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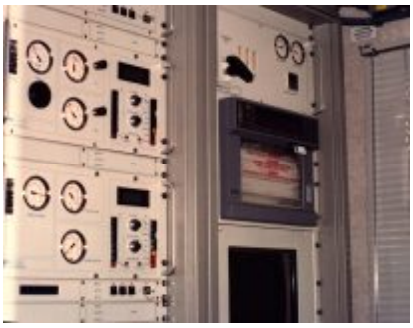

Report on Air Quality In the Vicinity of the SELCHP Facility

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Report on Air Quality in the Vicinity of the South East London Combined Heat & Power Facility

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For CREED UK

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SUMMARY

1. Background

1.1 South East London Combined Heat and Power Ltd (SELCHP) own an Energy from Waste (EfW) facility in North Lewisham, London. The facility receives over 400,000 tonnes per year of municipal solid waste from the London Boroughs of Lewisham, Greenwich and Bexley as well as from Westminster City Council. The facility consists of two identical incinerators, which each process 29 tonnes of waste per hour. The waste is incinerated at temperatures above 850^{o}C in highly controlled conditions and the resulting hot gases are used to generate high-pressure steam, which in turn drives a turbo generator. Most of the 35MW of electricity generated by this process is exported to the National Grid, supplying enough power for around 30,000 homes. The remainder is used to power the facility.

1.2 The hot gases, now much cooler, enter the state-of-the art Air Pollution Control systems. First of all, fine activated carbon is introduced and this removes dioxins/furans, heavy metals and other organics by absorbing them into its pore structure. The gases then enter semi-dry scrubbers, where a lime and water mixture is sprayed in at high speeds, neutralizing acid gases, such as hydrogen chloride and sulphur dioxide. Finally the gases pass through a bag filter house, where dust is removed down to a size of 10 microns (1 micron is equal to a thousandth of a millimetre). The cleaned, cooled gases are then released to the atmosphere via a 100m stack.

1.3 The SELCHP facility operates in accordance with the Environment Agency's (EA) authorisation AE7236. This means that pollution levels have to be proven to be at least as low as those given in the 1989 EU Directive on air pollution. In fact the EA's requirements are stricter than those in the EU Directive. The SELCHP facility operates well within its Authorisation limits.

1.4 Despite SELCHP operating to the highest standards of environmental performance there have been long standing public concerns that the chimney stack emissions from the facility are harming the health of the local community. These concerns have been discussed during several meetings that SELCHP has attended with local residents, councillors and the local Member of Parliament.

1.5 As one way of allaying residents fears SELCHP offered to fund an independent study to investigate any effect that stack emissions from SELCHP might have on local air quality.

1.6 The SELCHP facility is operated by Onyx Aurora, part of the Onyx Environmental Group. Creed UK, the Environment, Energy and Research Centre for the Group commissioned Oakwood Environmental Services to carry out a four week ambient air monitoring project on behalf of SELCHP Ltd. Oakwood Environmental Services (OES) are a niche consultancy specialising in monitoring ambient & stack emissions from a range of processes and subsequently advising clients on the impact of their operations. The Principal, Dr Roger Brown, of OES has over 20 years experience in scientific consultancy work centred on air pollution and trace organic species such as Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans.

1.7 The monitoring location was chosen by SELCHP in consultation with OES and a fully automated ambient air trailer together with some manual sampling equipment was located at the Onyx Vehicle Maintenance Depot at Baltic Wharf Deptford. The location is approximately 1km from the plant and the SELCHP plant is on a bearing of 265^{o} (W-WSW) from the monitoring station.

1.8 The period was specifically chosen by Creed UK/SELCHP as the 1st week the plant was operating normally, for the following 2 weeks the plant was undergoing major planned/scheduled maintenance (and hence shutdown) and the final 4th week the plant was operating as normal once more, following its shutdown.

2. Monitoring Programme

2.1 Scope of the Monitoring Programme

2.1.1 Principally, monitoring was performed using a mobile laboratory fitted with continuous on-line instrumentation together with additional extractive equipment (weekly samples) for hydrogen chloride (HCl), polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (PCDD/Fs), trace metals, total suspended particulate matter (TSP) and vapour phase mercury (Hg).

2.1.2 Monitoring was conducted at the Baltic Wharf Depot between 25th August and 21st September 2000.

A summary of the monitoring techniques is shown in Table 1.

Table 1 Summary of Monitoring Activities deployed for Creed UK

Determinand	Methodology	Sampling Type/Period
Air		
Nitric oxide (NO)	Chemiluminescence	On-line
Nitrogen dioxide (NO_2)	Chemiluminescence	On-line
Sulphur dioxide (SO_2)	UV Fluorescence	On-line
Carbon monoxide (CO)	NDIR	On-line
Fine particulate matter (PM_{10})	TEOM	On-line
Total volatile organic compounds (VOCs)[(a)]	FID	On-line
Total suspended particulates (TSP)	High-vol	Weekly
Hydrogen chloride (HCl)	Denuder tube	Weekly
Vapour phase mercury (Hg)	Silver wire method	Weekly
Trace metals[(b)]	High-vol, ICP/OES[(c)]	Weekly
Polycyclic aromatic hydrocarbon (PAHs)	High-vol, GCMS [(d)]	Weekly
Dioxins and furans (PCDD/Fs)	High-vol, GCMS	Weekly
Meteorological Measurements		
Wind speed	Anemometer	On-line
Relative humidity	Capacitive humidity sensor	On-line
Wind direction	Wind vane	On-line
Temperature	Thermistor	On-line

(a) Measured as non-methane hydrocarbons (NMHC), methane (CH_4) and total hydrocarbons (THC).
(b) As, Cd, Co, Cr, Cu, Hg, Pb, Mn, Ni, Sb, Sn, TI and V in the particulate phase.
(c) High volume sampler and analysis by inductively coupled plasma/optical emission spectrometry (ICP/OES).
(d) High volume sampler and analysis by high-resolution gas chromatography mass spectrometry (GC-MS).

2.2 Site Selection

2.2.1 The site was chosen, as it was West/West South West of the site whilst the predominant wind direction for winds in the UK are South Westerly. The location was about 1km from the site and hence the site could be an area of potential impact from the Energy from Waste (E*f*W) plant as determined by SELCHP. Finally because of the value of the equipment being deployed the site provided a secure location.

2.2.2 The monitoring which is the subject of this report was conducted at one site only and details are shown below:

Table 2: Selected Monitoring Site

Site Code	Site Name	Monitoring Period

Baltic Wharf - BW	Onyx Depot Baltic Wharf	Weekly & Online samples 25 August to 21st September 2000 (4 weeks)

2.3 Scope of the Report

2.3.1 The purpose of this report is to present the results of the monitoring campaign conducted.

2.3.2 The report is split into separate weeks for easy comparison, of the data and to allow the effect of the SELCHP operation to be evaluated.

2.3.3 The Plant outage was as follows:

- Boiler 1: 1st September refuse stopped being introduced at 02:56, oil burning was used a supplementary fuel from 03:42 to 04:17
- Boiler 2: 1st September refuse stopped being introduced at 02:48 with supplemental oil burning from 03:42 to 05:12.

2.3.4 The plant came back on stream as follows:

- Boiler 2: Heating up with oil 11 September 13:20 to 12 September at 02:35, refuse was introduced from 01:25 onwards.
- Boiler 1: Heating up with oil 12 September 11:12 to 12 September at 23:10 Refuse was introduced from 22:25 onwards.

