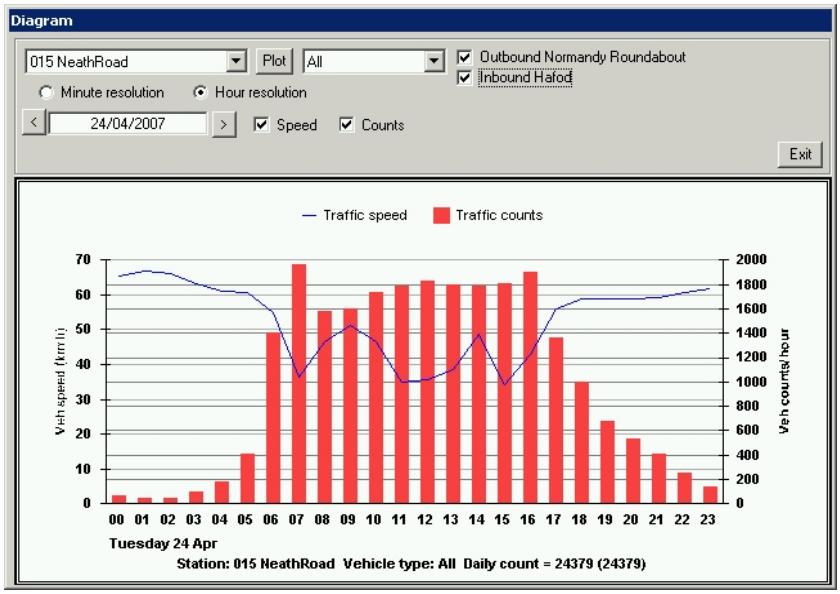
All vehicles are classified into the EUR6 classification scheme at point of detection as well as the speed of the vehicle. This information has again been provided for use within the modelling under development. Examples of the detailed flow information now available are given within annexe 3.



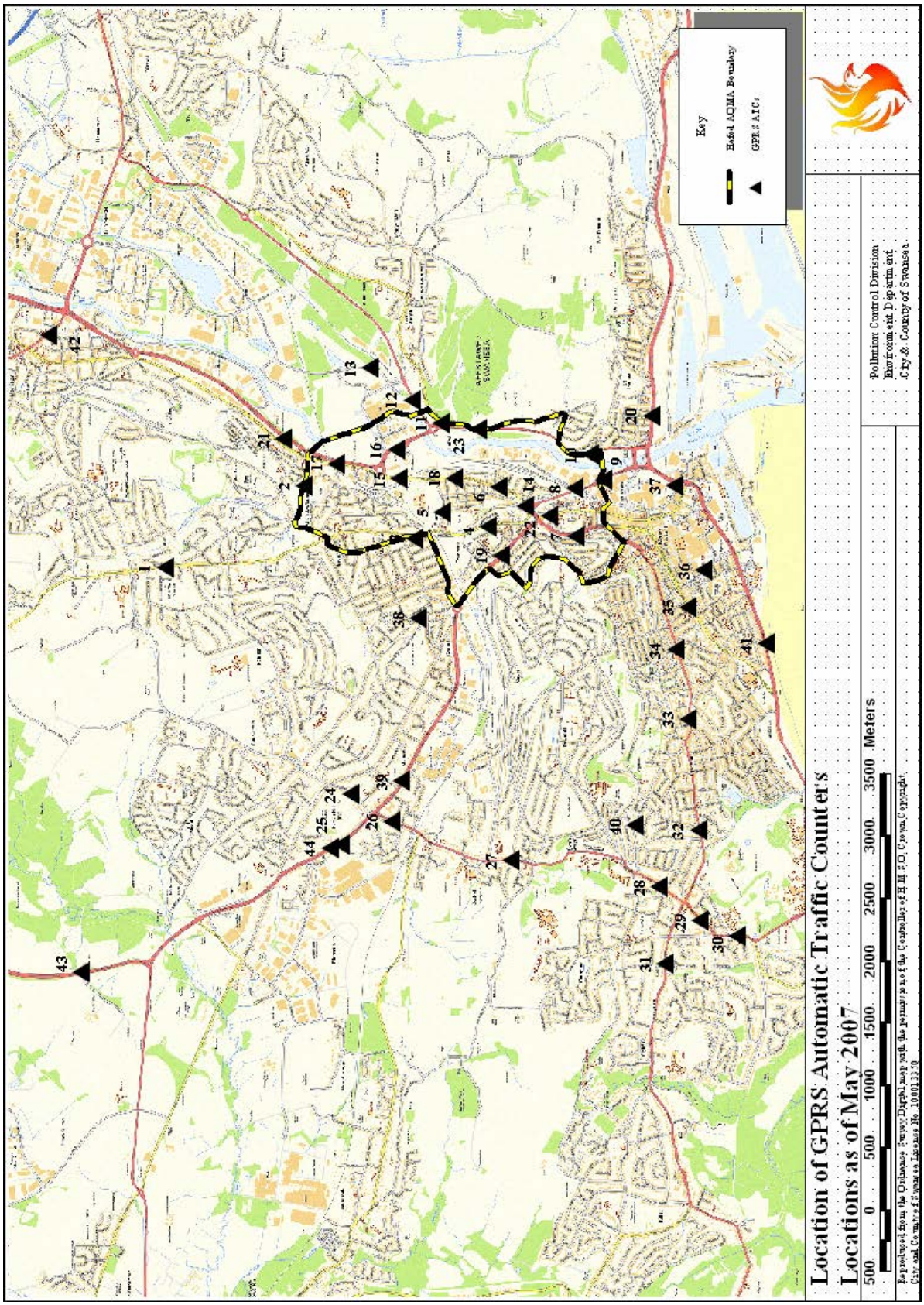
ATC 15 Neath Road is located opposite Morfa Terrace (see sec 4.1.5.2 site 29 for NO_2 tube data) on the B4603. The ADT for 2006 is 22032 with the AWDT being 23520. 1 minute resolution traffic flow data enables detection of congestion in almost "real-time".



The direction of formation of congestion can be established by separation of the directions. Here the congestion can be seen within the outbound lane. Notice the 3 significant periods of slow moving vehicles during the AM, midday and PM periods.



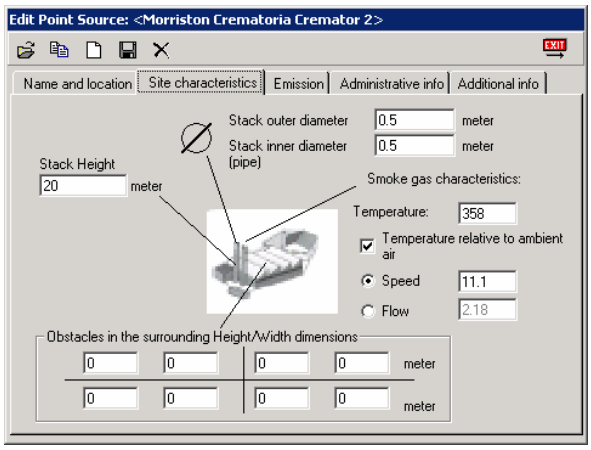
This 1 hour data integration view does not enable easy detection of these significant congestion periods

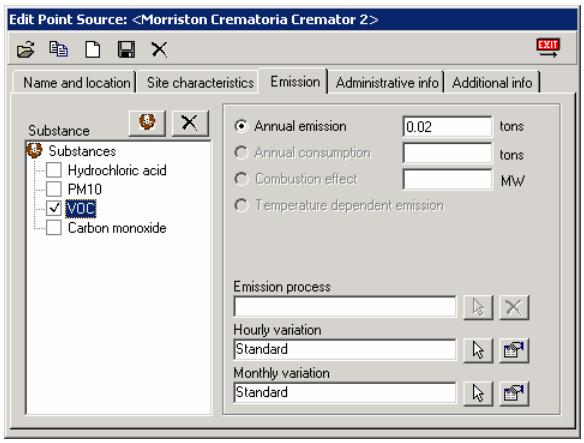


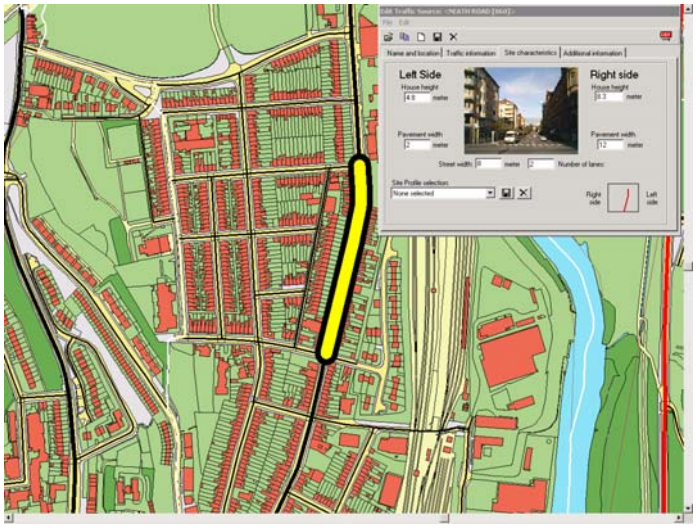
Map 43 - Location of GPRS Automatic Traffic Counters

- Discussions have commenced to develop an interface to manage the dissemination of information to local media i.e. traffic bulletins and roadside signage. This system will receive output predictions from Nowcaster and will take logical decisions upon what messages are disseminated to the local news media as well as the variable message signs located initially within the lower Swansea valley. Discussions are ongoing with regard to the specification of the variable message signs.

- Emissions data is being collated and inputted into an emissions database (EDB) which will be central to the system. The information required is extensive and includes all point source /area/grid emissions sources.





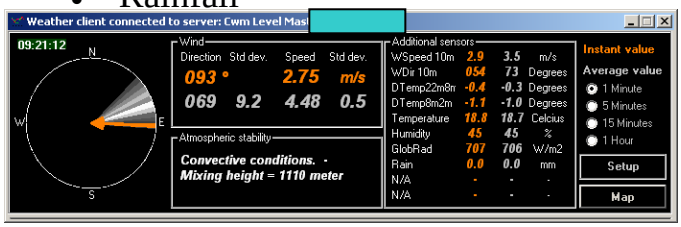


Every road **link** is in process of being classified and the details inputted into the EDB in order that the model understands the local geometry and conditions influencing dispersion in that road link.Width of road/pavement and building heights are being provided as parameters into the emissions database.

- Installation of a dedicated 30m meteorological mast at Cwm Level Park within the lower Swansea Valley to provide high quality temperature and wind profiles data in the lowest atmospheric layer in the valley into the models.

