

# Welsh Air Quality Forum – Annual Conference

## Action Plan Progress

Phil Govier  
City & County of Swansea

# Swansea Air Quality Management

## Hafod Air Quality Action Plan (NO<sub>2</sub> Road Traffic Sources)

Consultation undertaken = Yes

Number of Respondents = 3

Number of “Nutters” Responding = 2

Action Plan submitted – December 2004

Where are we now ?

(An overview as a colleague commented “You have been at this since 2001 {Declaration of AQMA} and don’t appear to have achieved bugger all” !!

- Action Plan contains 10 key actions:

# Hafod Air Quality Action Plan – Action Points

- [Action Point 1](#) - Traffic management measures on Neath Road
- [Action Point 2](#) - Park and Ride provision
- [Action Point 3](#) - Improved Bus provision
- [Action Point 4](#) - Bus Corridor Enhancements
- [Action Point 5](#) - Enhancements of Bus/Rail Stations
- [Action Point 6](#) - Safe Routes to School
- [Action Point 7](#) - Vehicle Emissions Testing
- [Action Point 8](#) - Quay Parade Bridges Improvements
- [Action Point 9](#) - City & County of Swansea Vehicle Fleet
- [Action Point 10](#) - Traffic Management Systems with Air Quality Monitoring Feedback

## How are Swansea Progressing with the Hafod Air Quality Action Plan ?

### Action Point:

1. Traffic Management Measures - some works “complete” (Landore P&R Express Bus Route) but dependant upon funding for implementation of The Integrated Hafod Transport Study
2. Park & Ride Provision – now expanded to 3 sites operating all year (very popular/successful)
3. Improved Bus Provision – minimum level of service, bus priority routes, concessionary bus fares, free bus travel for elderly
4. Bus Corridor Enhancements – message signs, raised kerbs, upgraded bus shelters and proposed start of Metro service.
5. Enhancements of Bus/Rail Stations – High Street Transport Interchange completed during 2004 (TG and Objective 1 funding). Quadrant bus station refurbishment still awaited
6. Safe Routes to School – approx a dozen completed. Development of school Travel Plans has now seen the main focus of development

## Action Point:

7. Vehicle Emissions Testing – no funding for Police costs, labour intensive, WAG fund never materialised. Equipment is being kept serviced and calibrated
8. Quay Parade Bridges Improvements – feasibility studies remain ongoing
9. City & County of Swansea Vehicle Fleet

Action Point 10 (The Swansea Project) has two main themes :

1. Modelling and predictive works (Nowcaster)
2. Dissemination / presentation of data via local radio media (traffic updates) /Internet / general public etc ([www.swansea.airqualitydata.com](http://www.swansea.airqualitydata.com)) and roadside message signs

## **The Swansea Project - what are we trying to achieve ?**

- Develop a working traffic emissions forecast model that feeds a traffic management system driven by air quality considerations.

### **What will this enable us to achieve ?**

- The ability to forecast poor air quality conditions within any identified street/ road link up to 3 hours in advance of those conditions occurring and to attempt redirection of traffic from those areas.

### **Added benefits**

- The ability to model emissions from any source i.e. point source at authorised process, grid source, area source
- Detection of congestion in almost real-time and dissemination of traffic flow information