3. Mobile Monitoring Results for the 25th August to 21st September 2000 at the Onyx Baltic Wharf Vehicle Depot.

3.1 Comparison of Monitored Data with Air Quality Standards/Guidelines

Mobile Laboratory Results

3.1.1 The concentration of pollutants measured at the site together with relevant air quality standards and guidelines are shown in Table 3.

3.1.2 There were no exceedances of limits/guideline levels and the air pollution levels according to the DETR Air Quality bandings at the location were low with respect to sulphur dioxide, nitrogen dioxide, PM_{10}s and carbon monoxide.

Weekly Extractive Results

3.1.3 The results for trace metals, hydrogen chloride, PCDD/Fs, PAHs and mercury are shown in Table 4.

Trace Metals

3.1.4 Concentrations of trace metals-in-air measured over the period are all well within the relevant air quality guidelines.

Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/fs)

3.1.5 The mean concentration of total PCDDs/Fs at the Baltic Wharf Depot was 18 fg I-TEQm^{-3} over the four-week period. This is approximately 25% lower than those concentrations measured in London since 1996 (3½ year mean of 26.4 fg I-TEQ m^{-3} reported on the AEA Technology NETCEN Website).

PAHs

3.1.6 Concentrations of PAHs measured over the four-week period were within the range of those measured at a background urban site in London in 1991 through to 1997 as reported by AEA Technology NETCEN Website.

Table 3

Comparison of Monitored Data at Baltic Wharf Depot 25th August to 21st September 2000 with Standards and Guidelines (ug m^{-3} unless otherwise specified)

Organisation[a]	Standard or Guideline	Monitored Value[b]	
NITROGEN DIOXIDE	(ug m^{-3})	(ug m^{-3})	
EU limit value (98%ile)[c]	200	101.5	
EU guide value(98%ile)[c]	135	101.5	
EU guide value(50%ile) [c]	50	53.2	
WHO (1 hour)	200	137	
NAQS (1 hour)[d]	287	137	
EPAQS(1 hour)[d]	287	137	
DETR Air Quality Banding	(ug m^{-3})	ppb	**Percentage of Readings in band**
Low	<287	<150	100%
Moderate	287-571	150-299	0%
High	572-762	300-399	0%
Very High	>763	>=400	0%
SULPHUR DIOXIDE	(ug m^{-3})	(ug m^{-3})	
EU limit value(annual median)[b]	80/120	10.8	
EU guide value(98%ile)[c]	250/350	34.1	
EU guide value(24-hour)[c]	100-150	68.7	
WHO (10 min)[e]	500	73.2	
WHO (24 hour)	125	69	
NAQS (15-minute)[d,e]	267	73	
EPAQS(99.9%ile)[e,d]	267	70	
DETR Banding	(ug m^{-3})	**ppb**	**Percentage of Readings in band**
Low	<267	<100	100%
Moderate	267-531	100-199	0%
High	532-1065	200-399	0%
Very High	>1069	>400	0%

table 3.xls Table 3 (sum)

Table 3 Cont.

Organisation[a]	Standard or Guideline	Monitored Value[b]	
CARBON MONOXIDE	**($mg\ m^{-3}$)**	**($mg\ m^{-3}$)**	
NAQS (8hr running Mean)	11.7	1.31	
EPAQS	11.7	1.31	
WHO (15 min)	100.0	2.38	
WHO (8 hr)	10.0	1.05	
DETR AQ Bands			
	($mg\ m^{-3}$)	**ppm**	**Percentage of Readings in band**
Low	<12	<10	100%
Moderate	13-16	10-14	0%
High	17-22	15-19	0%
Very High	>=23	>=20	0%
FINE PARTICULATE MATTER (PM_{10})			
	($ug\ m^{-3}$)	**($ug\ m^{-3}$)**	
NAQS (24 hr running mean)	50	27.4	
EPAQS (99% ile)	50	26.6	
DETR AQ Bands			
	($ug\ m^{-3}$)	**Percentage of Readings in band**	
Low	<50	100%	
Moderate	50-74	0%	
High	75-99	0%	
Very High	>=100	0%	
Methane			
		(ppm)	
Monthly mean	-	**1.50**	
Non-methane Hydrocarbons			
		(ppm as methane equivalents)	
Monthly mean	-	**0.18**	

[a] *EU = European Union, WHO = World Health Organisatio, NAQS = National Air Quality Strategy, EPAQS = Expert Panel on Air Quality Standards*

[b] *The monitored value is expressed statistically in the same way as the standard/guideline.*

[c] *The monitored value is measured over one month; the standard is based on a year of measurements*

[d] *Revised to reflect the current UK National Air Quality Strategy (published July 1997)*

[e] *The monitored value is a 15-minute mean concentration*

table 3.xls Table 3 (sum)

Table 4

Comparison of Monitored Data at Baltic Wharf Depot 25th August to 21st September 2000 with Standards and Guidelines (ug m^{-3} unless otherwise specified)

Organisation[a]	Standard or Guideline	Monitored Value[b]
Hydrogen Chloride		
LAQS [c,e]	(ug m^{-3}) 7	(ug m^{-3}) **0.27**
Total Suspended Particulates		
EU limit value (annual mean)[c]	(ug m^{-3}) 150	(ug m^{-3}) **45.9**
PCDD/Fs	-	(fg m^{-3}) **18**
PAH's	-	(ng m^{-3}) 3.6
Trace Metals **(sum of As, Cd, Co, Cr, Hg, Mn, Ni, Sb, Sn, Tl, V)**	-	(ng m^{-3}) **206**

[a] EU = European Union, WHO = World Health Organisation, NAQS = National Air Quality Strategy, EPAQS = Expert Panel on Air Quality Standards

[b] The monitored value is expressed statistically in the same way as the standard/guideline.

[c] The monitored value is measured over one month; the standard is based on a year of measurements

[d] Revised to reflect the current UK National Air Quality Strategy (published July 1997)

[e] Long term air quality standard based on the Health and Safety Executive Occupational Exposure Limits

alldata.xls Table 4 (sum)

4. Comparison of Measured Data with Data Recorded at Eltham Automatic Urban Network (AUN) Site

4.1.1 Measurements of NO, NO_2, SO_2, CO and PM_{10} are measured automatically on behalf of the DETR (Department of Environment Transport and Regions) at a urban background site at the Ecology Centre, Bexley Rd (A210), Eltham, and although the Baltic Wharf Site is considerably more industrialized and 4 miles north west of the Eltham site, it was thought that this would be a useful indicator of general air quality. Good correlations between the data sets indicate that national/continental source and or weather conditions are influencing air quality. Conversely where the data sets show a poor correlation this indicates that immediate local sources predominate and affect the air quality at the sites.

The results of the comparison showed:

- The air quality was indistinguishable during operation or shutdown periods of the EfW. This included a period where traffic was significantly reduced due to a national hauliers/farmers protest about fuels costs.

- The diurnal variations of NO_2 were generally higher at the Baltic Wharf site but showed very similar trends and good agreement throughout the monitoring period.

- SO_2 levels at both sites were consistently low although slightly higher levels were recorded at Baltic Wharf. The AUN data is un-validated and was suspect in that data was often below the detectable limit of the instruments.

- Concentrations of NO_2 & PM_{10}s at the site were higher than at the Eltham AUN site but peaks and troughs occur at approximately the same time corresponding to the rush hour periods of traffic.