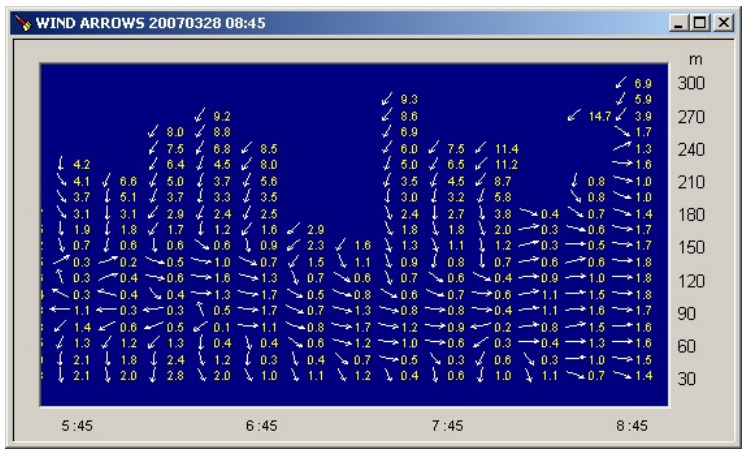
Meteorological parameters measured

- Wind Speed at 30m
- Wind Direction at 30m
- Global Radiation at 30m
- Wind Speed at 1Om
- Wind Direction at 10m
- 22m Differential Temperature
- 8m Differential Temperature
- 2m Absolute Temperature
- 2m Relative Humidity
- Rainfall



- Installation of an AQ500 “Wind Profiler” within the lower Swansea Valley.

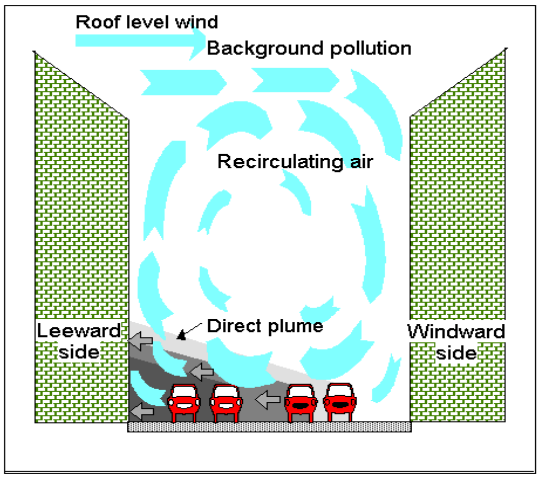
This equipment measures the wind speed and wind direction in 15m “layers” up to its maximum height range of 300m.

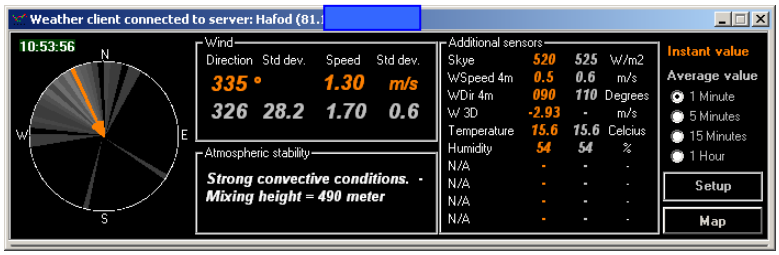


- Establishment of a street canyon meteorological station within Neath Road. This station has been fixed to the front elevation of the Hafod Post Office opposite the open path air quality measurements being undertaken by the Hafod DOAS. This station will supply the meteorological information to validate Nowcaster and other modelling output/predictions/forecasts.

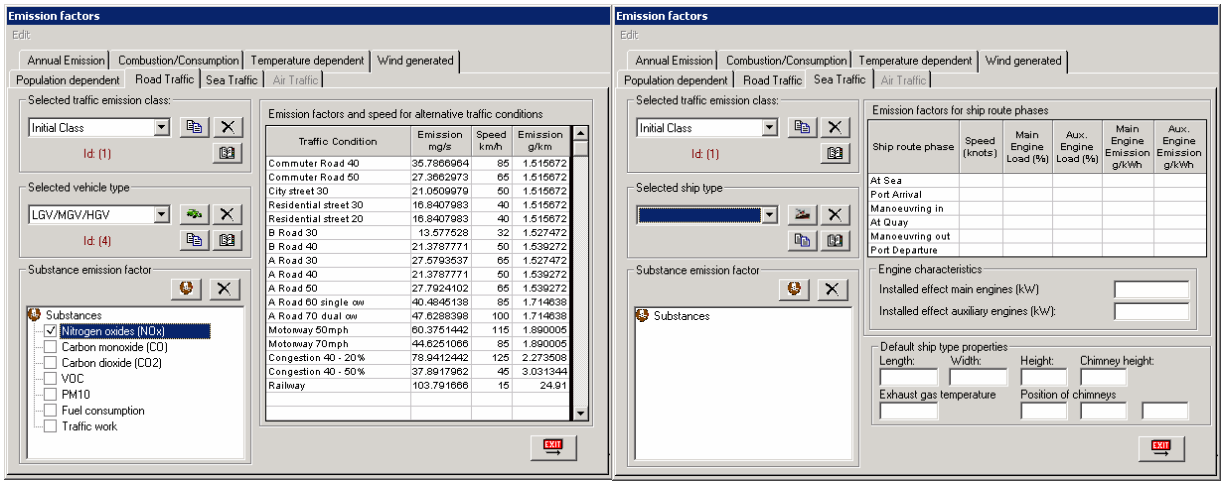
Meteorological parameters measured

- Global Radiation
- Wind Speed 5m above roof ridge level
- Wind Direction 5m above roof ridge level
- Horizontal Wind Speed at first floor level
- Horizontal Wind Direction at first floor level
- Vertical Wind Speed at first floor level
- Air Temperature at first floor level
- Relative Humidity at first floor level

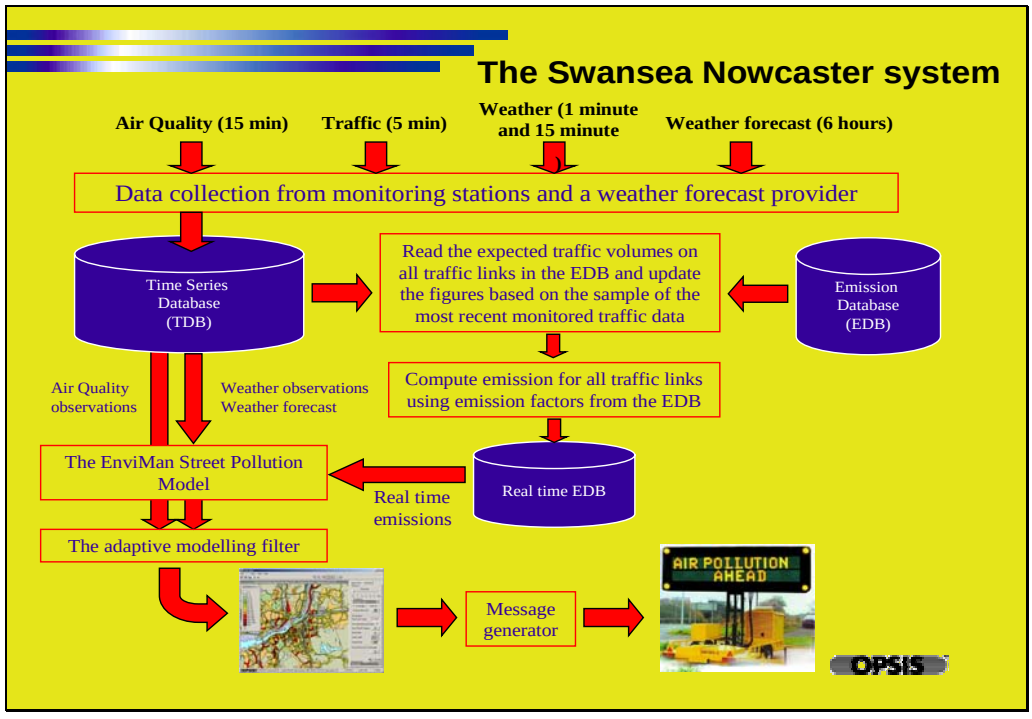




- Development of emission factors for all modes of transportation.



- A schematic of the system under development is shown below



Schematic 1 - Swansea Nowcaster Traffic Management System

- Additional air quality monitoring stations have been installed within St.Thomas (see action point 8 above) and an additional 10 laser light scattering PM_{10} analysers were installed during 2007.

- The Nowcaster model interface with the system under development is still undergoing customisation to allow unattended import of all required datasets and automatic operation and output of predictions. This is taking longer than anticipated.
- An interface is being developed to allow local media and the public to view the live Nowcaster mapping predictions – they will be able to view the statistics for the nearest traffic counter, look at the air quality forecast for the roads and even chart the data if they wish.
- The system will send emails to local media i.e. The Wave, Swansea Sound, Real Radio and even national stations (Radio 2,3,4 etc) for use in their traffic forecasts - we can detect traffic congestion in almost real time from the ATC data and broadcast this information
- In addition, messages will be sent to roadside signs to try and encourage a certain % of the traffic flow to divert from the failing area/ congested area and also to provide additional information regarding detected congestion/planned road works notifications etc.

As a result of the considerable testing and development works now ongoing it is envisaged that the system will be proven by December 2008**. However, further expansion and development of the system will be severely restricted by the current budgetary constraints. There is no Capital allocation for 2007 or 2008 or even subsequent years for this project and there was also a reduction in the Pollution Control Revenue budget for the financial year 2007/2008. This reduction has again been seen within the revenue Budget for 2008/2009.** These comments are also relevant to the hard physical works on the ground planned within the Hafod Air Quality Management Area.