# Modelling

## Data sources

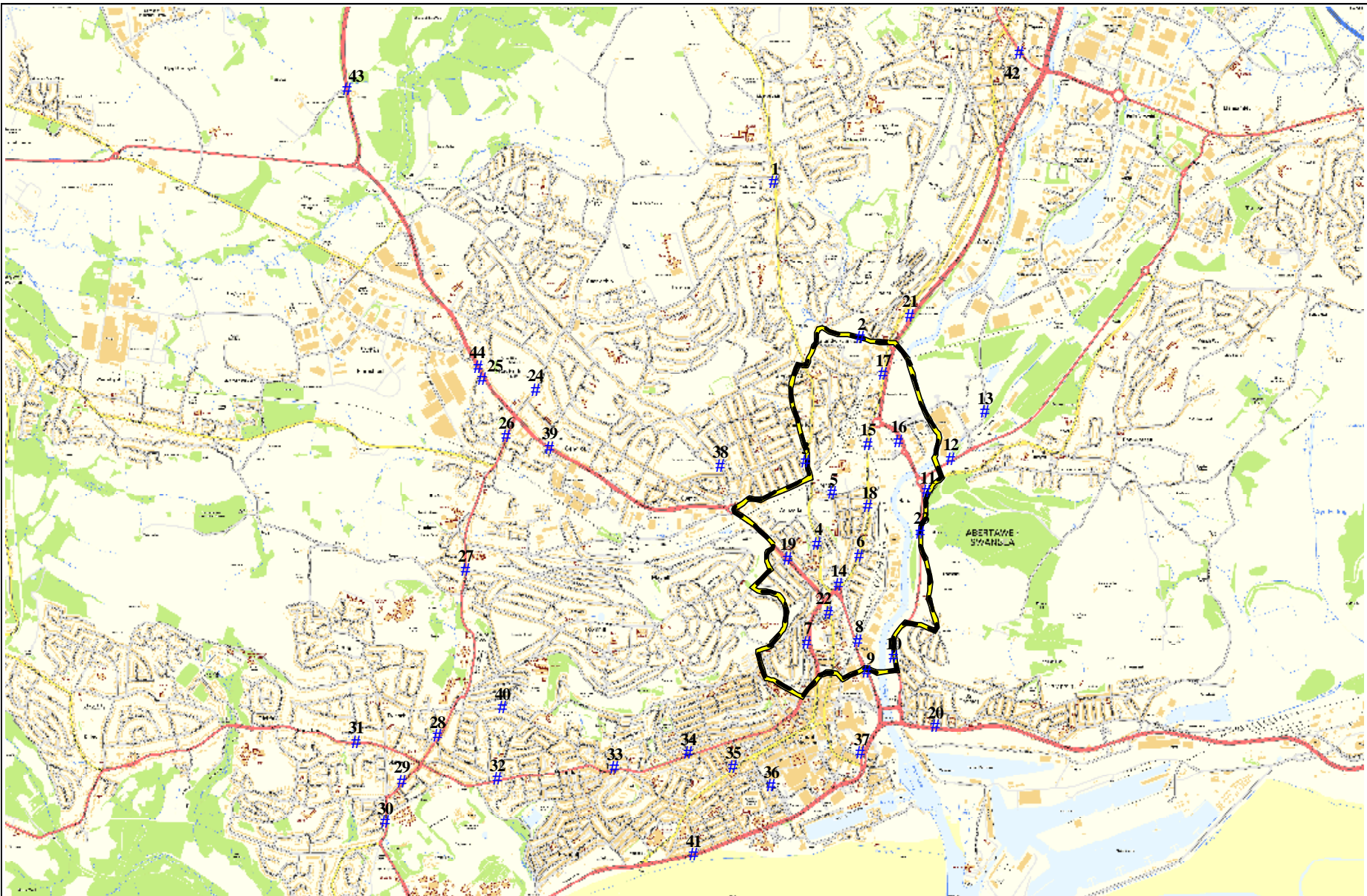
- Air quality monitoring - 5 sites (AURN, Morfa, Morryston, Hafod and St Thomas DOAS)
- Weather monitoring – Locally monitored data from
  - 30m Mast Cwm Level Park
  - Hafod Post Office Street Canyon
  - AQ500 SODAR Wind Profiler, and
  - Forecast meteorological data for the next 72 hours based on 10k resolution model for lower Swansea Valley area
- Traffic monitoring – 44 GPRS ATC's and mobile Radar / tube counters (for temp surveys – 207 surveys completed during 2007- 134 completed during 2006)

## **Data requirements - a brief overview:**

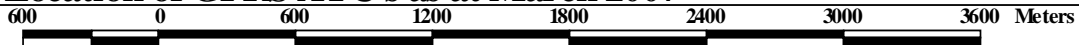
- Construction of an emissions database
- Identify and classify every road
- Details required of road width, pavement width, distance and height of buildings on each road section
- All industrial, point and area sources included within emissions database
- Digital maps
- Identification and mapping of all “sensitive receptors” - care homes/nursing homes, schools etc

### **Major Data Inputs:**

- Vehicle by vehicle traffic data.
- Meteorological forecasts/measured data.
- Real-time air quality monitoring data



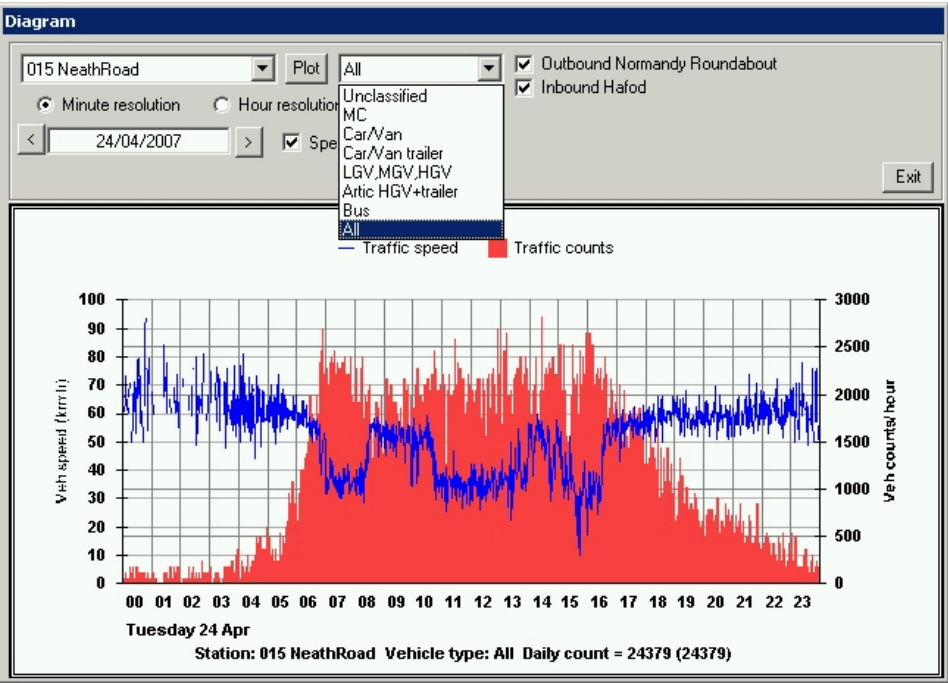
**Swansea Air Quality Management Project**  
**Location of GPRS ATC's as at March 2007**



Reproduced from the Ordnance Survey Digital map with the permission of the Controller of H.M.S.O. Crown Copyright.  
 City and County of Swansea Licence No. 100013350