- PM_{10} concentrations at the two sites had good trend agreement, and the magnitude was similar suggesting that meteorological conditions and mass transport issues.

5. Conclusions

5.1 To conclude the good agreement suggested that regional and meteorological effects predominated in controlling the pollution levels and the pollution appeared to be mainly due to vehicular activity given the good correlation between CO, NO_2 and PM_{10}.

5.2 Indeed all the other measured pollutants (SO2, dioxins/furans and PAHs) were low, when compared to published data for other monitoring sites around the London Area.

5.3 There is no significant impact of the SELCHP facility on the air quality in the vicinity, and no indication of a significant air pollution source in the West/South West of the monitoring site. Pollution levels appeared to originate mainly from vehicular activity.

5.4 In addition to quantifying the impact of SELCHP, this study, has found that the levels of air pollution in the particular area of Deptford were during this study within National & European standards and guidelines.

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1. INTRODUCTION

1.1 BACKGROUND

1.1.1 South East London Combined Heat and Power Ltd (SELCHP) own an Energy from Waste (E*f*W) in North Lewisham, London. The facility receives over 400,000 tonnes per year of municipal solid waste from the London Boroughs of Lewisham, Greenwich and Bexley as well as from Westminster City Council. The facility consists of two identical incinerators, which each process 29 tonnes of waste per hour. The waste is incinerated at temperatures above 850^{o}C in highly controlled conditions and the resulting hot gases are used to generate high-pressure steam, which in turn drives a turbo generator. The 35MW of electricity generated by this process is used to power the facility and the remainder is exported to the National Grid, supplying enough power for around 30,000 homes.

1.1.2 The hot gases, now much cooler, then enter the state-of-the art Air Pollution Control systems. First of all, fine activated carbon is introduced and this removes dioxins/furans, heavy metals and other organics by absorbing them into its pore structure. The gases then enter semi-dry scrubbers, where a lime and water mixture is sprayed in at high speeds to, neutralizing acid gases, such as hydrogen chloride and sulphur dioxide. Finally the gases pass through a bag filter house, where dust is removed down to a size of 10 microns (1 micron is equal to a thousandth of a millimetre). The cleaned, cooled gases are then released to the atmosphere via a 100m stack.

1.1.3 The SELCHP facility operates in accordance with the Environment Agency's (EA) authorisation AE7236. This means that pollution levels have to be proven to be at least as low as those given in the 1989 EC Directive on air pollution. In fact the EA's requirements are stricter than those from Europe, and yet SELCHP still operates well within its Authorisation limits.

1.1.4 Despite SELCHP operating to the highest standards of environmental performance there has been long standing public concern that the chimney-stack emissions from the facility are harming the health of the local community. These concerns have been discussed during several meetings that SELCHP has attended with local residents, councillors and the local Member of Parliament. As one way of allaying residents fears SELCHP has offered to fund an independent study to

investigate any effect that stack emissions from SELCHP may have on local air quality.

1.1.5 The SELCHP facility is operated by Onyx Aurora, part of the Onyx Environmental Group. Creed UK, the Environment, Energy and Research Centre for the Group commissioned Oakwood Environmental Services to carry out a four week ambient air monitoring project on behalf of SELCHP Ltd. Oakwood Environmental Services are a niche consultancy specialising in monitoring ambient & stack emissions and advising clients on the impact of their operations. The Principal of OES, Dr Roger Brown has over 20 years experience in scientific consultancy work centred on air pollution and Trace Organic Species such as Dioxins/Furans.

1.1.6 SELCHP facility is situated at Landmann Way near Deptford.

1.1.7 The monitoring location was chosen by SELCHP in consultation with OES and a fully automated ambient air trailer together with some manual sampling equipment located at the Onyx Vehicle Maintenance Depot at Baltic Wharf Deptford. The location is approximately 1km from the plant and the SELCHP plant was on a bearing of 265^{o} (W-WSW) from the monitoring station.

1.1.8 The period was specifically chosen by Creed UK/SELCHP as the 1st week the plant was operating normally, for the following 2 weeks the plant was undergoing major planned/scheduled maintenance (and hence shutdown) and the final 4th week the plant was operating as normal once more, following its shutdown. As part of their ongoing environmental interest they commissioned Oakwood Environmental Services to undertake an ambient air survey in the vicinity of the plant over a 4-week period.

1.1.9 The location was chosen by SELCHP and a fully automated ambient air trailer together with some manual sampling equipment located at the Onyx Vehicle Maintenance Depot at Baltic Wharf Deptford. The location is approximately 1km from the plant and the SELCHP plant was on a bearing of 265^{o} (W / WSW) approximately from the monitoring station.

1.1.10 The period was specifically chosen by SELCHP as the 1st week the plant was operating normally, for the following 2 weeks the plant was undergoing planned/scheduled maintenance (and hence shutdown) and the final 4th week the plant was operating as normal once more, following its shutdown.

1.1.11 The report shows data for the whole period and some data is split into separate periods for easy comparison, and to allow the effect of the SELCHP operation to be evaluated.

1.1.12 The Plant outage was as follows:

- Boiler 1: 1st September refuse stopped being introduced at 02:56, oil burning was used a supplementary fuel from 03:42 to 04:17
- Boiler 2: 1st September refuse stopped being introduced at 02:48 with supplemental oil burning from 03:42 to 05:12.

1.1.13 The plant came on stream as follows:

- Boiler 2: Heating up with oil 11 September 13:20 to 12 September at 02:35, refuse was introduced from 01:25 onwards.
- Boiler 1: Heating up with oil 12 September 11:12 to 12 September at 23:10 Refuse was introduced from 22:25 onwards.

1.2 MONITORING PROGRAMME

1.2.1 Pollutants

1.2.1.1 A summary of the characteristics of the pollutants monitored during the programme is as follows.

1.2.1.2 **Nitrogen dioxide (NO_2)** is an acid gas that may be formed from nitrogen and oxygen present in the air and also from the oxidation of nitric oxide (NO). Fuel combustion is the main source of NO_2 in the air. The main sources in the UK are vehicles and to a lesser extent, industry.

1.2.1.3 **Sulphur dioxide (SO_2)** is a colourless, acid gas. The main sources of SO_2 are combustion of sulphurous fuels and some industrial processes. Domestic coal fires were historically a significant source but are no longer so in most parts of the UK.

1.2.1.4 **Carbon monoxide (CO)** is colourless, odourless and tasteless. Incomplete fuel combustion in vehicles is the primary source; with road transport accounting for 90% of emissions in the UK. Indoor concentrations can be high due to gas fires and cookers, tobacco smoking and heating boilers.

1.2.1.5 **Particles** less than 10m (0.01 millimetres) in diameter **(PM_{10})** are small enough to stay airborne for long periods of time. Natural sources, road transport and industry are the major sources of these particles in the UK and diesel vehicles produce proportionately more than petrol ones. Airborne particles of all sizes (both smaller and larger than 10min diameter) are collectively known as **total suspended particles (TSPs)**.

1.2.1.6 **Methane(CH_4)** is a colourless, odourless gas with no direct health effects. It is produced from the decomposition of vegetable matter and is naturally present in the atmosphere.

1.2.1.7 **Non-methane hydrocarbons (NMHCs)**, also known as volatile organic compounds (VOCs), includes many different chemicals. Sources include industry, incomplete combustion (e.g. from vehicles) and evaporation of exposed liquids (e.g. petrol). NMHCs include such compounds as benzene and 1,3-butadiene.