8 Planning Policies

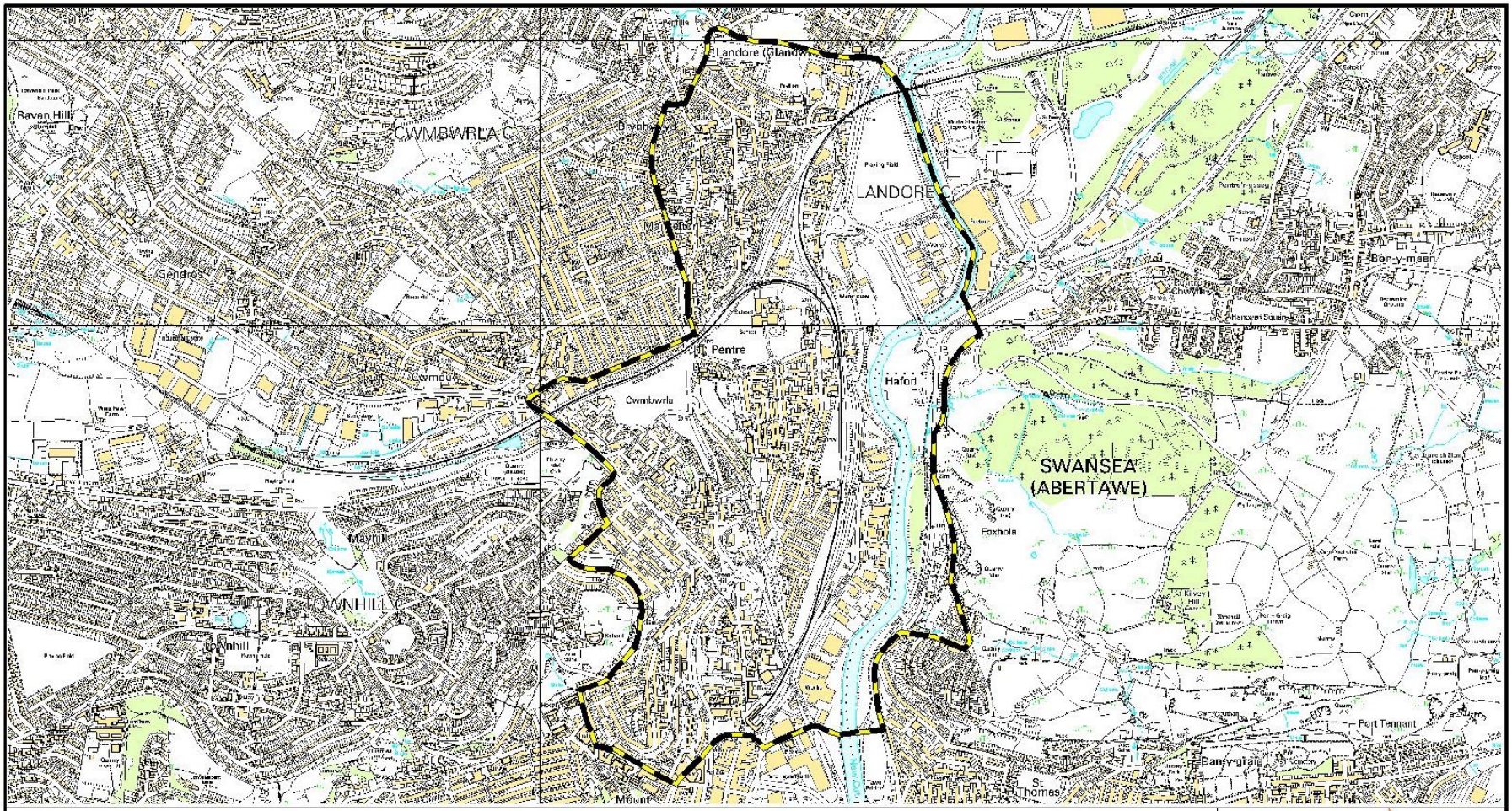
Policy EV40 has been inserted within the authorities draft Unitary Development Plan. In particular, sub policies within policy EV40 seek to clarify the authorities position with regard to air quality considerations.

1.8.8 Pollution may cause significant damage to human health, quality of life, residential amenity, and the natural and historic environment. This policy seeks to ensure that developments that would result in unacceptable high levels of noise, light or air pollution are appropriately located away from residential areas, other sensitive developments and areas of landscape, natural environment and heritage importance. The policy also seeks to ensure that incompatible development and land uses are not located close to existing sources of potential pollution.

1.8.9 The adverse effects of pollution are an important consideration when determining planning applications. When assessing new development proposals the Council will seek to minimise the impact of pollution of all kinds, and where possible planning conditions will be used to minimise environmental harm. The Council will look to the statutory environmental agencies to use there anti pollution legislative powers to monitor and enforce against discharges, noise, etc.

1.8.10 *Planning permission will not be granted for development that would be harmful to air quality by virtue of emissions from the development itself or the additional new traffic movements it would generate. Neither will permission be granted where a development is proposed that would increase the number of exposed individuals in an area likely to fail UK air quality objectives (proposed or in Regulations). This may be a declared Air Quality Management Area (AQMA), or an area that might become an AQMA if the application were to be granted.*

Annexe 1



The Hafod Air Quality Management Area (N02)

City & County of Swansea (Hafod Air Quality Management Area (NO2)) Order 2001

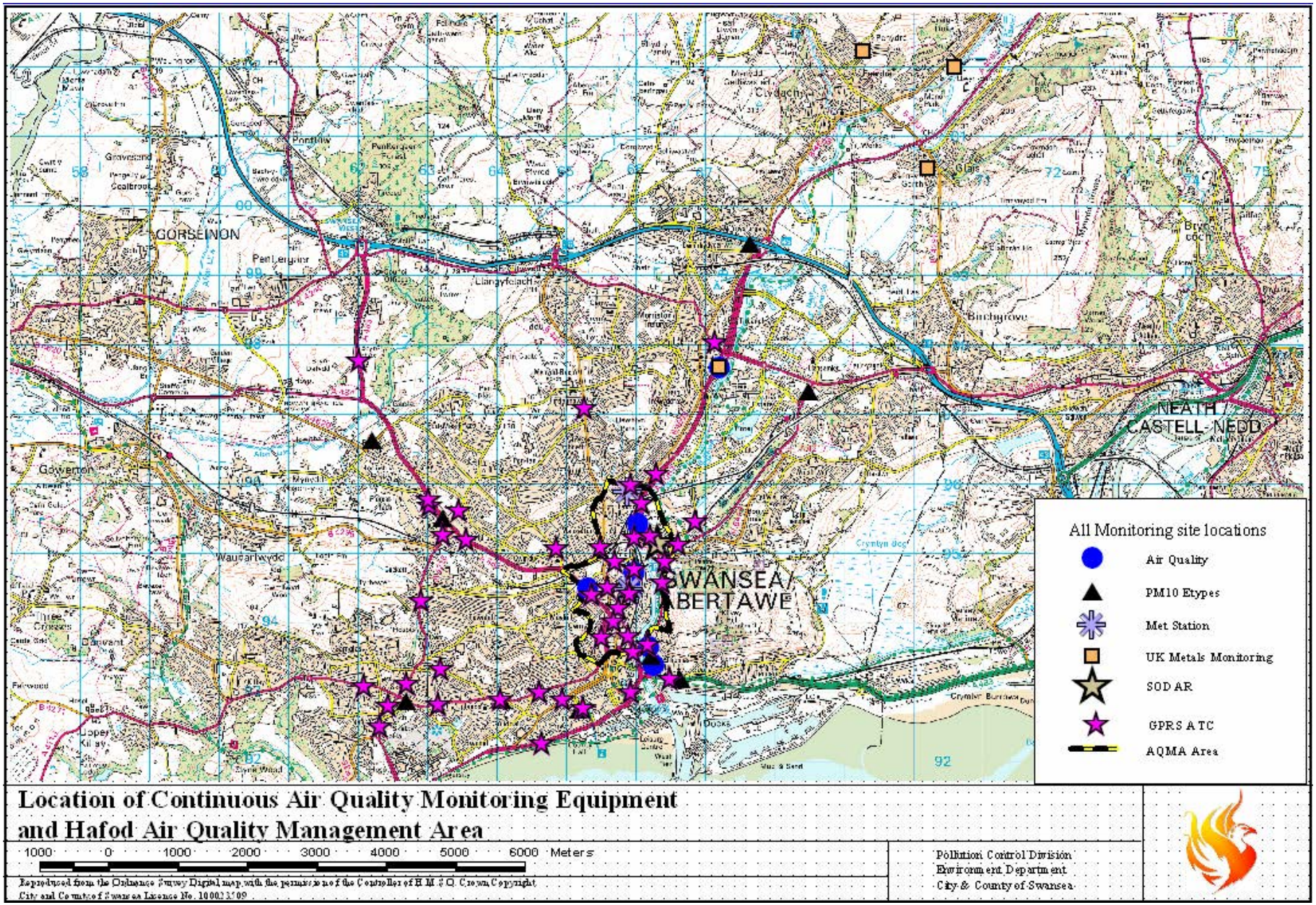
300 0 300 600 900 1200 1500 Meters

N W E S

Scale 1:12000

Pollution Control Division
Environment Department
City & County of Swansea

Annexe 2



Location of Continuous Air Quality Monitoring Equipment and Hafod Air Quality Management Area

1000 0 1000 2000 3000 4000 5000 6000 Meters

Pollution Control Division
Environment Department
City & County of Swansea

Annexe 3

1	**Station:**	**015 NeathRoad**																				
2	**Year:**	**2007**																				
3	**ADT:**	**22368**	**AWDT:**	**23976**	**Mean speed:**		**50.6**	**km/h**														
4																						
5																						

	Monthly variation:	
	January	94.6
	February	81.2
	March	110.7
	April	99.6
	May	99.6
	June	101.0
	July	102.3
	August	101.5
	September	100.6
	October	103.0
	November	105.4
	December	99.3

Vehicle class contribution to total flow and mean speed in class		
Vehicle class:	Flow %:	Mean speed (km/h):
Unclassified vehicles	0.0	-999.0
Motorcycles	0.5	50.4
Cars or light Vans	83.3	54.7
Cars or light Vans with Trailer	0.3	47.1
Heavy Van, Mini bus, L/M/HGV	14.4	54.0
Articulated lorry, HGV+Trailer	0.3	44.9
Bus	1.2	45.7