Pollution Control Division  
 Environment Department  
 City & County of Swansea

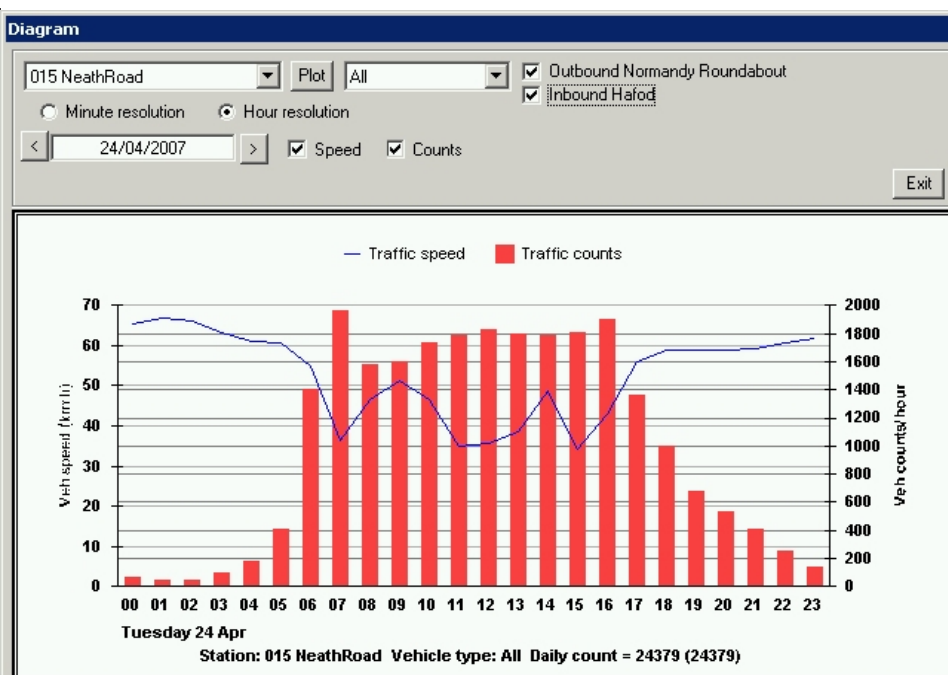
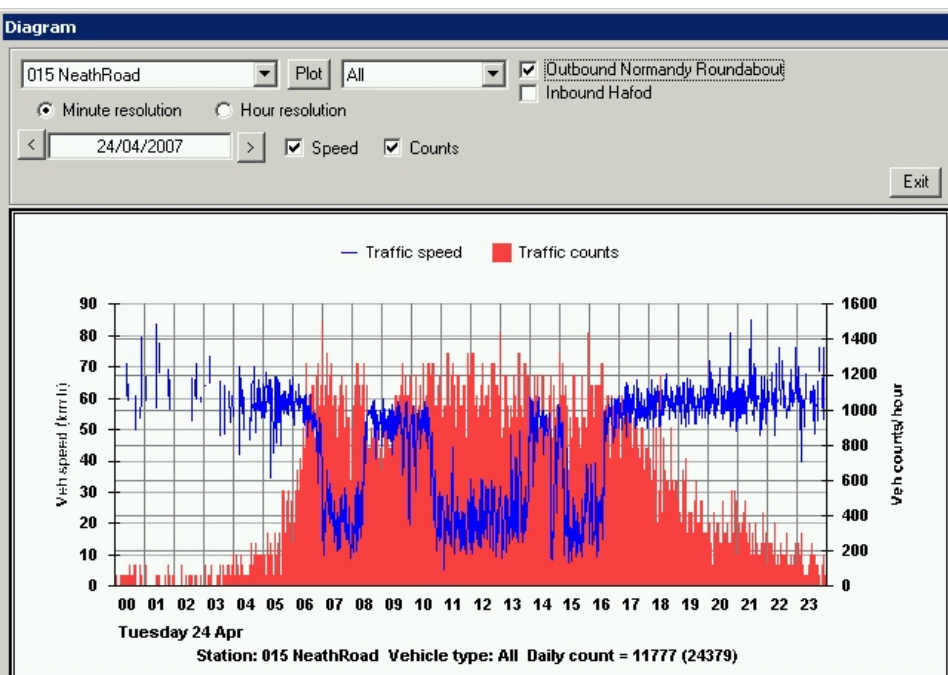




# Example of GPRS ATC data – 1 minute integration

This ATC is located on a “B road”- Neath Rd, Hafod – notice high daily flow and congestion during AM and PM periods

By selecting outbound lane the congestion can be seen at the 1 minute integration – not easily seen at 1 hr integration