1.2.1.8 **Hydrogen chloride (HCl)** is a colourless gas at room temperature, which dissociates readily in water, forming an acidic solution. Sources of HCl include combustion of coal, uncontrolled combustion of chlorinated materials, although it is also produced from marine aerosols.

1.2.1.9 **Trace metals** are those metals that are found in very small amounts in the environment. The metals being monitored are: arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), lead (Pb), manganese (Mn), nickel (Ni), antimony (Sb), tin (Sn), thallium (Tl) and vanadium(V).

1.2.1.10 **Polychlorinated dibenzo-*p*-dioxins (PCDDs) and Polychlorinated dibenzo-furans (PCDFs)** are commonly referred to as dioxins and furans. They are a class of compounds with a particular chemical structure that contain carbon, hydrogen, oxygen and chlorine atoms. There are 75 PCDDs and 135 PCDFs, each differing in the number and position of the chlorine atoms within the molecular structure. Each separate chemical is known as a *congener*. Of these PCDDs and

PCDFs, 17 congeners are of concern with respect to human health and are monitored in this study.

1.2.1.11 These 17 chemicals have been assigned an international toxicity rating (called an *International Toxic Equivalent Factor*, or I-TEF)[(1)], with the most toxic (2, 3, 7, 8-TCDD) having an I-TEF of 1.0. The I-TEF for all 17 congeners are presented in Annex A.

1.2.1.12 The toxicity of a mixture of PCDDs and PCDFs relative to 2, 3, 7, 8-TCDD can be calculated by multiplying the concentrations of the 17 congeners present in the mixture by their respective I-TEFs. The resulting products are called *Toxic Equivalents* (TEQs). The summation of individual TEQs for a mixture of PCDDs and PCDFs is termed the *International Toxic Equivalent* or I-TEQ) of the mixture.

1.2.1.13 The main source of PCDDs and PCDFs is combustion processes, although they are also made as unwanted by-products of various chemical and bleaching processes.

1.2.1.14 **Polycyclic aromatic hydrocarbons (PAHs)** are organic compounds composed of two or more fused aromatic rings, many of which are carcinogens. The major source of PAHs is the incomplete combustion of coal, oil, petrol and wood and they exist in the atmosphere in both the vapour and particulate phases. There are hundreds of different PAHs. Those that are monitored through this survey are: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz[*a*]anthracene, chrysene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, benzo[*a*]pyrene, benzo[*ghi*]perylene, indeno[*123-cd*]pyrene and dibenzo[*ah*]anthracene. Naphthalene, fluorene, phenanthrene and their alkyl derivatives are the major PAH components of diesel emissions. The monitoring results are presented as the sum of the particulate and vapour phases for each compound.

(1) NATO-CCMS (1988) **International Toxicity Equivalent Factor (I-TEF) Method of Risk Assessment for Complex Mixtures of Dioxins and Related Compounds. Pilot Study on International Information Exchange on Dioxins and Related Compounds**. Report No 176, North Atlantic Treaty Organisation, Committee on Challenges of Modern Society.

1.2.2 Scope of the Monitoring Programme

1.2.2.1 Principally, monitoring was performed using a mobile vehicle fitted with on-line instruments and with additional extractive apparatus (weekly samples) for HCl, PAHs, PCDD/Fs, trace metals, TSP and vapour phase mercury. The on-line monitoring instruments are compatible with the instruments employed in the Automated Urban network (AUN), sponsored by the Department of the Environment Transport and Regions (DETR).

1.2.3 Monitoring Programme Team

1.2.3.1 Oakwood Environmental Services (OES) was responsible for the overall management of this study, the sampling and the production of reports. Other members of the team included:

- Scientific Analysis Laboratory (SAL) is responsible for the analysis of the mercury tubes.
- EUS Laboratories (EUS) for the Polychlorinated dibenzo-p-dioxin and dibenzofuran and polycyclic aromatic hydrocarbon analyses.
- Technichem (TC) Ltd for the heavy metal analysis
- ETi Group is responsible for servicing the on-line monitoring equipment.
- University of Birmingham (U of B) performed the analysis of the HCl denuder tubes.

Table 1.1 Summary of Monitoring Activities for CREED UK

Determinand	Methodology	Averaging Period	Sampling Responsibility	Analysis Responsibility
Air				
NO	Chemiluminescence	On-line	OES	OES
NO_2	Chemiluminescence	On-line	OES	OES
SO_2	UV Fluorescence	On-line	OES	OES
CO	NDIR	On-line	OES	OES
PM_{10}	TEOM	On-line	OES	OES
Total VOCs[(a)]	FID	On-line	OES	OES
TSP	Hi-vol	Weekly	OES	EUS
HCl	Denuder tube	Weekly	OES	U of B
Vapour phase Hg	Silver wool method	Weekly	OES	SAL
Trace metals[(b)]	Hi-vol	Weekly	OES	TC
PAHs	Hi-vol	Weekly	OES	EUS
PCDD/Fs	Hi-vol	Weekly	OES	EUS

Table 1.1 cont.

Determinand	Methodology	Averaging Period	Sampling Responsibility	Analysis Responsibility
Meteorological Measurements				
Wind speed	Anemometer	On-line	OES	OES
Relative humidity	Capacitive humidity sensor	On-line	OES	OES
Wind direction	Wind vane	On-line	OES	OES
Temperature	Thermistor	On-line	OES	OES

(a) Measured as non-methane hydrocarbons (NMHCs) and methane.
(b) As, Cd, Co, Cr, Cu, Hg, Pb, Mn, Ni, Sb, Sn, TI and V in the particulate phase.

1.3 SITE SELECTION

1.3.1 Site Selection Criteria

1.3.2 The site was chosen as it was West/South West of the site, in addition the predominant wind direction for winds in the UK are south westerly hence the area had the potential to be impacted upon from the SELCHP plant.

1.3.2.1 The monitoring location chosen was approximately 1km from the SELCHP, with the plant on a bearing of 265^{o} (W - WSW) approximately from the monitoring station. The location was chosen & arranged by SELCHP in consultation with OES. The relative positions of the monitoring location and the SELCHP facility are shown in Figure 1.1.

1.3.2.2 In addition to air quality considerations there was a need for access to a secure site, a safe power supply and protection from vandalism. The Onyx Baltic Wharf Site at Deptford met all these criteria.

1.4 SCOPE OF THE REPORT

1.4.1 This report presents the results of a visit made to the above site between the 25th August and 21st September 2000. This report also compares the data obtained in Deptford with data (where possible) obtained simultaneously from the DETR AUN site at Eltham (East London/Greenwich). This site is a background Urban site situated at an Ecology Centre, Bexley Rd (A210), Eltham.


Surrey Commercial Docks
Baltic Wharf
SELCHP
Deptford
New Cross

Figure 1.1

2. MONITORING RESULTS FROM ONYX VEHICLE MAINTENANCE DEPOT BALTIC WHARF

2.1 SUMMARY

2.1.1 The mobile monitoring laboratory was sited at Baltic Wharf from 20:00 on the 25th August through to 9:00 on the 21st September 2000. Manual zero and span calibrations were performed four times during this period and as a result 8 hours of ambient air pollutant concentrations were not recorded.

2.1.2 Auto-calibrations of the SO_2, NO_2 and CO analysers resulted in the loss of one hour of data, these occurred at 01:00 each night.