Day % variation profiles - normalised to AWDT for each vehicle class

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	0.0	0.0	0.0	0.7	0.7	0.7	0.5	1.2	1.5	0.0	0.0	0.0	0.5	1.5	2.1	0.0	0.0	0.0	0.0	0.0	0.0
01-02	0.0	0.0	0.0	0.7	0.7	0.7	0.3	1.0	1.3	0.0	0.0	0.0	0.4	1.4	2.2	0.0	0.0	0.0	0.0	0.0	0.0
02-03	0.0	0.0	0.0	0.7	0.7	0.7	0.3	0.8	1.1	0.0	0.0	0.0	0.4	1.2	2.1	1.1	0.0	0.0	0.0	0.0	0.0
03-04	0.0	0.0	0.0	0.7	0.7	0.7	0.3	0.6	0.8	0.0	0.0	0.0	0.4	0.9	1.5	1.1	0.0	0.0	0.0	0.0	0.0
04-05	0.0	0.0	0.0	1.4	1.4	0.7	0.6	0.7	0.6	0.0	0.0	0.0	0.6	0.7	0.9	1.1	0.0	0.0	0.0	0.0	0.0
05-06	0.0	0.0	0.0	2.2	1.4	0.7	1.2	0.9	0.6	1.2	0.0	0.0	1.4	0.9	0.6	1.1	0.0	0.0	1.1	0.4	0.0
06-07	0.0	0.0	0.0	4.3	1.4	0.7	3.5	1.5	0.8	3.7	1.2	0.0	4.3	1.9	0.8	3.4	1.1	0.0	3.2	1.8	0.0
07-08	0.0	0.0	0.0	6.5	2.2	1.4	6.4	2.8	1.0	7.3	2.4	1.2	7.5	3.3	1.1	9.2	3.4	0.0	6.7	4.9	0.0
08-09	0.0	0.0	0.0	5.8	2.9	1.4	6.6	4.1	1.7	9.8	3.7	1.2	8.2	4.5	1.5	11.5	3.4	0.0	8.4	7.4	0.7
09-10	0.0	0.0	0.0	4.3	4.3	2.9	5.8	5.5	3.4	8.5	4.9	2.4	7.9	5.3	2.6	9.2	4.6	0.0	8.1	8.1	2.1
10-11	0.0	0.0	0.0	4.3	5.8	4.3	6.0	6.8	5.0	8.5	6.1	2.4	7.9	6.0	3.4	8.0	2.3	0.0	8.1	8.1	2.8
11-12	0.0	0.0	0.0	5.0	7.2	5.0	6.5	7.7	6.1	8.5	6.1	3.7	7.9	5.9	3.8	6.9	3.4	1.1	8.4	8.8	2.8
12-13	0.0	0.0	0.0	5.8	7.2	5.0	6.8	7.7	6.6	8.5	6.1	3.7	7.7	5.4	3.9	6.9	11.5	1.1	8.4	8.4	2.8
13-14	0.0	0.0	0.0	6.5	7.9	5.8	6.9	7.3	6.5	8.5	4.9	3.7	7.7	4.9	3.8	5.7	5.7	1.1	8.4	8.8	2.8
14-15	0.0	0.0	0.0	6.5	7.9	6.5	7.3	6.8	6.1	9.8	3.7	2.4	7.9	4.4	3.5	5.7	3.4	1.1	8.1	8.1	2.8
15-16	0.0	0.0	0.0	8.6	7.9	6.5	7.9	6.4	5.5	8.5	3.7	2.4	7.5	4.0	3.1	6.9	2.3	1.1	8.4	7.7	2.8
16-17	0.0	0.0	0.0	10.1	6.5	5.8	8.2	5.8	4.7	7.3	2.4	2.4	6.2	3.6	2.6	8.0	2.3	1.1	8.4	7.7	2.5
17-18	0.0	0.0	0.0	7.9	5.8	5.0	7.1	5.3	4.1	4.9	2.4	1.2	4.7	3.2	2.2	4.6	2.3	1.1	6.0	5.6	2.1
18-19	0.0	0.0	0.0	5.0	4.3	3.6	5.4	4.7	3.5	2.4	1.2	1.2	3.6	2.9	2.0	2.3	1.1	1.1	2.8	2.8	1.4
19-20	0.0	0.0	0.0	3.6	2.9	2.9	4.2	3.8	2.9	1.2	1.2	1.2	2.5	2.5	1.5	2.3	1.1	0.0	1.8	1.8	1.1
20-21	0.0	0.0	0.0	3.6	2.2	2.2	3.1	2.9	2.3	1.2	1.2	0.0	1.7	2.2	1.3	1.1	0.0	0.0	1.4	1.8	1.1
21-22	0.0	0.0	0.0	2.9	2.2	1.4	2.3	2.4	1.7	0.0	1.2	0.0	1.3	2.0	1.0	1.1	0.0	0.0	1.1	1.4	1.1
22-23	0.0	0.0	0.0	2.2	1.4	1.4	1.6	2.0	1.3	0.0	0.0	0.0	1.0	1.8	0.8	1.1	0.0	0.0	1.1	1.4	0.7
23-24	0.0	0.0	0.0	0.7	0.7	0.7	1.0	1.7	0.9	0.0	0.0	0.0	0.8	1.9	0.7	1.1	0.0	0.0	0.4	0.4	0.4
Daily total:				**100.0**	**86.3**	**66.9**	**100.0**	**90.3**	**70.2**	**100.0**	**52.4**	**29.3**	**100.0**	**72.4**	**49.2**	**100.0**	**48.3**	**9.2**	**100.0**	**95.1**	**29.8**

Day speed variation profiles

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	-	-	-	61.3	60.9	62.9	62.1	61.9	62.3	57.3	66.4	62.0	61.7	62.4	62.3	49.8	46.8	55.6	54.7	53.7	54.0
01-02	-	-	-	65.7	60.3	66.0	63.1	63.3	63.9	59.2	61.9	56.2	62.8	63.3	63.5	55.7	61.8	62.8	50.8	57.5	55.0
02-03	-	-	-	64.1	60.9	67.1	63.6	64.6	65.4	63.5	64.3	59.8	63.6	64.2	64.5	55.4	62.2	38.3	57.7	54.2	62.6
03-04	-	-	-	52.9	52.9	65.6	62.1	64.2	65.9	62.0	60.6	64.7	62.4	63.0	64.4	51.3	60.6	45.3	49.2	51.0	55.9
04-05	-	-	-	57.0	58.7	59.8	61.0	62.8	64.3	58.5	63.0	52.6	60.0	60.7	62.9	52.9	55.4	55.1	52.7	50.5	61.7
05-06	-	-	-	54.5	53.9	62.0	60.4	61.9	63.1	58.0	58.8	49.9	58.7	60.2	60.6	51.5	52.1	55.5	50.5	54.1	55.6
06-07	-	-	-	53.0	53.5	56.1	56.6	60.4	62.5	54.1	57.7	55.3	55.4	59.4	60.4	48.4	53.3	54.4	47.8	48.7	58.3
07-08	-	-	-	43.7	54.8	61.2	47.4	57.2	60.9	43.4	53.4	58.2	46.3	56.2	58.6	41.4	52.6	54.9	42.3	47.2	54.5
08-09	-	-	-	42.1	53.1	55.9	46.3	55.3	59.3	42.6	52.2	56.0	45.5	54.5	57.5	41.3	50.7	54.7	42.4	46.0	50.7
09-10	-	-	-	45.0	51.8	53.7	49.4	53.3	57.2	46.9	50.4	54.8	48.8	52.3	56.2	45.7	49.5	54.4	45.4	46.6	47.8
10-11	-	-	-	47.3	47.9	53.6	49.9	50.7	55.5	47.6	49.1	54.1	49.4	50.1	54.8	45.9	48.4	53.5	46.4	46.3	48.1
11-12	-	-	-	45.8	43.1	53.9	48.5	46.9	53.9	46.0	43.8	50.4	48.0	46.1	53.6	44.0	38.8	48.4	45.8	43.4	48.0
12-13	-	-	-	45.9	41.2	51.2	48.0	45.4	53.2	45.4	40.1	51.0	47.4	44.1	52.8	43.3	39.3	48.7	45.6	42.2	47.5
13-14	-	-	-	45.4	42.5	52.3	48.1	46.7	53.2	44.8	41.9	49.9	47.3	45.5	52.8	43.5	42.8	50.3	45.3	43.2	47.6
14-15	-	-	-	43.5	47.4	55.1	47.2	49.5	54.0	43.9	45.0	51.6	46.4	48.6	53.5	42.2	44.6	52.5	44.3	44.9	47.2
15-16	-	-	-	38.1	50.3	56.6	43.4	51.8	54.8	39.4	47.3	52.4	42.4	50.8	54.3	37.8	48.6	52.6	40.7	46.4	47.9
16-17	-	-	-	35.9	50.2	56.1	42.1	51.7	55.6	36.4	48.1	54.4	40.6	50.9	54.7	34.8	48.3	50.9	38.7	45.9	46.8
17-18	-	-	-	44.0	49.3	59.6	47.5	52.6	56.5	42.0	47.5	53.7	46.4	51.3	56.0	39.4	51.2	50.3	42.7	45.6	47.6
18-19	-	-	-	51.8	57.9	56.6	53.4	55.6	56.9	49.9	50.1	53.7	53.0	55.1	56.6	49.3	53.7	52.7	47.3	49.2	47.3
19-20	-	-	-	55.3	57.2	60.0	55.2	56.6	57.5	52.3	51.1	53.2	54.8	56.2	56.9	49.3	57.5	50.4	48.0	48.7	47.1
20-21	-	-	-	56.3	60.3	60.3	56.0	57.6	58.0	54.3	55.1	55.5	55.7	57.5	57.6	47.9	51.6	55.4	47.0	47.7	44.5
21-22	-	-	-	57.5	62.3	56.7	56.8	58.0	58.5	53.6	55.6	54.3	56.3	58.3	58.0	47.3	55.1	53.1	45.5	47.2	43.3
22-23	-	-	-	56.9	57.4	57.0	58.4	58.9	59.7	55.2	51.9	54.0	58.0	59.2	59.2	44.2	52.9	53.9	46.9	47.6	43.6
23-24	-	-	-	57.5	60.3	57.0	60.3	60.3	60.9	53.1	56.1	55.8	59.7	60.5	60.6	51.5	54.2	51.9	47.3	48.3	43.2
Daily mean:	**-999.0**	**-999.0**	**-999.0**	**48.9**	**52.3**	**57.1**	**53.6**	**56.1**	**58.9**	**46.0**	**49.1**	**53.5**	**52.9**	**55.4**	**58.0**	**43.8**	**48.8**	**52.2**	**45.2**	**46.6**	**47.5**