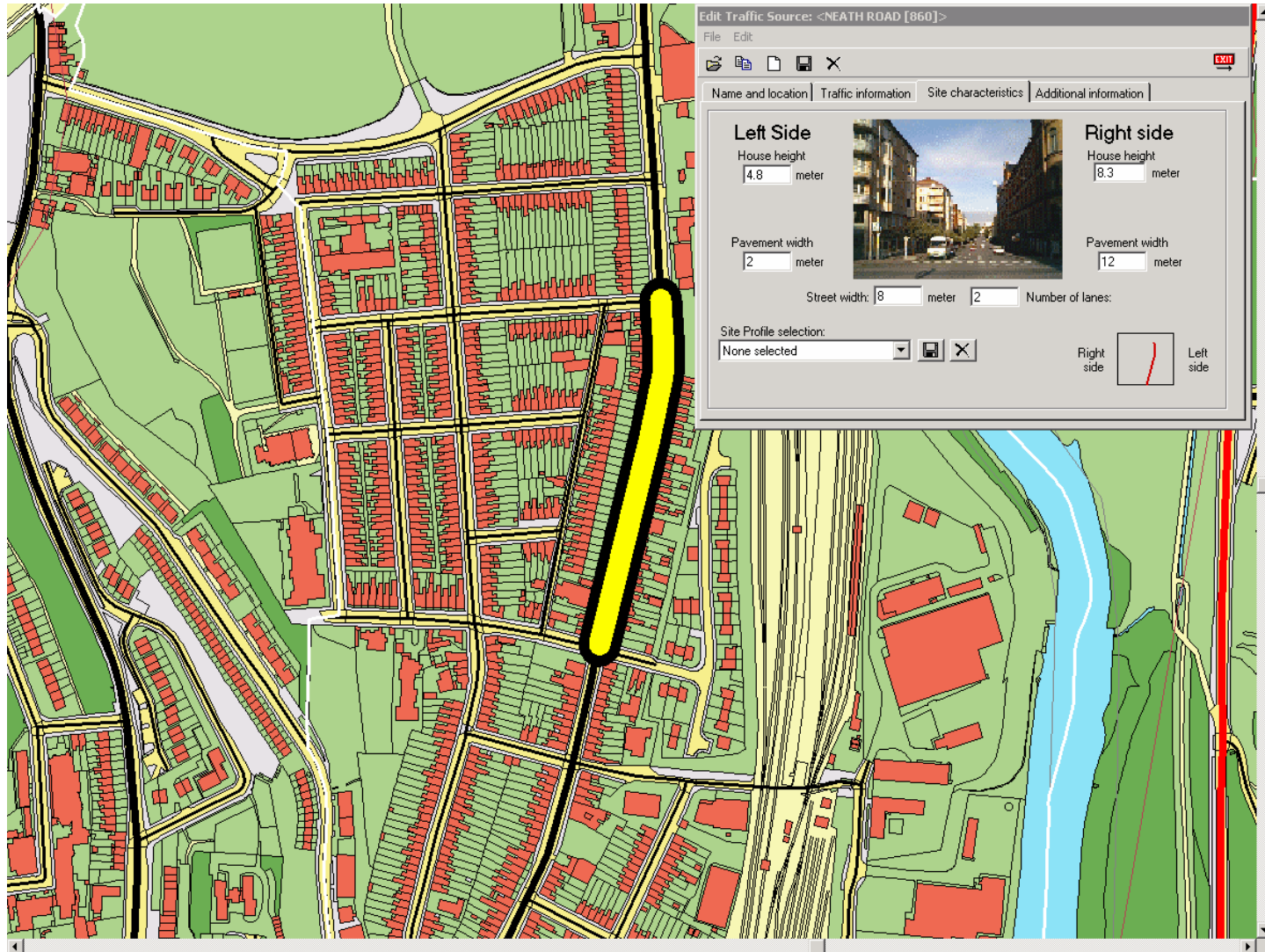
## **Additional Traffic monitoring**

**Currently 10 radar based traffic counters. Features:**

- Operated on battery
- Individual vehicle identification
- 3-5 vehicle classes (length based identification)
- Speed detection
- Used for one week campaigns at each site
- Providing infill detail for traffic mapping of smaller roads



Every road link is in process of being classified and the details inputted into the EDB in order that the model understands the local conditions influencing dispersion in that road link



Nowcaster will use the geometry details together with the actual traffic flow data and all meteorological conditions to compute the predicted air quality within that road link.

Nowcaster will automatically have the latest data with updated annual daily average / diurnal flow pattern as links will be formed between the data collection software and the EDB

Traffic profiles can be set to further fine tune the traffic behaviour for that road link

When the EDB is complete we will be able to run additional reports on emissions for example from Wards or Post Code or even by local authority (all Welsh LA are already in the EDB for their grid data emissions) by specifying the search keys to use.

**Edit Traffic Source: <HIGH STREET (STRYD FAWR) [839]>**

File Edit

Name and location | Traffic information | Site characteristics | Additional information

Traffic flow

10896 Annual daily average 0 Hourly critical flow

Normal traffic condition: B Road 30 Critical traffic condition: B Road 30

Traffic profile: Vehicles

- MC
- Car/Light van
- Car/Light van Trailer
- LGV/MGV/HGV
- HGV+Trailer
- Bus

Profile settings for selected vehicle

8.4 Vehicle fraction of total (%) (100)

Drive pattern throughout the day: SWGR022 Class 6

Drive pattern over the year: SWGR022

Standard Traffic profile selection: None selected

**Edit Traffic Source: <NEATH ROAD [860]>**

File Edit

Name and location | Traffic information | Site characteristics | Additional information

Extra info

Local Authority: City and County of Swansea (Id: 20)

Ward: Landore (Id: 16)

Post code: SA1\_5 (Id: 6)

Branch: Road transport (Id: 5)

Ship route phase: None selected (Id: 0)

Date for EDB update

Original date: [ ]

Last update: 3/20/2007

by User: phil

## Model Validation

- Why bother to validate the model ?
- Seen as vital requirement of the project.
- Best achieved by validating the predicted model output against measured air quality data along a typical congested street.
- The Hafod OPSIS DOAS measures NO, NO<sub>2</sub>, O<sub>3</sub> and benzene approx. 18 inches from the front façade of a 250m section of terraced housing along Neath Road at a height of approximately 3-4 meters (first floor level)