2.1.3 The extractive samples however were started at the same time approximately and collected weekly over the subsequent 4 weeks up to the 21st September. The data capture period was considered from the point at which data logging started and will be seen from Table 2.1 to be very good in excess of 96% for the whole period.

Table 2.1 Full Monitoring Period 21st August to 21st September

Determinand	Minimum	Maximum	Mean	% Data Capture
Sulphur dioxide (ppb)	<1	25.8	3.74	96.1
Carbon monoxide (ppm)	0.03	1.63	0.22	99.4
Nitrogen dioxide (ppb)	7.25	71.8	28.7	97.1
Nitric oxide (as ppb (NO_2))	<1	258	29.7	97.1
Oxides of Nitrogen (as ppb (NO_2))	9	300	58.0	97.1
PM_{10} ($\mu g\ m^{-3}$)	<1	59.4	14.0	99.8
Methane (as ppm (C))[(a)]	0.87	5.60	1.50	99.2
Non-methane hydrocarbons (as mg(C) m^{-3})[(a)]	0.04	1.52	0.18	99.2
Total hydrocarbons (as mg(C) m^{-3})[(a)]	1.13	6.08	1.69	99.2
Wind speed ($m\ s^{-1}$)	0	11.2	0.89	100
Relative humidity (%)	36.0	94.0	73.3	100
Wind direction	-	-	SE-SSE [(b)]	100
Rainfall (mm over period)	-	14.6	-	100
Temperature (°C)	9.7	28.4	17.3	100

(a) Expressed as carbon (C) equivalents
(b) The predominant wind directions

2.1.4 In all 636 hours of data was recorded as 15-minute averages. The mobile laboratory and extractive samples were collected over the full 27/28-day period. These results are also shown later in section 2.2, graphically in Figures 2.1 to 2.5. Figures 2.8 & 2.9 present the meteorological data that accompanied the chemical speciation of the air pollution.

2.1.5 Weekly HCl, TSP and total PCDD/F concentrations are presented in Table 2.2, whilst trace metal and PAH concentrations are presented graphically in Figures 2.6 and 2.7 respectively in section 2.2. Weekly mean concentrations of all the species monitored on a weekly basis as part of this study (TSP, HCl, trace metals, individual PCDD/Fs and PAHs are presented in Tables D1 to D4 in Annex D

Table 2.2 Weekly mean concentrations of HCl, TSP, Heavy Metals and PCDD/Fs measured at Baltic Wharf Depot.

Species	25/8/00 to 31/8/00	31/8/00 to 7/9/00	7/9/00 to 14/9/00	14/9/00 to 21/9/00	Four Week Mean
HCl (mg m^{-3})	0.32	0.33	0.25	0.20	0.27
Total Heavy Metals (As,Cu,Pb,Cd,Cr,Ni,Mn,Sb,Sn,V,Co,Tl,Hg)(ng m^{-3})	195	159	287	184	206
TSP (mg m^{-3})	62.6	49.3	42.9	29.0	45.9
PCDD/Fs (fg I-TEQ m^{-3}) (b)	16	4.4	7.6	5.7	8.5

(a) nanogramme ng m^{-3} = 1 x 10^{-9} g m^{-3}.
(b) femtogramme fg m^{-3} = 1 x 10^{-15} g m^{-3}. Total PCDD/F concentration assuming non-detected levels as zero.

2.2 COMMENTARY AND COMPARISON WITH STANDARDS AND GUIDELINES

2.2.1 Introduction

2.2.1.1 Comparison of measured concentrations with the relevant standards and guidelines is presented in this section of the report.

2.2.2 Nitrogen Dioxide

2.2.2.1 Concentrations of NO_2 recorded at Baltic Wharf Depot are shown with the relevant standards and guidelines for NO_2 in Table 2.3. The data has also been expressed as a percentage of the relevant standard in the table. However it should be noted that this direct comparison is not always valid as the monitoring periods are based on yearly sets of data rather than on one month as in this case. If the monitored values are taken as being representative of a longer period (eg one year) then the comparison becomes valid.

Table 2.3

Comparison of Monitored Data (NO_2) at Baltic Wharf Depot 25th August to 21st September 2000 with Standards and Guidelines (ug m^{-3})

Organisation	Standard or Guideline	Monitored Value[a]	Data as % of criterion	
EU limit value[b]	200	101.5	50.7	
EU guide value[b]	135	101.5	75.2	
EU guide value[c]	50	53.2	106.5	
WHO (1 hour)	200	137	68.5	
NAQS (1 hour)[d]	287	137	47.8	
EPAQS(1 hour)[d]	287	137	47.8	
DETR Air Quality Banding				
Low	<287	<150	636	100%
Moderate	287-571	150-299	0	0%
High	572-762	300-399	0	0%
Very High	>763	>=400	0	0%

[a] *The monitored value is expressed statistically in the same way as the standard/guideline.*

[b] *The monitored value is the 98th percentile of hourly means measured over one month; the standard is based on a year of measurements*

[c] *The monitored value is the 50th percentile of hourly means measured over one month; the standard is based on a year of measurements*

[d] *Revised to reflect the current UK National Air Quality Strategy (published July 1997)*