1	**Station:**	**022 HighStreet**																				
2	**Year:**	**2007**																				
3	**ADT:**	**10896**	**AWDT:**	**11040**	**Mean speed:**		**36.2**	**km/h**														
4																						
5																						
6		Monthly variation:			Vehicle class contribution to total flow and mean speed in class																	
7		January	91.6		Vehicle class:			Flow %:		Mean speed (km/h):												
8		February	96.1		Unclassified vehicles			0.0		-999.0												
9		March	102.4		Motorcycles			0.7		33.6												
10		April	96.8		Cars or light Vans			83.3		41.3												
11		May	98.1		Cars or light Vans with Trailer			0.2		30.1												
12		June	100.8		Heavy Van, Mini bus, L/M/HGV			7.0		37.7												
13		July	102.4		Articulated lorry, HGV+Trailer			0.4		30.4												
14		August	102.1		Bus			8.4		34.3												
15		September	100.4																			
16		October	101.2																			
17		November	103.7																			
18		December	104.8																			
19																						
20	Day % variation profiles - normalised to AWDT for each vehicle class																					
21		Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
22	Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
23	00-01	0.0	0.0	0.0	0.0	1.3	1.3	1.6	4.5	5.5	0.0	0.0	0.0	0.5	1.1	1.9	2.0	0.0	0.0	0.1	0.1	0.2
24	01-02	0.0	0.0	0.0	0.0	0.0	1.3	1.1	3.7	5.2	0.0	0.0	0.0	0.3	1.1	2.1	2.0	2.0	0.0	0.0	0.0	0.1
25	02-03	0.0	0.0	0.0	0.0	0.0	1.3	0.8	2.7	4.2	0.0	0.0	0.0	0.5	0.8	1.7	2.0	2.0	0.0	0.1	0.1	0.1
26	03-04	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.7	2.8	0.0	0.0	0.0	0.6	0.7	0.9	0.0	0.0	0.0	0.1	0.0	0.1
27	04-05	0.0	0.0	0.0	1.3	1.3	0.0	0.7	1.2	1.5	0.0	0.0	0.0	1.4	1.2	0.5	2.0	2.0	0.0	0.2	0.1	0.1
28	05-06	0.0	0.0	0.0	1.3	0.0	0.0	1.3	1.1	0.9	7.7	0.0	0.0	2.5	1.9	0.6	2.0	2.0	0.0	1.0	0.3	0.0
29	06-07	0.0	0.0	0.0	2.6	1.3	0.0	3.3	1.7	1.0	7.7	0.0	0.0	4.4	2.6	0.8	2.0	2.0	0.0	3.1	1.6	0.1
30	07-08	0.0	0.0	0.0	3.9	1.3	0.0	5.6	2.7	1.3	7.7	7.7	0.0	7.4	4.2	1.0	2.0	2.0	0.0	6.2	4.9	0.3
31	08-09	0.0	0.0	0.0	3.9	2.6	1.3	6.0	4.0	2.1	7.7	7.7	0.0	9.3	5.1	1.4	4.0	0.0	0.0	8.2	7.6	0.9
32	09-10	0.0	0.0	0.0	3.9	2.6	1.3	5.3	5.1	3.5	7.7	7.7	0.0	9.0	5.2	1.8	4.0	2.0	0.0	8.7	8.4	1.9
33	10-11	0.0	0.0	0.0	3.9	3.9	2.6	5.3	6.0	4.6	7.7	7.7	0.0	8.2	5.2	1.8	4.0	4.0	0.0	8.7	8.6	2.4
34	11-12	0.0	0.0	0.0	5.2	5.2	3.9	5.7	6.6	5.5	7.7	7.7	0.0	8.0	4.7	1.8	6.0	4.0	0.0	8.6	8.6	2.5
35	12-13	0.0	0.0	0.0	6.5	9.1	3.9	6.0	6.9	5.9	7.7	7.7	0.0	7.7	4.5	1.8	6.0	8.0	2.0	8.5	8.5	2.6
36	13-14	0.0	0.0	0.0	7.8	10.4	3.9	5.9	6.5	5.9	7.7	7.7	0.0	7.3	4.1	1.6	8.0	8.0	2.0	8.4	8.3	2.5
37	14-15	0.0	0.0	0.0	9.1	6.5	3.9	6.5	6.2	5.9	7.7	0.0	0.0	7.7	3.7	1.6	10.0	4.0	2.0	8.0	8.0	2.7
38	15-16	0.0	0.0	0.0	11.7	6.5	3.9	6.9	5.9	5.7	7.7	7.7	0.0	7.2	3.6	1.6	12.0	4.0	2.0	7.5	8.0	2.6
39	16-17	0.0	0.0	0.0	11.7	5.2	5.2	7.0	5.9	5.4	7.7	7.7	0.0	5.6	3.3	1.6	12.0	4.0	2.0	7.5	7.6	2.5
40	17-18	0.0	0.0	0.0	7.8	3.9	3.9	6.5	6.0	5.1	7.7	0.0	0.0	3.6	2.8	1.5	8.0	2.0	2.0	5.6	5.6	2.0
41	18-19	0.0	0.0	0.0	3.9	2.6	2.6	5.8	6.4	5.0	0.0	0.0	0.0	2.5	2.4	1.5	2.0	0.0	2.0	3.1	3.0	1.7
42	19-20	0.0	0.0	0.0	3.9	2.6	3.9	5.0	7.0	4.7	0.0	0.0	0.0	1.9	3.2	1.6	2.0	0.0	2.0	1.9	2.0	1.3
43	20-21	0.0	0.0	0.0	3.9	3.9	2.6	4.1	6.8	3.9	0.0	0.0	0.0	1.5	3.2	1.2	2.0	0.0	2.0	1.6	1.8	1.0
44	21-22	0.0	0.0	0.0	3.9	3.9	2.6	3.5	5.9	3.2	0.0	0.0	0.0	1.1	2.5	0.9	2.0	0.0	2.0	1.5	1.5	0.9
45	22-23	0.0	0.0	0.0	2.6	2.6	1.3	3.0	5.3	2.8	0.0	0.0	0.0	1.0	1.9	0.7	2.0	0.0	2.0	1.2	1.3	0.7
46	23-24	0.0	0.0	0.0	1.3	1.3	1.3	2.6	5.3	2.5	0.0	0.0	0.0	0.8	1.7	0.6	2.0	0.0	0.0	0.5	0.5	0.4
47	**Daily total:**				**100.0**	**77.9**	**51.9**	**100.0**	**115.2**	**94.1**	**100.0**	**69.2**	**0.0**	**100.0**	**70.7**	**32.3**	**100.0**	**52.0**	**22.0**	**100.0**	**96.0**	**29.7**
48																						
49	Day speed variation profiles																					
50		Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
51	Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
52	00-01	-	-	-	48.8	41.5	41.7	47.7	46.3	47.3	42.7	39.0	34.0	44.0	42.9	44.1	36.4	34.4	33.0	42.3	39.9	39.2
53	01-02	-	-	-	48.9	39.4	39.8	49.1	48.2	48.9	-	-	47.8	45.8	45.7	45.4	38.6	37.6	36.5	43.9	40.0	39.8
54	02-03	-	-	-	51.2	51.0	46.0	49.5	49.4	50.5	41.3	-	51.0	47.5	45.2	46.7	37.5	37.0	39.4	46.5	45.3	40.0
55	03-04	-	-	-	44.8	51.4	54.1	48.8	49.8	51.2	35.8	-	44.0	50.4	45.4	47.4	35.7	35.5	27.1	42.4	45.1	40.4
56	04-05	-	-	-	47.2	52.2	43.8	47.7	49.3	49.9	46.8	39.5	41.0	46.9	44.7	44.3	36.7	39.4	44.5	40.1	41.3	37.8
57	05-06	-	-	-	42.7	43.9	44.0	45.8	47.1	48.3	41.5	38.1	46.0	42.5	42.0	38.0	37.6	39.2	27.3	37.3	38.7	33.4
58	06-07	-	-	-	39.8	42.6	45.1	43.2	45.3	46.3	39.0	42.0	46.6	40.3	42.6	37.3	34.0	37.3	27.0	36.6	38.0	37.9
59	07-08	-	-	-	31.9	42.8	39.1	39.1	42.6	44.9	32.2	38.7	35.8	36.2	40.4	38.4	30.1	32.4	27.3	34.8	35.9	38.6
60	08-09	-	-	-	26.9	37.7	41.7	36.3	40.4	43.7	28.4	38.1	38.9	33.3	37.7	39.5	26.0	31.7	27.5	32.9	34.6	37.4
61	09-10	-	-	-	26.4	34.3	42.1	35.6	38.2	41.9	29.6	31.9	38.8	32.7	35.6	37.6	26.7	26.7	32.7	32.3	33.4	35.8
62	10-11	-	-	-	29.1	28.9	37.4	35.8	36.6	40.8	29.8	31.4	36.5	32.8	34.0	37.2	28.3	27.0	34.9	32.4	32.5	35.0
63	11-12	-	-	-	27.1	31.6	36.9	35.2	35.8	39.6	29.2	26.1	30.5	32.1	33.0	35.8	25.6	29.2	31.5	31.8	32.3	34.2
64	12-13	-	-	-	25.0	23.5	40.2	34.6	33.9	39.4	28.1	20.8	33.2	31.2	29.9	35.6	27.0	25.7	28.4	31.3	30.9	34.0
65	13-14	-	-	-	25.6	25.1	38.1	34.3	34.1	39.3	27.7	23.4	34.6	30.5	29.8	35.2	27.2	22.6	32.1	31.0	30.9	33.6
66	14-15	-	-	-	22.3	30.0	38.6	33.5	36.0	39.3	26.0	26.9	32.5	29.2	32.0	35.2	26.5	26.6	31.1	30.4	32.1	34.0
67	15-16	-	-	-	21.5	30.7	38.2	33.6	36.7	39.4	24.7	26.9	33.3	29.1	32.5	35.7	27.9	28.2	28.3	30.3	32.4	33.9
68	16-17	-	-	-	20.4	32.0	42.5	34.0	37.0	39.9	24.1	30.1	34.7	29.3	33.1	35.9	28.2	27.9	34.6	30.5	32.4	34.6
69	17-18	-	-	-	26.4	33.1	41.7	36.5	38.7	40.9	25.5	29.1	32.7	32.2	35.1	37.2	28.2	30.1	33.5	32.0	33.2	34.5
70	18-19	-	-	-	35.8	41.5	43.5	39.8	40.8	41.5	29.6	32.5	31.5	35.8	38.0	38.9	29.1	26.9	32.4	34.1	34.8	35.6
71	19-20	-	-	-	41.6	39.4	40.3	41.3	41.4	42.1	32.2	32.9	33.3	37.6	39.2	39.3	31.2	34.3	33.0	34.7	34.3	36.1
72	20-21	-	-	-	45.0	40.2	45.4	42.4	42.3	43.0	35.0	30.6	35.2	39.3	40.5	40.1	35.3	37.0	35.9	34.3	34.6	34.2
73	21-22	-	-	-	45.9	39.9	48.2	43.3	43.0	44.0	33.8	25.1	37.7	40.2	41.2	40.1	36.4	33.6	35.9	34.8	34.4	33.9
74	22-23	-	-	-	49.1	39.5	50.9	44.2	44.0	45.0	34.7	26.8	34.0	40.2	41.7	41.8	36.4	36.8	35.4	35.9	36.1	35.0
75	23-24	-	-	-	44.3	43.2	51.4	45.7	45.7	46.4	38.4	38.1	41.0	41.6	41.9	43.6	35.5	35.1	33.6	39.0	37.5	36.8
76	**Daily mean:**	**-999.0**	**-999.0**	**-999.0**	**32.2**	**34.8**	**41.9**	**40.7**	**41.8**	**43.9**	**29.5**	**30.5**	**35.4**	**37.2**	**38.4**	**39.6**	**30.2**	**30.8**	**32.8**	**34.1**	**34.6**	**35.5**

Station:	**023 FoxholeRoad**																					
Year:	**2007**																					
ADT:	**22344**	**AWDT:**	**23568**	**Mean speed:**		**53.8**	**km/h**															

Monthly variation:	
January	97.5
February	98.3
March	84.6
April	99.4
May	102.1
June	103.6
July	101.0
August	103.2
September	100.4
October	103.1
November	105.6
December	101.7

Vehicle class contribution to total flow and mean speed in class

Vehicle class:	Flow %:	Mean speed (km/h):
Unclassified vehicles	0.0	-999.0
Motorcycles	0.5	56.4
Cars or light Vans	93.1	58.3
Cars or light Vans with Trailer	0.2	50.1
Heavy Van, Mini bus, L/M/HGV	5.0	56.2
Articulated lorry, HGV+Trailer	0.2	52.3
Bus	0.9	45.5