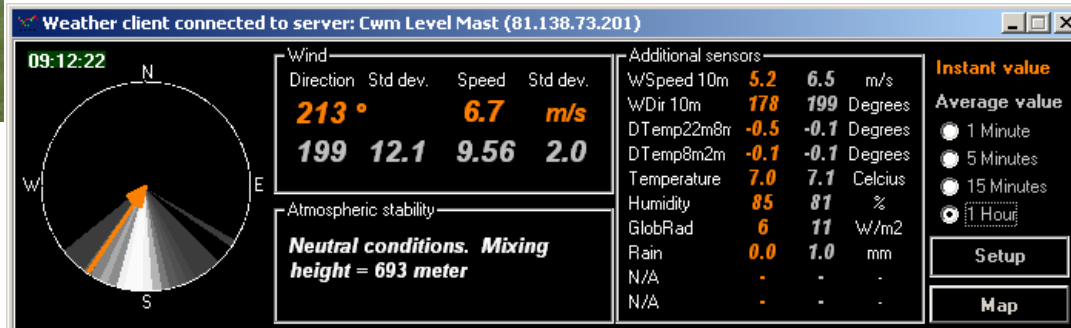
## Meteorological data

- **30m Mast Cwm Level Park**

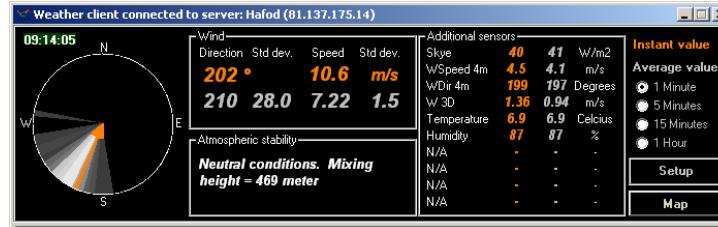
By far the greatest influence on air quality in Swansea are the prevailing meteorological conditions. These are influenced by the topography of the lower valley i.e. wintertime inversion layers forming in the lower valley area.

We need to measure and understand (and supply the data to the models) what is happening – not only Nowcaster will use the meteorological data - the other dispersion models will also use any met data that is available.

A 30m mast at Cwm Level Park has been installed which will measure temperature and wind profiles in the lowest atmospheric layer in the valley.

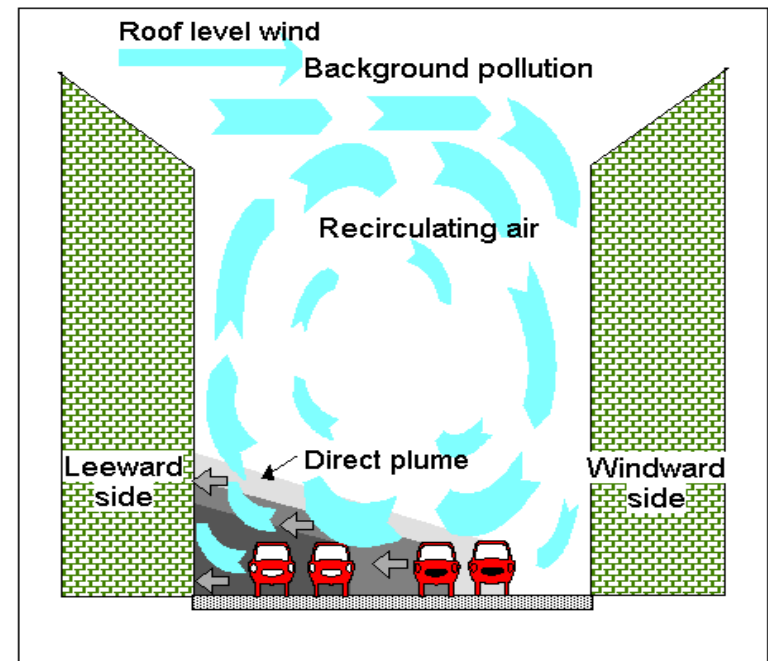


As part of the validation process a meteorological station has been established opposite the DOAS transmitter - fixed to the front facade of the Hafod Post Office



## Parameters measured

- Vertical and horizontal wind speed and wind direction will be recorded at 1st floor level.
- Global radiation , horizontal wind speed and wind direction from 4m above roof ridge level.
- Ambient air temperature and relative humidity measured at 1st floor level.
- All measurements will have a resolution of 1 minute and will aid the definition of the vertices and mixing capacity of the street.
- These measurements will also be used to determine and evaluate the atmospheric chemistry responsible for the formation of  $\text{NO}_2$  and ozone within the street.