alldata.xls Table 2

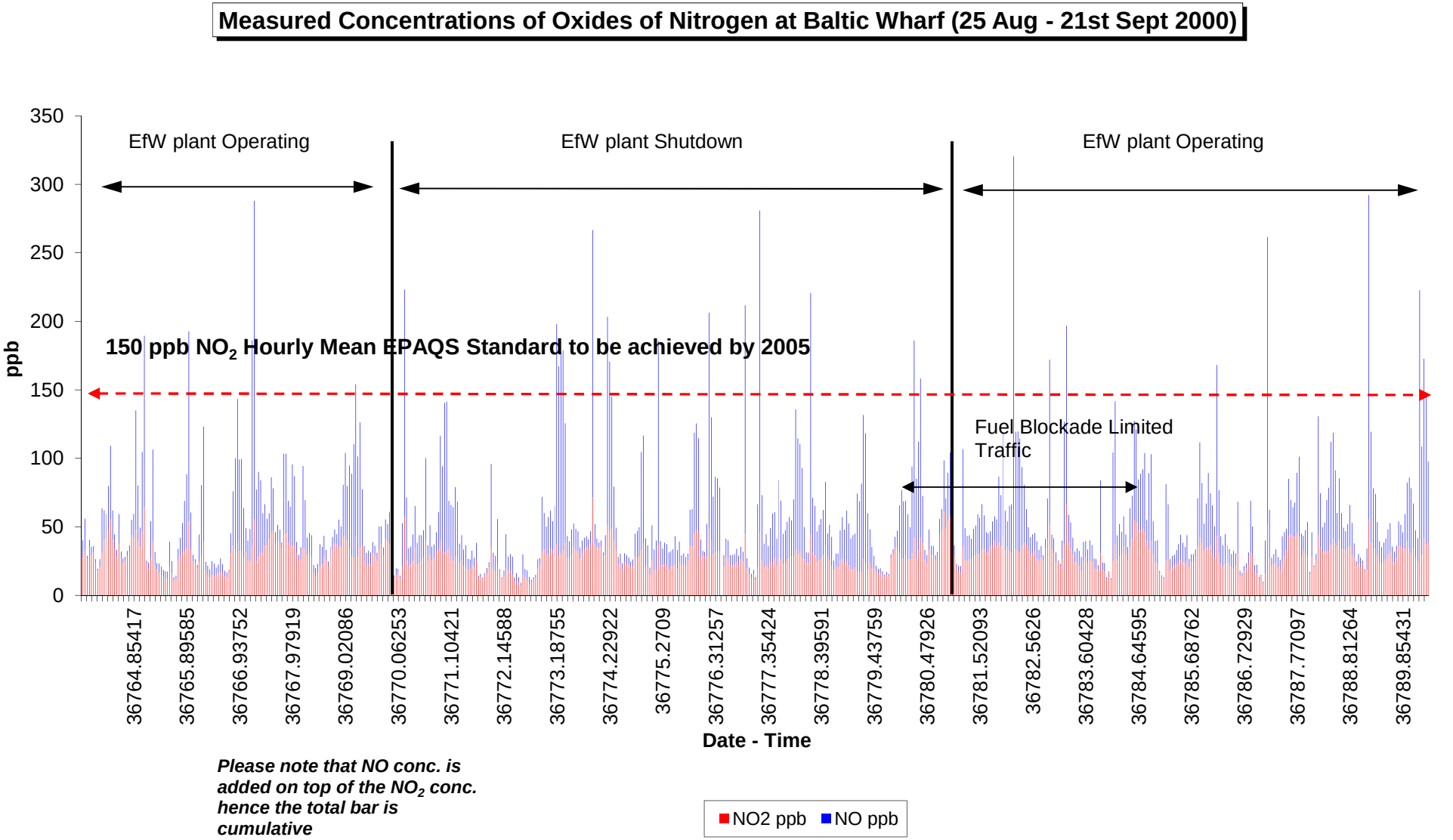

Measured Concentrations of Oxides of Nitrogen at Baltic Wharf (25 Aug - 21st Sept 2000)
EfW plant Operating
EfW plant Shutdown
EfW plant Operating
150 ppb NO2 Hourly Mean EPAQS Standard to be achieved by 2005
Fuel Blockade Limited Traffic
ppb
350
300
250
200
150
100
50
0
36764.85417
36765.89585
36766.93752
36767.97919
36769.02086
36770.06253
36771.10421
36772.14588
36773.18755
36774.22922
36775.2709
36776.31257
36777.35424
36778.39591
36779.43759
36780.47926
36781.52093
36782.5626
36783.60428
36784.64595
36785.68762
36786.72929
36787.77097
36788.81264
36789.85431
Date - Time
Please note that NO conc. is added on top of the NO2 conc. hence the total bar is cumulative
NO2 ppb
NO ppb

Figure 2.1 (a)

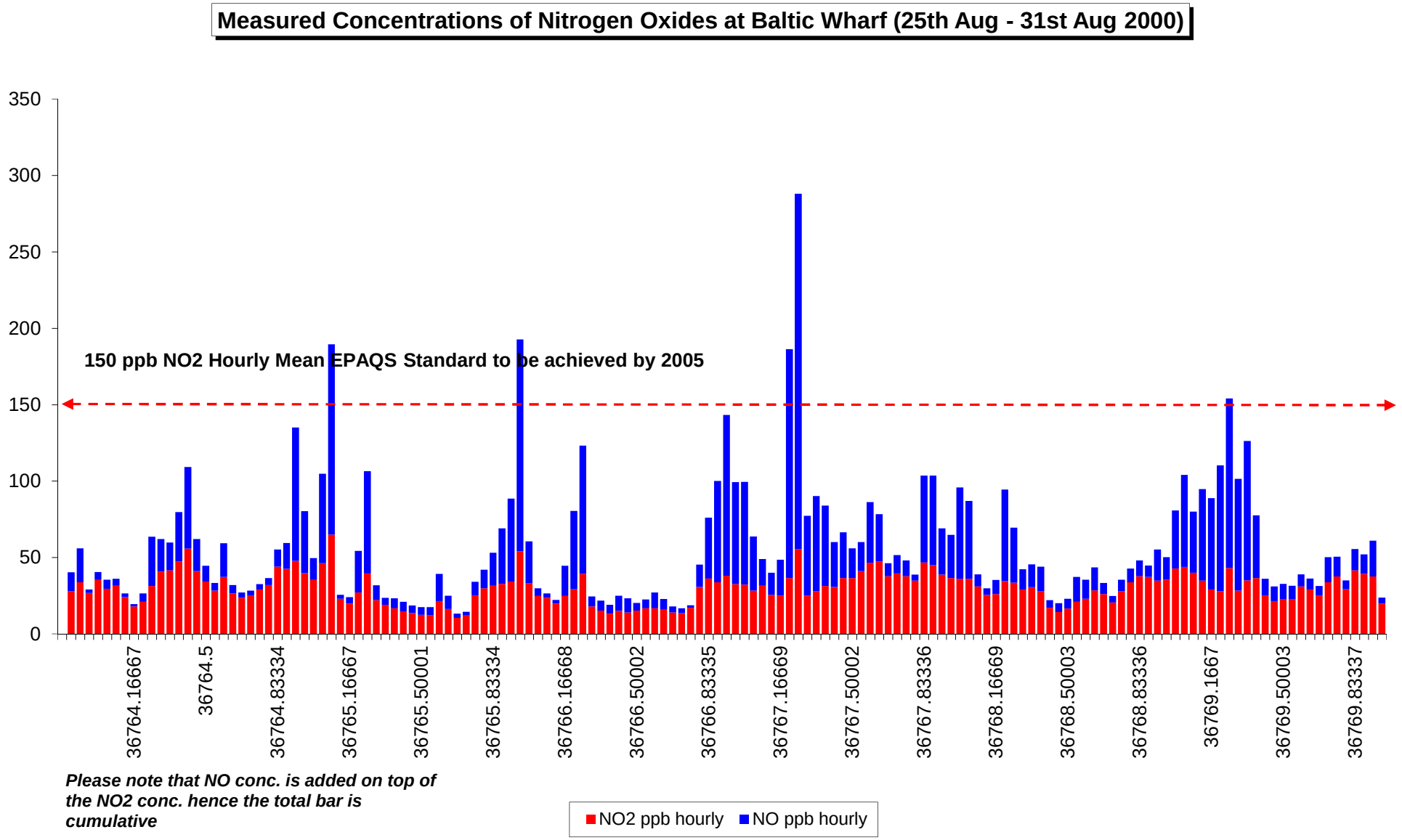
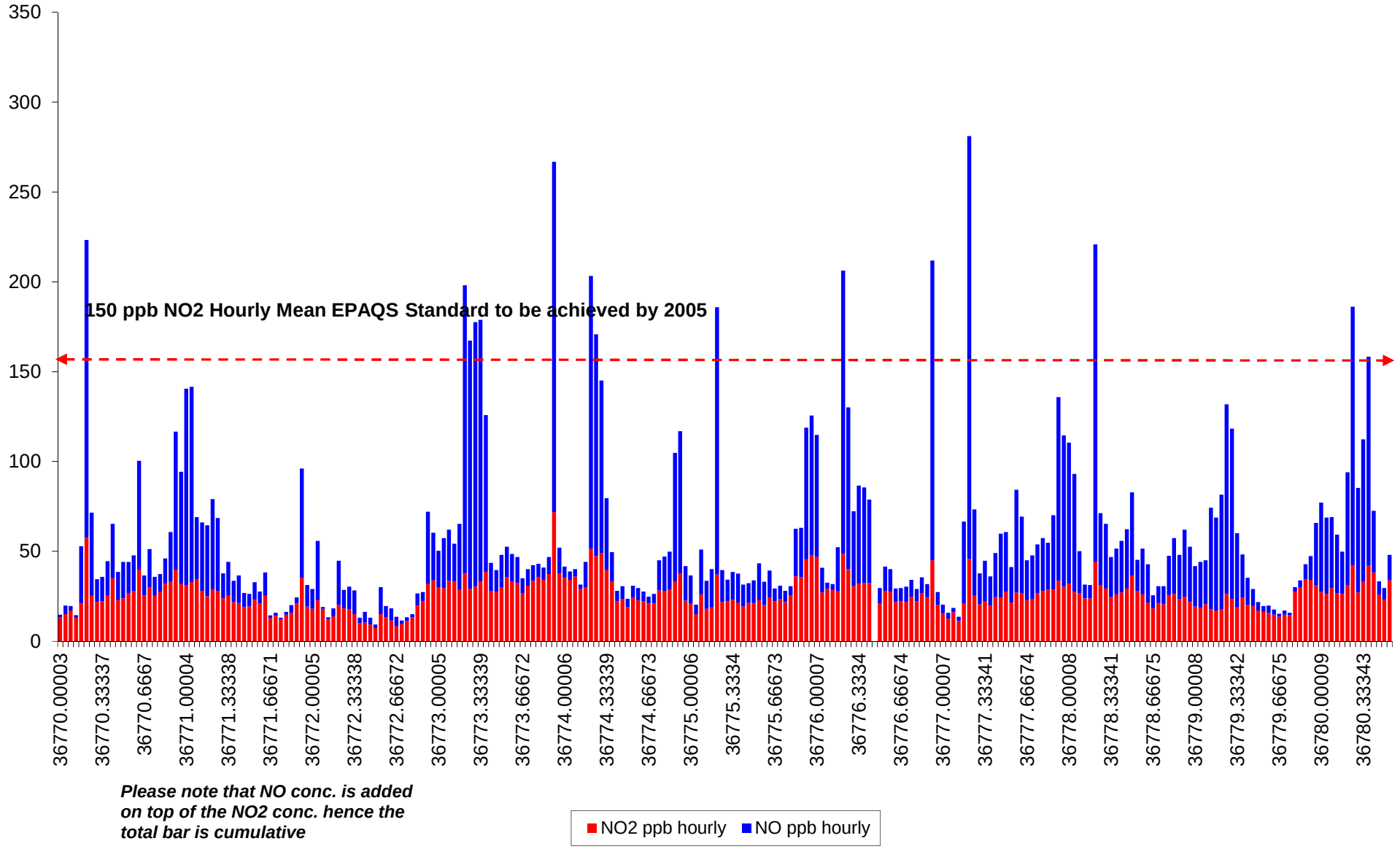