Day % variation profiles - normalised to AWDT for each vehicle class

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	0.0	0.0	0.0	0.0	0.8	0.8	0.4	1.2	1.3	0.0	0.0	0.0	0.2	0.5	0.7	0.0	1.6	0.0	0.0	0.4	0.4
01-02	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.1	0.0	0.0	0.0	0.2	0.5	0.8	0.0	1.6	0.0	0.0	0.0	0.4
02-03	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.9	0.0	0.0	0.0	0.2	0.4	0.6	1.6	1.6	0.0	0.0	0.0	0.4
03-04	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.0	0.0	0.0	0.4	0.4	0.3	1.6	1.6	0.0	0.0	0.0	0.0
04-05	0.0	0.0	0.0	0.8	0.8	0.0	0.4	0.6	0.4	0.0	0.0	0.0	0.9	0.7	0.3	1.6	1.6	0.0	0.4	0.4	0.0
05-06	0.0	0.0	0.0	2.5	1.6	0.8	1.0	0.8	0.5	0.0	2.0	0.0	2.0	1.4	0.5	1.6	1.6	0.0	1.3	0.9	0.4
06-07	0.0	0.0	0.0	5.7	2.5	0.8	3.1	1.5	0.7	3.9	2.0	2.0	5.3	2.8	1.1	4.8	3.2	1.6	5.7	2.6	0.4
07-08	0.0	0.0	0.0	7.4	3.3	1.6	6.1	2.7	1.0	7.8	3.9	3.9	8.2	3.8	1.4	8.1	3.2	1.6	9.7	4.4	0.4
08-09	0.0	0.0	0.0	5.7	4.9	2.5	6.4	4.3	1.8	9.8	7.8	3.9	9.5	4.4	1.6	9.7	3.2	1.6	9.3	6.2	0.9
09-10	0.0	0.0	0.0	4.1	4.9	3.3	5.8	5.8	3.5	9.8	7.8	3.9	9.5	4.4	1.9	9.7	1.6	1.6	7.5	7.0	1.8
10-11	0.0	0.0	0.0	4.1	5.7	5.7	6.2	7.2	5.4	9.8	7.8	7.8	9.0	3.9	2.0	9.7	1.6	1.6	7.0	6.6	2.2
11-12	0.0	0.0	0.0	5.7	9.0	5.7	6.7	8.1	6.8	9.8	7.8	5.9	8.7	3.7	2.2	9.7	3.2	1.6	7.0	6.6	1.8
12-13	0.0	0.0	0.0	5.7	9.0	7.4	7.0	8.4	7.3	7.8	7.8	5.9	8.4	3.4	2.2	8.1	3.2	1.6	7.5	7.0	2.2
13-14	0.0	0.0	0.0	6.6	9.0	8.2	7.1	8.1	7.3	9.8	5.9	5.9	8.2	2.7	2.0	6.5	3.2	1.6	7.5	7.0	2.2
14-15	0.0	0.0	0.0	6.6	9.8	9.0	7.4	7.7	7.1	9.8	5.9	5.9	8.1	2.3	1.8	6.5	3.2	1.6	8.4	6.2	2.2
15-16	0.0	0.0	0.0	8.2	9.8	9.8	8.1	7.3	6.2	7.8	3.9	3.9	7.0	1.9	1.5	6.5	1.6	1.6	8.8	5.7	2.2
16-17	0.0	0.0	0.0	9.8	7.4	8.2	8.4	6.9	5.1	5.9	3.9	3.9	5.0	1.6	1.2	4.8	1.6	1.6	7.5	5.7	2.2
17-18	0.0	0.0	0.0	9.0	6.6	8.2	7.3	6.1	4.2	3.9	3.9	3.9	3.4	1.5	0.9	3.2	1.6	1.6	5.3	4.4	1.8
18-19	0.0	0.0	0.0	5.7	4.9	4.9	5.7	5.0	3.6	2.0	2.0	2.0	2.3	1.5	0.9	1.6	1.6	0.0	2.2	2.6	1.8
19-20	0.0	0.0	0.0	4.9	2.5	3.3	4.3	4.2	2.9	2.0	2.0	2.0	1.4	1.4	0.8	1.6	0.0	0.0	1.3	1.8	1.3
20-21	0.0	0.0	0.0	3.3	2.5	1.6	3.2	3.2	2.2	0.0	0.0	0.0	0.8	1.3	0.5	0.0	0.0	0.0	1.3	1.8	1.3
21-22	0.0	0.0	0.0	1.6	1.6	0.8	2.3	2.4	1.6	0.0	0.0	0.0	0.6	0.9	0.4	0.0	0.0	0.0	0.9	1.3	1.3
22-23	0.0	0.0	0.0	1.6	0.8	0.8	1.5	2.0	1.1	0.0	0.0	0.0	0.4	0.7	0.3	1.6	0.0	0.0	0.9	1.3	0.9
23-24	0.0	0.0	0.0	0.8	0.0	0.0	0.9	1.6	0.7	0.0	0.0	0.0	0.3	0.5	0.2	1.6	0.0	0.0	0.4	0.4	0.4
Daily total:				**100.0**	**97.5**	**83.6**	**100.0**	**97.0**	**73.3**	**100.0**	**74.5**	**60.8**	**100.0**	**46.6**	**26.3**	**100.0**	**41.9**	**19.4**	**100.0**	**80.6**	**29.1**

Day speed variation profiles

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	-	-	-	73.1	69.3	68.0	65.1	64.8	65.1	58.0	55.6	56.8	61.5	59.9	60.6	55.5	56.2	52.9	57.2	56.4	57.1
01-02	-	-	-	59.1	63.9	72.9	66.0	66.4	67.1	54.8	57.6	51.0	60.2	61.8	62.4	56.7	54.8	52.8	55.4	57.2	59.7
02-03	-	-	-	71.9	66.0	74.5	65.7	67.0	68.2	52.1	50.7	52.4	63.0	62.8	65.5	56.4	55.1	54.3	54.2	57.3	63.6
03-04	-	-	-	72.6	79.2	65.0	65.4	66.5	68.7	57.2	53.9	50.0	62.8	64.0	67.1	55.8	54.5	52.2	53.1	56.6	63.9
04-05	-	-	-	75.8	79.6	45.5	64.9	65.6	66.4	55.4	52.7	54.8	64.2	64.1	64.6	55.0	55.2	55.5	53.9	57.4	60.9
05-06	-	-	-	64.3	69.0	72.0	64.2	64.5	65.1	56.3	54.7	60.2	63.1	63.8	62.8	56.4	55.1	59.2	47.9	59.6	56.4
06-07	-	-	-	60.6	65.8	60.5	60.7	63.3	65.0	54.0	57.8	54.7	59.1	62.0	62.1	55.3	58.8	55.9	47.4	51.3	59.5
07-08	-	-	-	51.7	61.6	66.5	53.3	61.0	63.7	47.8	54.5	56.7	51.5	58.7	60.1	49.8	55.9	56.7	45.5	48.1	58.0
08-09	-	-	-	49.1	58.4	57.5	51.6	58.6	61.9	47.3	54.4	56.1	50.2	56.9	59.5	49.4	55.0	59.5	44.0	45.8	50.0
09-10	-	-	-	52.1	54.5	57.9	53.6	56.5	59.5	50.2	53.2	55.4	52.4	55.1	57.8	51.5	56.0	56.8	44.7	44.3	44.6
10-11	-	-	-	53.7	54.6	58.2	53.5	54.4	57.5	50.1	50.6	54.2	52.2	53.0	55.9	52.3	52.1	55.7	45.0	44.3	43.6
11-12	-	-	-	51.5	51.2	55.5	52.0	52.2	55.5	49.2	48.7	52.3	50.7	50.9	54.5	51.3	48.0	50.3	44.2	43.7	42.3
12-13	-	-	-	50.5	49.5	54.2	51.7	50.9	54.2	48.6	46.9	50.7	50.2	49.0	52.6	51.1	44.0	50.9	44.3	42.9	41.7
13-14	-	-	-	51.9	50.8	55.0	52.3	51.7	54.6	49.5	48.2	51.4	51.0	50.0	53.7	50.7	47.5	53.4	44.8	43.7	42.7
14-15	-	-	-	52.3	54.7	58.1	52.9	53.9	55.3	49.9	51.6	52.5	51.7	52.7	54.5	51.4	52.3	54.2	45.6	44.9	42.8
15-16	-	-	-	50.9	57.2	57.6	51.6	55.2	56.7	48.2	51.3	54.2	50.3	54.0	55.3	49.7	53.2	51.5	44.9	45.9	45.3
16-17	-	-	-	50.0	56.8	62.7	50.5	55.3	58.0	45.8	52.6	54.3	49.0	53.8	56.4	48.6	52.0	48.0	43.8	45.2	43.8
17-18	-	-	-	51.7	55.7	63.5	52.1	55.1	58.4	47.9	50.5	52.6	50.7	53.3	57.2	46.8	46.2	56.0	43.7	44.7	43.7
18-19	-	-	-	54.9	60.4	63.0	54.9	57.1	59.0	49.5	49.6	54.4	53.0	55.7	58.9	49.9	49.4	55.9	44.0	46.3	44.0
19-20	-	-	-	58.1	61.6	62.4	57.3	58.3	59.8	51.9	53.8	51.4	55.5	57.0	58.7	52.6	51.1	50.2	44.1	46.8	44.5
20-21	-	-	-	60.7	60.1	61.0	58.5	59.1	60.3	53.2	53.4	53.9	57.2	58.6	58.4	54.8	54.4	52.0	43.9	47.6	43.3
21-22	-	-	-	60.1	59.2	62.3	59.7	59.8	60.8	53.4	52.2	53.2	57.5	57.9	59.2	53.9	50.1	59.9	43.5	46.5	42.2
22-23	-	-	-	62.5	62.0	61.4	61.1	60.5	62.0	51.1	57.4	53.4	59.1	58.7	60.0	54.8	53.2	59.6	45.5	47.9	43.5
23-24	-	-	-	69.7	69.3	58.8	63.2	62.7	63.8	54.1	56.3	58.0	60.2	61.5	64.0	56.0	53.0	58.4	50.5	50.4	46.7
Daily mean:	**-999.0**	**-999.0**	**-999.0**	**55.5**	**58.4**	**59.9**	**57.6**	**59.2**	**61.1**	**49.3**	**51.7**	**53.6**	**55.4**	**57.2**	**59.1**	**52.0**	**53.0**	**54.7**	**45.2**	**46.9**	**45.7**

Station:	**027 Cockett Road**																					
Year:	**2007**																					
ADT:	**22320**	**AWDT:**	**23760**	**Mean speed:**		**41.0**	**km/h**															

Monthly variation:	
January	95.3
February	96.3
March	102.5
April	100.6
May	101.4
June	102.4
July	102.9
August	102.6
September	101.5
October	101.4
November	98.9
December	94.2

Vehicle class contribution to total flow and mean speed in class

Vehicle class:	Flow %:	Mean speed (km/h):
Unclassified vehicles	0.0	-999.0
Motorcycles	0.9	43.3
Cars or light Vans	92.6	46.1
Cars or light Vans with Trailer	0.2	35.9
Heavy Van, Mini bus, L/M/HGV	5.5	43.4
Articulated lorry, HGV+Trailer	0.2	35.6
Bus	0.6	34.0