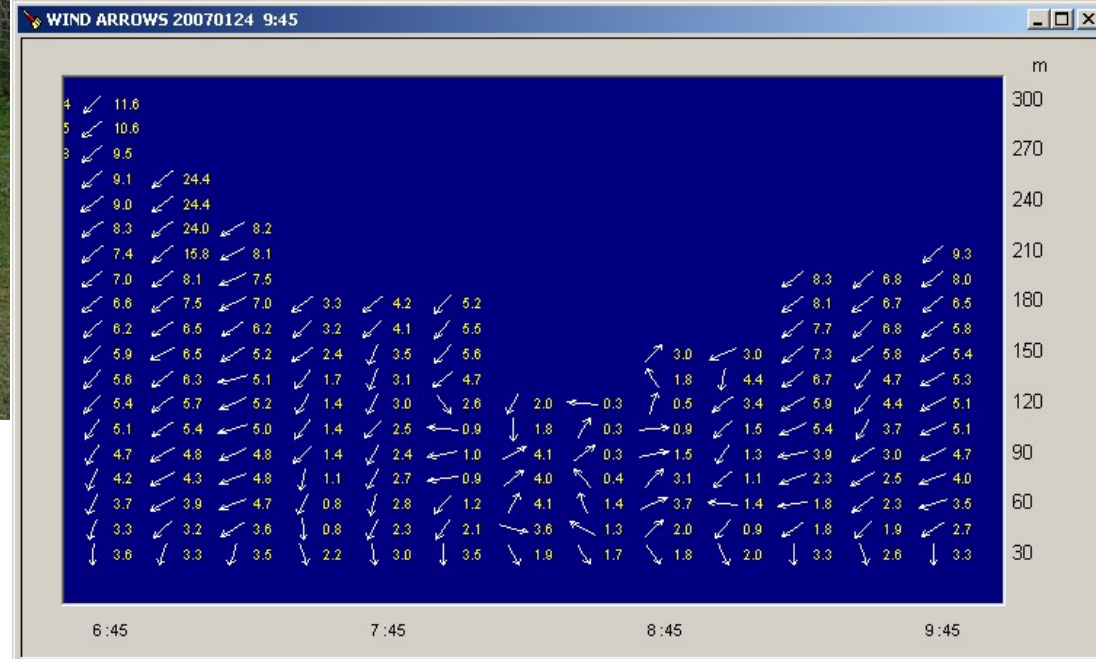
# Wind Profiler AQ500 – located within Morfa TAC compound

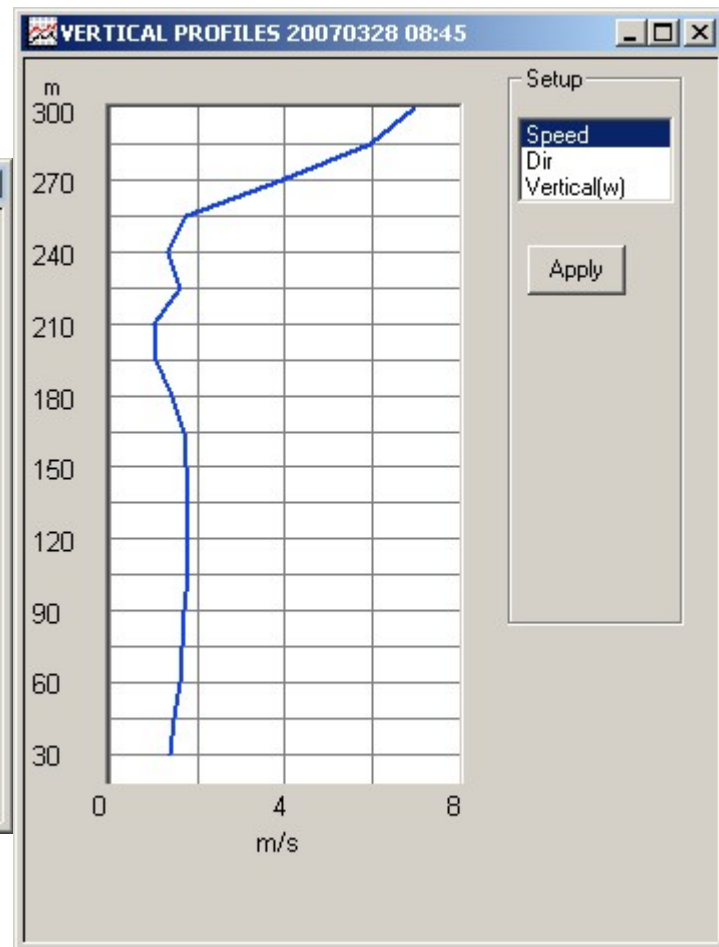
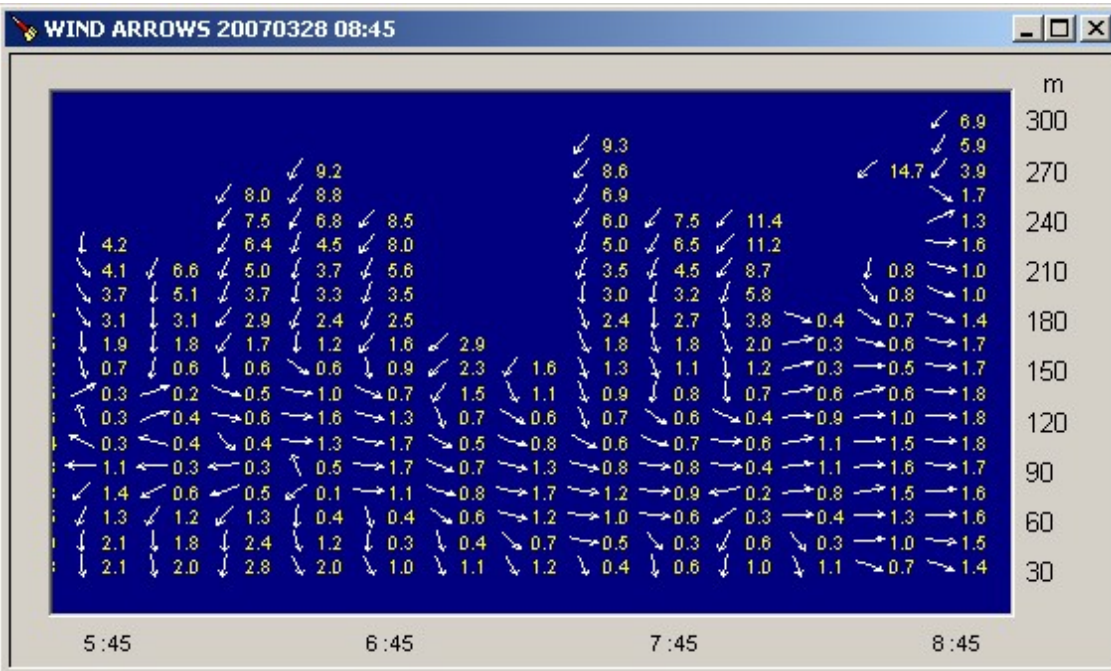