Measured Concentrations of Nitrogen Oxides at Baltic Wharf (25th Aug - 31st Aug 2000)
350
300
250
200
150
100
50
0
150 ppb NO2 Hourly Mean EPAQS Standard to be achieved by 2005
36764.16667
36764.5
36764.83334
36765.16667
36765.50001
36765.83334
36766.16668
36766.50002
36766.83335
36767.16669
36767.50002
36767.83336
36768.16669
36768.50003
36768.83336
36769.1667
36769.50003
36769.83337
Please note that NO conc. is added on top of the NO2 conc. hence the total bar is cumulative
NO2 ppb hourly
NO ppb hourly

Figure 2.1 (b)

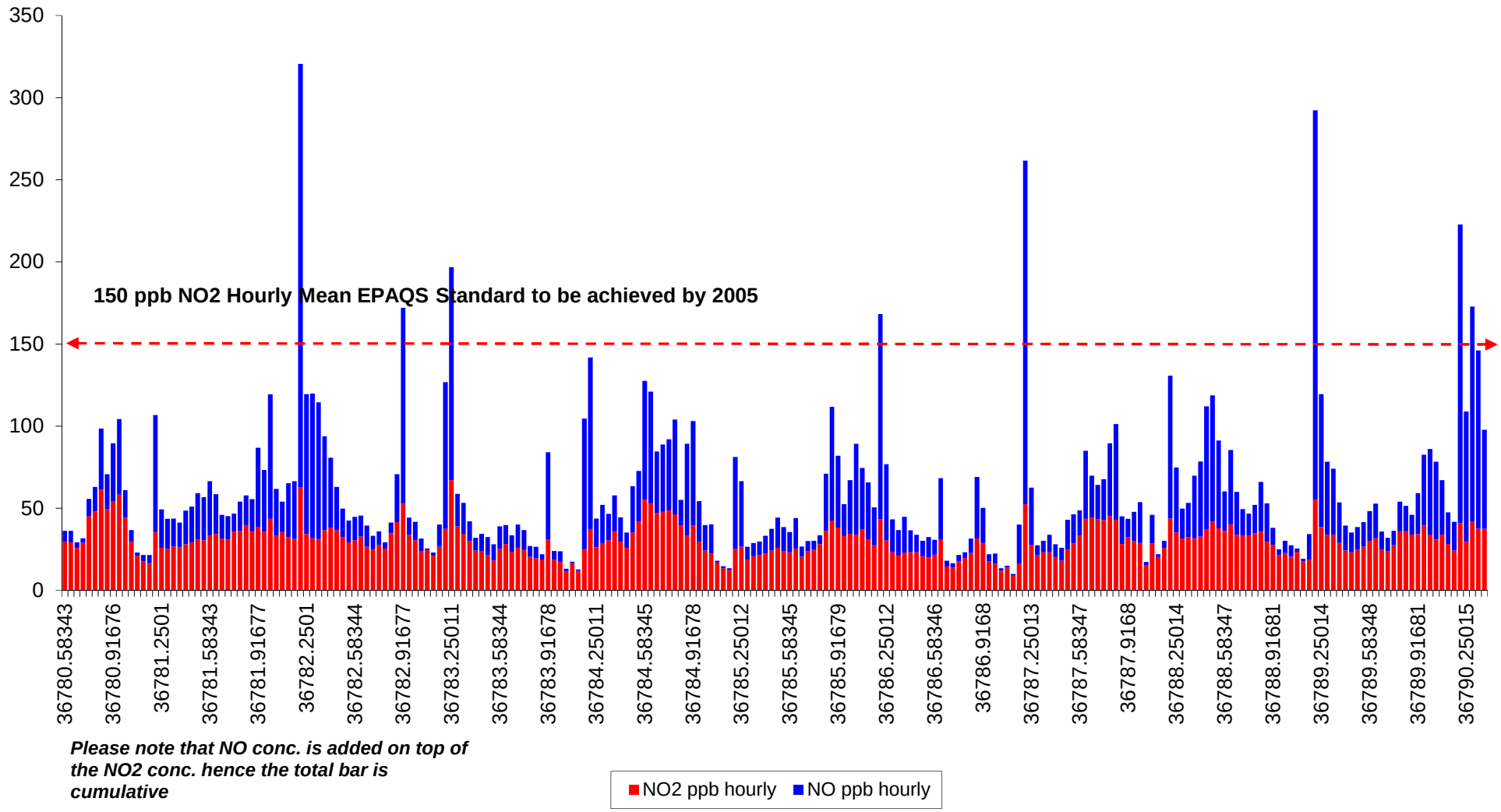
Measured Concentrations of Nitrogen Oxides at Baltic Wharf (1st Sept - 11th Sept 2000)