Day % variation profiles - normalised to AWDT for each vehicle class

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	0.0	0.0	0.0	1.0	1.4	1.4	0.4	0.8	0.9	0.0	0.0	0.0	0.3	0.6	0.6	0.0	0.0	0.0	0.6	0.6	1.2
01-02	0.0	0.0	0.0	0.5	1.0	1.4	0.2	0.5	0.6	0.0	0.0	0.0	0.3	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
02-03	0.0	0.0	0.0	0.5	1.0	1.0	0.1	0.3	0.4	0.0	0.0	0.0	0.3	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0
03-04	0.0	0.0	0.0	0.5	0.5	1.0	0.2	0.3	0.3	0.0	0.0	0.0	0.4	0.5	0.4	0.0	0.0	0.0	0.6	0.0	0.0
04-05	0.0	0.0	0.0	1.4	1.0	1.4	0.4	0.5	0.3	0.0	0.0	0.0	0.9	0.9	0.4	0.0	1.5	0.0	1.9	0.6	0.0
05-06	0.0	0.0	0.0	2.4	1.4	1.4	1.2	0.9	0.6	0.0	1.8	0.0	1.8	1.4	0.6	1.5	3.1	1.5	3.1	1.9	0.0
06-07	0.0	0.0	0.0	4.3	2.4	2.4	3.4	1.6	1.0	1.8	1.8	1.8	4.4	2.2	0.8	3.1	3.1	1.5	8.7	3.7	0.0
07-08	0.0	0.0	0.0	5.2	2.9	2.4	5.8	2.7	1.3	7.1	5.4	1.8	6.8	3.4	1.3	6.2	1.5	1.5	10.6	6.2	0.6
08-09	0.0	0.0	0.0	5.2	3.3	2.9	6.5	4.2	2.2	8.9	5.4	3.6	9.0	4.5	1.6	7.7	3.1	1.5	8.7	6.8	1.9
09-10	0.0	0.0	0.0	5.2	4.8	3.3	6.3	5.7	3.9	8.9	7.1	5.4	9.6	4.8	2.0	7.7	3.1	1.5	7.5	5.6	1.9
10-11	0.0	0.0	0.0	6.2	4.3	4.3	6.4	6.6	5.3	8.9	8.9	5.4	9.1	5.0	2.5	6.2	3.1	3.1	6.2	4.3	1.2
11-12	0.0	0.0	0.0	6.2	5.2	4.8	6.8	7.2	6.3	8.9	8.9	7.1	8.7	4.5	2.5	7.7	4.6	3.1	5.6	4.3	0.6
12-13	0.0	0.0	0.0	7.1	5.7	5.2	7.0	7.5	6.9	8.9	8.9	7.1	7.8	3.9	2.6	7.7	3.1	3.1	6.2	4.3	1.2
13-14	0.0	0.0	0.0	6.2	5.7	5.7	7.1	7.3	6.8	8.9	7.1	5.4	7.9	3.5	2.4	7.7	4.6	3.1	7.5	4.3	1.2
14-15	0.0	0.0	0.0	6.7	5.2	6.2	7.2	6.8	6.4	8.9	7.1	7.1	7.8	3.0	2.2	9.2	3.1	1.5	7.5	4.3	1.2
15-16	0.0	0.0	0.0	6.7	6.2	7.1	7.2	6.5	6.2	8.9	5.4	5.4	7.0	2.7	2.0	10.8	3.1	1.5	7.5	4.3	1.2
16-17	0.0	0.0	0.0	6.2	5.7	7.1	7.1	6.3	5.8	7.1	3.6	5.4	5.3	2.6	2.0	9.2	3.1	1.5	6.8	3.7	1.2
17-18	0.0	0.0	0.0	6.2	4.8	6.7	7.0	5.9	5.3	5.4	3.6	3.6	4.0	2.4	1.8	6.2	1.5	1.5	5.0	3.7	1.2
18-19	0.0	0.0	0.0	5.7	3.8	5.2	6.1	5.1	4.4	3.6	3.6	1.8	2.9	1.9	1.4	4.6	1.5	1.5	3.1	2.5	0.6
19-20	0.0	0.0	0.0	5.2	3.3	3.8	5.0	4.0	3.7	1.8	1.8	1.8	2.0	1.3	1.1	3.1	1.5	0.0	1.2	0.6	0.0
20-21	0.0	0.0	0.0	4.3	3.3	3.3	3.7	2.9	2.7	1.8	1.8	1.8	1.4	0.9	0.8	1.5	0.0	0.0	0.0	0.6	0.0
21-22	0.0	0.0	0.0	3.3	2.9	2.4	2.5	2.1	1.8	0.0	0.0	0.0	0.9	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0
22-23	0.0	0.0	0.0	2.4	2.9	1.9	1.6	1.7	1.1	0.0	0.0	0.0	0.7	0.6	0.5	0.0	0.0	0.0	0.6	0.6	0.6
23-24	0.0	0.0	0.0	1.4	1.9	1.4	0.9	1.3	0.7	0.0	0.0	0.0	0.5	0.7	0.5	0.0	0.0	0.0	1.2	1.9	0.6
Daily total:				**100.0**	**80.5**	**83.8**	**100.0**	**88.8**	**75.0**	**100.0**	**82.1**	**64.3**	**100.0**	**53.1**	**31.9**	**100.0**	**44.6**	**27.7**	**100.0**	**65.2**	**16.8**

Day speed variation profiles

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	-	-	-	60.3	56.7	59.1	52.9	52.7	52.5	43.8	36.2	45.3	50.6	49.3	49.8	43.5	45.2	45.3	46.0	46.0	45.9
01-02	-	-	-	58.1	58.5	57.1	53.3	53.5	54.5	43.5	49.7	38.8	49.5	48.7	52.4	42.4	47.0	44.8	44.5	47.5	46.1
02-03	-	-	-	52.2	58.9	61.3	53.5	53.5	55.1	44.4	50.0	37.0	52.3	52.5	54.6	42.2	42.3	39.5	44.6	44.0	35.5
03-04	-	-	-	55.9	63.9	61.8	53.1	53.9	55.8	47.0	40.4	-	51.4	53.9	55.0	40.8	32.0	44.0	42.8	43.0	68.5
04-05	-	-	-	56.2	57.9	60.7	52.2	53.3	54.7	45.7	51.1	-	51.6	50.3	51.7	45.3	47.6	49.8	43.1	40.1	49.8
05-06	-	-	-	55.0	55.5	57.0	51.5	52.0	52.7	47.3	48.9	48.8	48.7	50.4	48.4	44.2	49.9	45.3	40.2	42.0	40.0
06-07	-	-	-	49.7	54.2	57.9	48.1	50.6	52.0	41.6	46.4	44.9	44.8	48.8	45.8	39.2	47.6	45.1	38.2	40.7	42.6
07-08	-	-	-	39.0	49.0	54.0	42.2	48.5	51.1	33.8	43.4	44.0	39.6	45.5	47.5	34.3	44.2	43.5	34.4	36.6	42.4
08-09	-	-	-	35.0	47.3	50.5	39.9	46.5	49.5	34.3	40.1	45.6	37.3	44.4	46.5	34.0	39.2	40.0	31.8	34.1	38.8
09-10	-	-	-	36.6	43.1	47.8	41.3	44.6	47.0	35.7	39.1	41.0	39.2	42.2	44.4	35.2	39.4	42.9	31.5	32.0	34.7
10-11	-	-	-	37.7	41.0	44.5	41.6	43.0	45.2	36.6	37.3	40.9	39.6	40.5	43.1	34.8	34.3	36.8	31.3	30.5	29.0
11-12	-	-	-	36.4	38.2	40.9	41.1	42.4	44.1	36.8	37.4	38.8	39.0	39.7	40.8	34.6	35.4	34.2	31.8	30.2	26.6
12-13	-	-	-	36.6	39.2	42.0	41.0	41.9	43.9	35.8	37.2	38.6	38.6	38.4	40.1	33.4	31.3	36.3	30.8	30.5	26.1
13-14	-	-	-	34.3	39.1	43.1	40.0	42.5	44.1	35.1	37.7	38.8	37.4	38.5	40.8	33.0	32.8	35.4	31.5	30.5	31.4
14-15	-	-	-	30.5	40.5	44.3	37.7	43.0	44.8	32.2	35.8	40.2	34.8	39.6	41.7	31.2	34.3	35.5	30.5	31.0	31.2
15-16	-	-	-	27.8	42.6	43.4	36.0	43.9	44.8	29.4	39.0	38.4	32.8	40.4	41.2	28.5	37.7	35.1	29.0	31.6	27.7
16-17	-	-	-	29.3	42.6	44.2	37.1	43.7	44.8	29.4	38.9	36.8	33.2	40.4	42.1	29.3	35.2	38.1	28.7	31.4	28.9
17-18	-	-	-	35.4	44.5	46.9	41.0	44.4	45.2	33.3	39.2	38.5	37.6	41.3	41.8	32.6	35.5	37.7	31.2	35.8	33.2
18-19	-	-	-	41.6	46.0	46.0	43.7	45.5	46.0	35.5	35.5	38.3	40.8	42.8	42.5	35.2	36.9	40.1	30.1	31.3	34.5
19-20	-	-	-	42.8	46.2	46.5	44.8	46.6	47.0	35.7	36.1	37.3	42.0	44.7	44.3	37.5	35.1	28.9	32.6	34.6	40.2
20-21	-	-	-	46.4	48.9	49.6	45.9	47.6	48.1	35.4	34.1	38.7	43.3	44.5	46.7	38.5	42.5	37.7	35.7	42.5	35.7
21-22	-	-	-	48.5	49.4	52.3	47.5	48.3	49.3	37.2	38.8	39.7	45.5	46.4	47.5	42.3	37.5	34.8	38.9	38.1	44.7
22-23	-	-	-	52.0	51.7	53.8	49.5	49.3	50.8	36.0	38.0	37.8	47.0	48.5	47.6	44.3	37.7	36.2	42.3	45.1	40.5
23-24	-	-	-	55.3	56.6	57.5	51.7	50.7	52.3	38.7	34.9	40.0	48.8	48.4	49.0	47.7	38.5	36.3	44.5	44.9	46.5
Daily mean:	**-999.0**	**-999.0**	**-999.0**	**41.5**	**47.0**	**49.3**	**45.3**	**47.6**	**49.0**	**34.7**	**38.8**	**39.9**	**42.6**	**44.9**	**46.0**	**34.9**	**38.4**	**38.3**	**33.8**	**34.7**	**34.3**

Station:	**037 Quay Parade**																					
Year:	**2007**																					
ADT:	**47592**	**AWDT:**	**49728**	**Mean speed:**		**36.2**	**km/h**															

Monthly variation:	
January	92.3
February	96.3
March	100.1
April	102.3
May	103.3
June	104.6
July	100.0
August	100.3
September	100.4
October	101.9
November	102.7
December	95.8

Vehicle class contribution to total flow and mean speed in class

Vehicle class:	Flow %:	Mean speed (km/h):
Unclassified vehicles	0.0	23.6
Motorcycles	2.6	38.8
Cars or light Vans	92.0	39.8
Cars or light Vans with Trailer	0.5	30.4
Heavy Van, Mini bus, L/M/HGV	3.8	36.4
Articulated lorry, HGV+Trailer	0.5	31.0
Bus	0.7	31.9