This equipment measures the wind speed and wind direction in 15m “layers” up to its maximum height range of 300m.

Plot below shows the effect of an inversion layer on local conditions. This is actual data from the Morfa TA site

Notice the low wind speeds and direction during the am rush hour in the valley and the formation above 120m of an inversion





- Meteorological data will be received via FTP from the National Environmental Research Institute (NERI) in Denmark. The forecast will span three days as hourly time series.

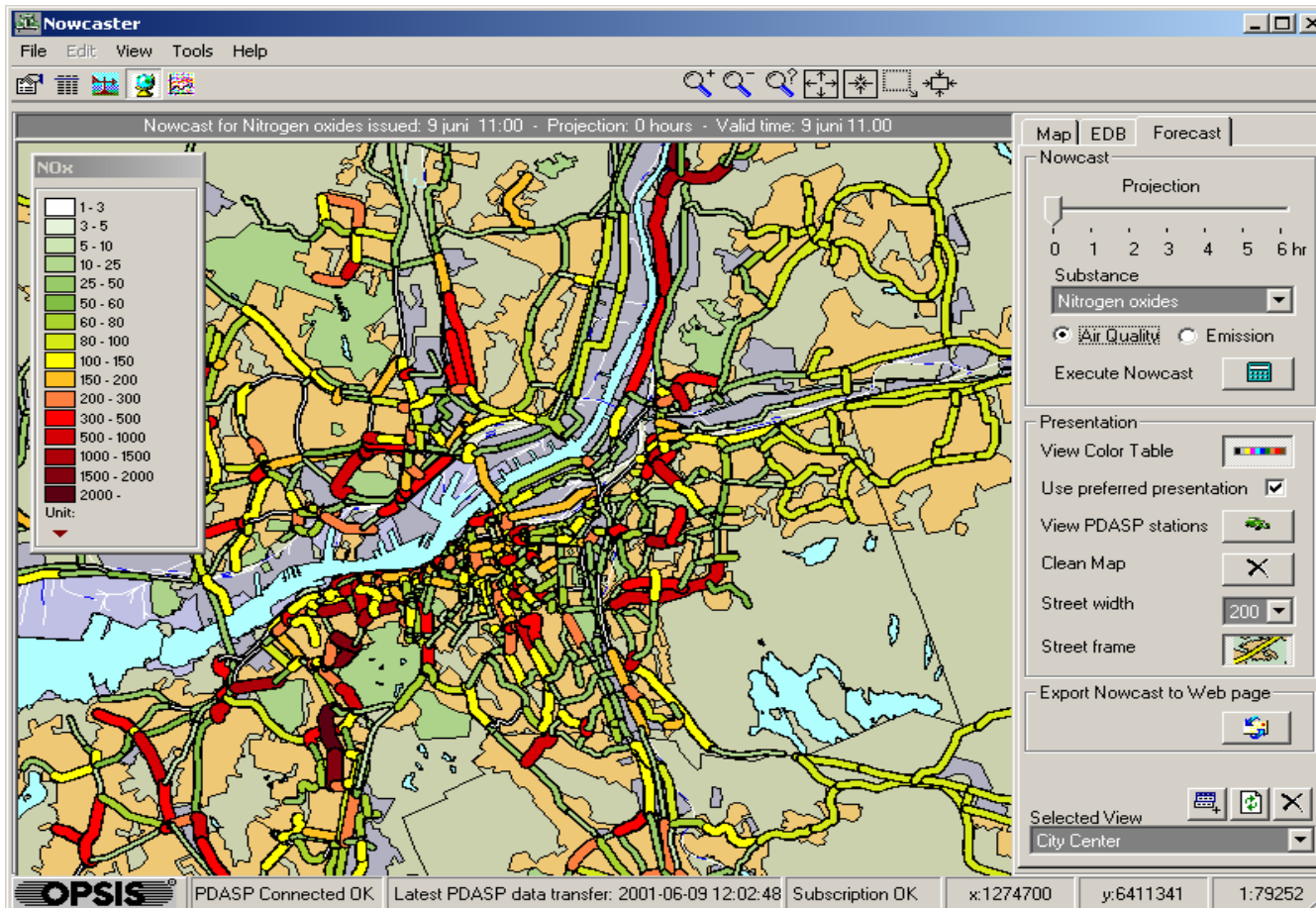
The forecasts will be updated four times every day, initialised at 00, 06, 12 and 18 UTC. The weather forecasts include the following parameters:

- Wind speed (10 m, 80 m and 800 m),
- Wind direction (10 m, 80m and 800m),
- Temperature (2 m, 80 m and 800 m),
- Mean sea level pressure,
- Precipitation (convective, stratisform and snow),
- Boundary layer height,
- Friction velocity, surface heat flux,
- Relative humidity,
- Cloud cover (low and high).

# What happens with the Nowcaster model output ?

Every hour Nowcaster carries out the computations for each identified road link – if conditions are expected to breach any predefined level then the output for those road links will be colour coded on maps and uploaded to our web pages/presentation software.

Example of basic Nowcaster output from Gothenburg



# Nowcaster developments

- An interface is being developed to allow local radio 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 radio media i.e. The Wave, Swansea Sound, Real Radio and even national stations for use in their traffic update bulletins - we can detect traffic congestion in almost real time from the ATC data and broadcast this information.
- Looking at link with Traffic Wales
- In addition, we have the opportunity to send messages to roadside signs to try and encourage a certain % of the traffic flow to divert from the failing area/ congested area.

# Emission Factors

Emission factors are required for all of the categories listed

These factors are fundamental to the operation of all of the models

OP SIS are developing these based on UK factors/guidance. These are now to be revisited in light of consultation on new UK factors and ARTEMIS project

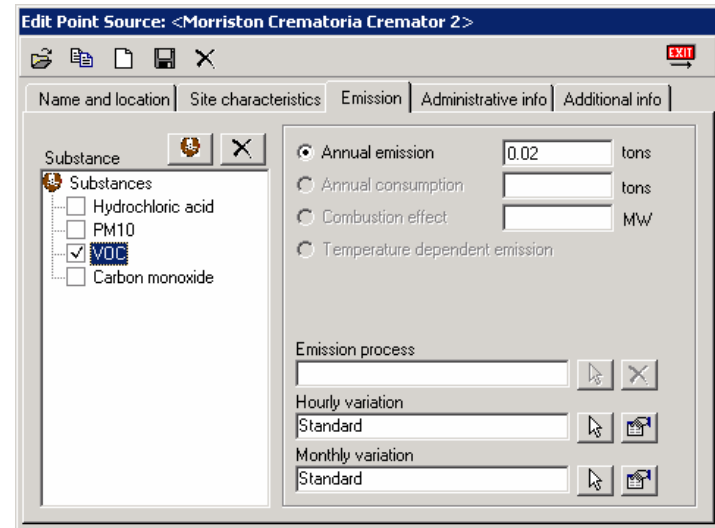
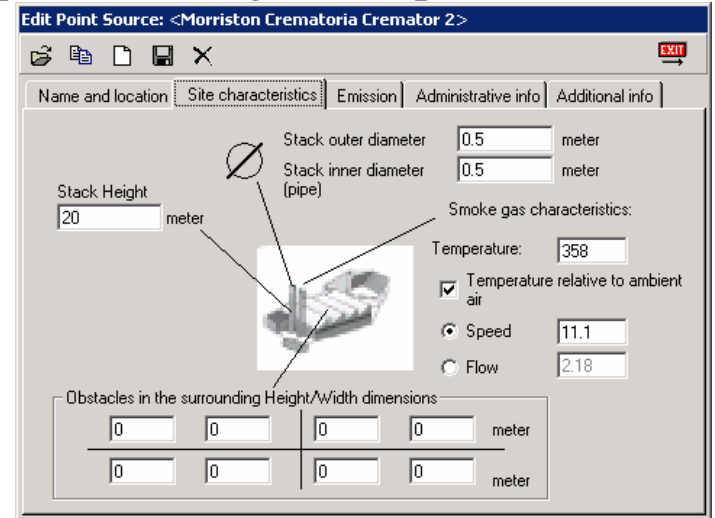
Traffic Condition	Emission mg/s	Speed km/h	Emission g/km
Commuter Road 40	35.7986964	85	1.515672
Commuter Road 50	27.3662973	65	1.515672
City street 30	21.0509979	50	1.515672
Residential street 30	16.8407983	40	1.515672
Residential street 20	16.8407983	40	1.515672
B Road 30	13.577528	32	1.527472
B Road 40	21.3787771	50	1.539272
A Road 30	27.5793537	65	1.527472
A Road 40	21.3787771	50	1.539272
A Road 50	27.7924102	65	1.539272
A Road 60 single ow	40.4846138	85	1.714638
A Road 70 dual ow	47.6288398	100	1.714638
Motorway 50mph	60.3751442	115	1.890005
Motorway 70mph	44.6251066	85	1.890005
Congestion 40 - 20%	78.9412442	125	2.273508
Congestion 40 - 50%	37.8917962	45	3.031344
Railway	103.791666	15	24.91

Emission factors – Example of data within EDB for Traffic Sources

# Point Sources

Currently inputting details of all of the emissions to air from the authorised processes. At present we are concentrating on those within our area but eventually processes from Neath Port Talbot and Carmarthenshire will be inputted into our EDB

This data will be used both by Nowcaster to compute expected “background” pollution for the Nowcaster model and also by the dispersion models



## What are the “obstacles” to Action Plan Implementation ?

- Finding the MONEY !!
- How practical is the Action Point ?
- Integration with other departments plans
- Delivering the action point(s) and quantifying the improvement(s)
- Undertaking the “Cost Benefit Analysis” that is required of us – this maybe outside of any in-house expertise ?
- Keeping up with the LAQM timetable
- Fitting this in with everything else !