Day % variation profiles - normalised to AWDT for each vehicle class

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	0.0	0.0	0.0	1.2	2.9	4.8	0.5	1.4	1.8	0.0	0.4	0.9	0.3	0.7	1.5	0.8	1.3	0.8	0.3	0.5	0.5
01-02	0.0	0.0	0.0	0.9	2.5	4.9	0.3	1.1	1.5	0.0	0.4	0.4	0.3	0.7	2.1	0.8	0.8	1.3	0.3	0.3	0.5
02-03	0.0	0.0	0.0	0.6	1.8	4.1	0.2	0.8	1.2	0.0	0.4	0.9	0.3	0.6	1.6	1.3	1.3	0.8	0.3	0.3	0.5
03-04	0.0	0.0	0.0	0.5	1.1	2.0	0.2	0.5	0.7	0.0	0.4	0.4	0.5	0.7	0.7	2.1	1.7	0.8	0.3	0.3	0.3
04-05	0.0	0.0	0.0	0.7	0.7	0.9	0.4	0.5	0.5	0.0	0.4	0.0	1.0	0.8	0.4	2.1	1.7	0.8	0.3	0.5	0.3
05-06	0.0	0.0	0.0	1.3	1.1	0.8	1.1	0.8	0.5	0.4	0.4	0.4	2.2	1.5	0.6	2.1	1.7	0.8	0.5	1.1	0.5
06-07	0.0	0.0	0.0	3.0	1.7	1.1	3.6	1.6	0.8	2.7	1.8	0.9	5.2	2.7	1.0	4.2	1.7	1.3	3.8	2.7	0.3
07-08	0.0	0.0	0.0	5.0	2.6	1.3	6.5	2.8	1.1	7.1	4.0	1.3	8.2	4.2	1.3	8.8	2.1	0.8	7.3	4.3	0.5
08-09	0.0	0.0	0.0	5.7	3.8	2.0	6.8	4.4	1.9	8.8	6.2	1.8	9.8	5.0	1.6	10.9	2.1	1.3	8.1	5.6	0.8
09-10	0.0	0.0	0.0	5.1	4.7	3.2	6.0	5.8	3.8	8.4	7.1	2.2	9.9	4.9	1.9	8.0	2.9	1.7	8.1	7.0	1.9
10-11	0.0	0.0	0.0	5.3	5.8	4.8	6.0	6.7	5.5	8.4	8.4	3.1	9.3	4.6	2.1	5.5	5.9	3.4	7.5	7.8	2.7
11-12	0.0	0.0	0.0	6.2	7.0	6.0	6.4	7.1	6.5	8.0	9.3	4.4	8.6	4.6	2.4	5.9	9.2	6.3	7.5	8.9	3.5
12-13	0.0	0.0	0.0	6.6	7.6	6.7	6.6	7.2	6.8	8.4	10.6	4.4	7.8	4.2	2.5	6.7	13.9	7.1	7.8	9.7	4.0
13-14	0.0	0.0	0.0	6.6	8.0	7.3	6.7	7.0	6.9	8.4	10.6	4.0	7.8	3.9	2.5	6.3	13.9	6.3	7.8	9.9	3.5
14-15	0.0	0.0	0.0	7.0	8.0	7.4	7.0	6.8	6.9	8.4	8.8	3.5	7.4	3.5	2.2	5.9	12.2	5.0	7.5	9.1	3.0
15-16	0.0	0.0	0.0	7.3	7.4	7.1	7.9	6.7	6.5	8.0	8.0	3.1	6.6	3.2	2.1	5.9	8.0	4.2	8.3	8.6	3.0
16-17	0.0	0.0	0.0	7.4	6.9	6.2	8.3	6.6	5.8	8.4	7.1	2.2	5.0	2.8	1.8	7.1	5.0	2.9	9.1	8.1	3.2
17-18	0.0	0.0	0.0	7.1	6.3	5.3	7.2	6.0	4.9	6.6	5.8	2.2	3.3	2.4	1.5	5.0	2.9	1.7	6.5	5.6	2.4
18-19	0.0	0.0	0.0	5.9	5.4	4.2	5.6	5.2	4.1	3.5	4.0	1.3	2.1	2.3	1.2	2.5	2.5	1.3	3.8	4.3	2.2
19-20	0.0	0.0	0.0	4.8	5.0	3.8	4.2	4.6	3.5	1.8	2.7	1.3	1.5	2.9	0.9	2.1	2.9	0.8	1.9	3.0	1.9
20-21	0.0	0.0	0.0	4.0	5.0	3.1	3.1	3.7	2.6	1.3	2.7	0.9	1.0	2.7	0.8	1.3	2.5	0.8	1.1	2.2	1.3
21-22	0.0	0.0	0.0	3.2	4.4	2.7	2.4	3.1	1.9	0.4	1.8	0.4	0.8	1.7	0.6	1.7	1.7	1.3	0.8	1.1	1.1
22-23	0.0	0.0	0.0	2.7	3.9	2.1	1.7	2.6	1.3	0.4	0.9	0.4	0.6	1.2	0.5	1.7	1.3	1.3	0.8	1.1	0.8
23-24	0.0	0.0	0.0	2.0	4.3	1.6	1.1	2.2	0.9	0.4	0.9	0.0	0.5	1.1	0.4	1.3	0.8	0.8	0.5	0.8	0.5
Daily total:				**100.0**	**108.0**	**93.4**	**100.0**	**95.2**	**77.9**	**100.0**	**103.1**	**40.7**	**100.0**	**62.9**	**34.3**	**100.0**	**100.0**	**53.8**	**100.0**	**102.7**	**39.2**

Day speed variation profiles

	Unclassified vehicles			Motorcycles			Cars or light Vans			Cars or light Vans with Trailer			Heavy Van, Mini bus, L/M/HGV			Articulated lorry, HGV+Trailer			Bus		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
00-01	-	-	-	43.0	42.2	40.3	43.2	41.1	40.1	38.6	32.9	32.1	40.9	38.0	36.1	35.7	32.9	29.8	41.2	38.5	34.1
01-02	-	-	-	43.2	42.5	40.3	43.5	42.0	40.2	39.2	36.5	32.7	41.5	38.6	35.4	35.4	31.5	28.2	43.3	41.2	36.9
02-03	-	-	-	43.7	43.5	41.9	44.4	43.1	41.4	40.1	34.8	34.9	43.8	41.4	37.7	33.7	34.6	29.4	44.4	40.9	39.5
03-04	-	-	-	45.6	44.9	43.5	45.5	44.5	44.0	39.3	39.4	37.4	44.8	42.0	40.9	35.4	32.0	32.6	44.3	41.8	40.9
04-05	-	-	-	46.3	46.0	45.2	46.2	45.3	45.3	37.4	40.4	33.0	44.9	44.2	42.8	38.0	34.9	35.3	41.5	42.3	41.2
05-06	-	-	-	46.0	47.5	46.1	45.7	45.6	45.3	37.7	38.9	37.5	43.5	44.1	40.9	38.1	38.7	36.2	40.4	40.9	42.1
06-07	-	-	-	42.4	45.5	46.2	42.8	44.4	45.4	32.0	39.8	38.4	39.3	41.9	42.0	33.2	39.8	37.8	33.9	39.7	41.1
07-08	35.0	-	-	34.9	43.0	45.1	38.2	42.2	44.4	27.6	37.2	37.8	33.9	39.1	41.2	26.7	38.7	35.4	27.6	37.2	39.8
08-09	-	-	-	32.8	41.3	42.8	36.8	40.6	43.0	26.9	36.0	37.5	33.4	38.2	40.4	25.1	36.5	37.1	26.1	36.2	38.9
09-10	-	-	-	35.8	38.5	40.6	37.6	38.6	40.7	30.4	34.3	34.4	35.1	36.0	38.0	27.7	32.1	34.9	29.7	33.1	34.9
10-11	-	27.0	-	36.8	35.5	37.2	37.8	36.5	38.2	32.0	29.7	28.4	35.6	32.7	34.8	30.8	29.8	32.7	31.8	30.8	30.4
11-12	-	-	-	35.7	31.4	34.4	36.9	33.9	35.9	30.5	25.5	25.3	34.3	29.2	30.8	30.7	26.1	29.4	30.9	26.4	26.0
12-13	-	17.0	-	35.3	27.9	33.3	36.5	31.8	34.9	29.5	21.5	23.0	33.8	25.8	29.9	29.7	24.2	27.6	30.6	24.0	23.2
13-14	-	-	36.0	35.5	27.4	33.5	36.6	31.6	35.0	29.9	21.4	26.0	34.0	25.1	29.0	29.9	24.0	25.4	30.7	22.4	22.9
14-15	-	-	-	35.9	30.2	34.8	36.7	32.5	35.6	30.9	21.9	25.3	34.1	27.1	30.4	29.9	25.1	28.0	31.1	23.7	26.2
15-16	-	-	-	34.5	33.6	37.1	35.6	34.8	36.6	29.6	27.0	31.0	32.3	29.9	31.6	27.7	28.0	31.3	28.7	27.6	28.2
16-17	22.0	-	-	33.3	35.7	38.9	34.8	36.1	37.7	28.0	29.8	31.2	30.5	32.0	33.5	25.1	28.2	30.3	27.1	30.0	31.4
17-18	28.0	-	-	36.5	38.0	40.4	37.3	37.5	39.1	29.5	31.9	32.5	33.3	33.8	35.1	27.8	31.9	36.7	30.4	32.1	34.2
18-19	-	-	-	39.7	37.6	40.1	39.4	37.7	39.3	32.3	30.2	30.2	36.3	33.7	36.4	32.7	31.9	34.9	33.3	30.5	33.7
19-20	-	-	-	39.6	35.3	40.8	39.0	36.3	39.8	30.9	26.4	32.2	36.0	32.3	37.3	33.9	28.5	33.7	32.5	27.7	34.2
20-21	-	-	-	40.8	36.3	41.3	39.6	36.6	40.9	31.0	28.0	32.3	37.0	33.0	38.6	34.0	27.9	33.8	34.3	27.7	36.3
21-22	-	-	-	41.5	38.2	41.4	40.6	37.8	41.5	32.7	29.5	31.3	38.2	34.4	39.6	34.6	32.2	35.3	38.3	33.8	38.5
22-23	-	-	-	41.9	39.8	43.3	41.5	39.1	42.4	34.0	32.3	35.8	39.1	36.0	40.2	35.6	33.3	35.1	38.8	36.0	39.3
23-24	-	-	-	42.4	40.6	42.6	42.2	40.0	42.9	34.6	34.2	33.9	40.5	37.0	40.8	36.4	33.7	36.2	40.7	36.3	40.5
Daily mean:	**28.3**	**14.7**	**36.0**	**38.7**	**37.9**	**40.2**	**39.9**	**38.7**	**40.4**	**30.5**	**29.6**	**30.7**	**36.7**	**34.9**	**36.5**	**30.9**	**30.6**	**32.1**	**31.9**	**31.2**	**32.7**