Please note that NO conc. is added on top of the NO2 conc. hence the total bar is cumulative

Figure 2.1 (c)

Measured Concentrations of Nitrogen Oxides at Baltic Wharf (11th Sept - 21st Sept 2000)

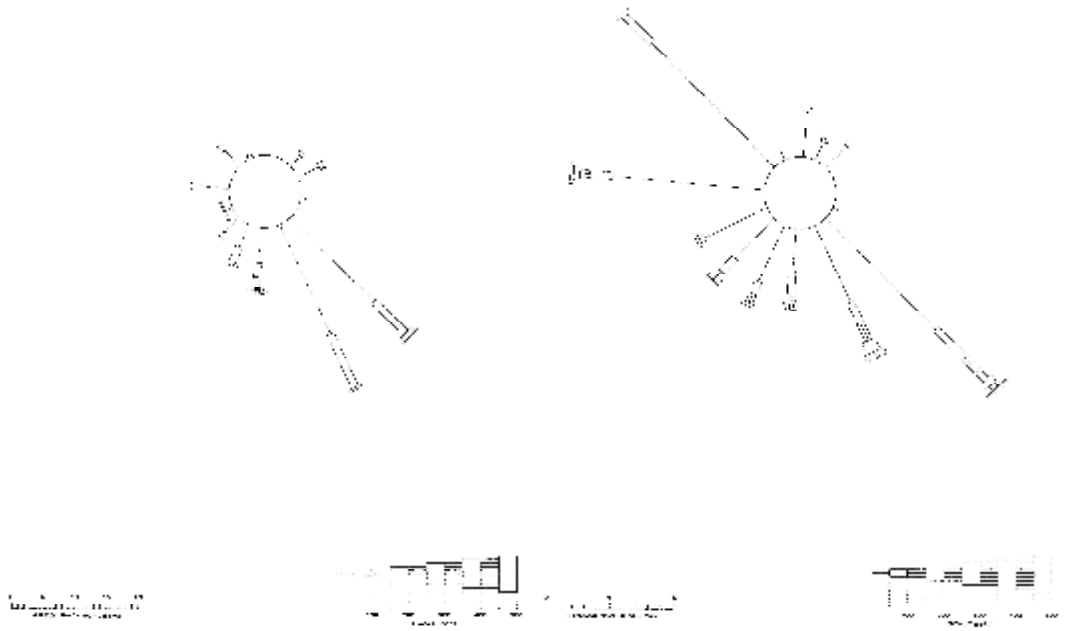


Please note that NO conc. is added on top of the NO2 conc. hence the total bar is cumulative

Figure 2.1 (d)

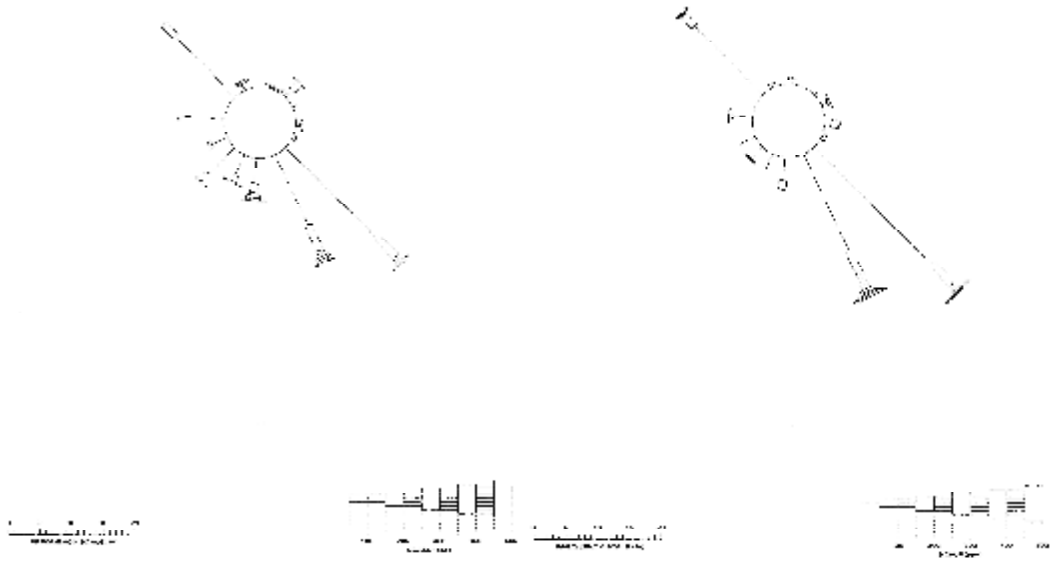
Nitric oxide Pollution Rose For Baltic Wharf Depot

N



Week 1: 25 Aug to 31 Aug 2000 **Week 2: 1 Sep to 7 Sep 2000**

W- -E



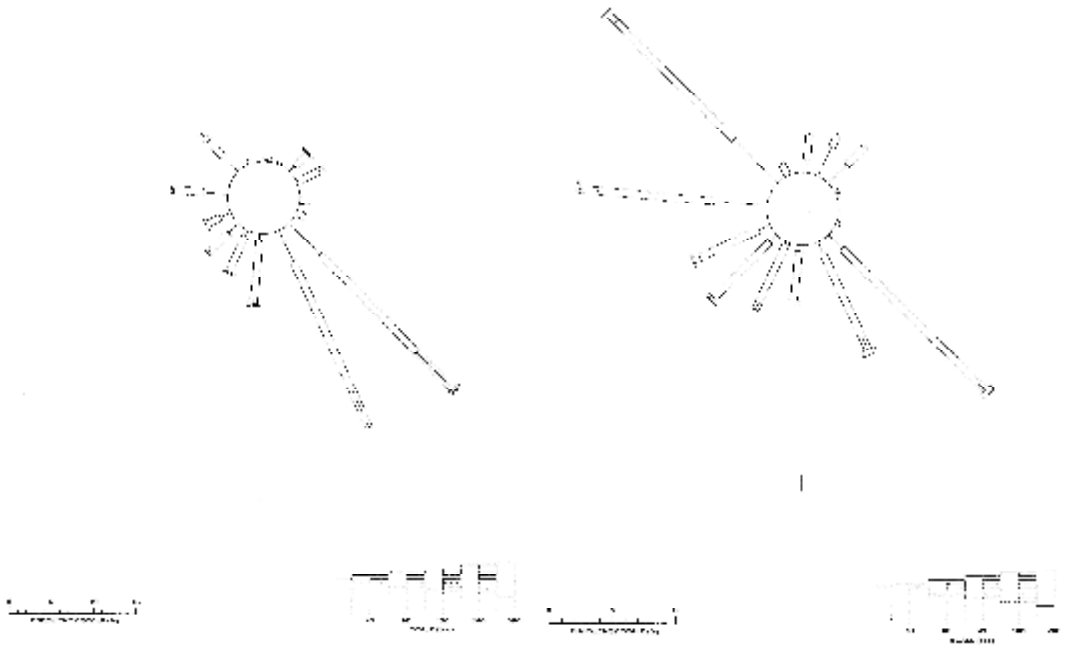
Week 3: 8 Sep to 14 Sep 2000 **Week 4: 15 Sep to 21 Sep 2000**

S

Figure 2.1 (e)

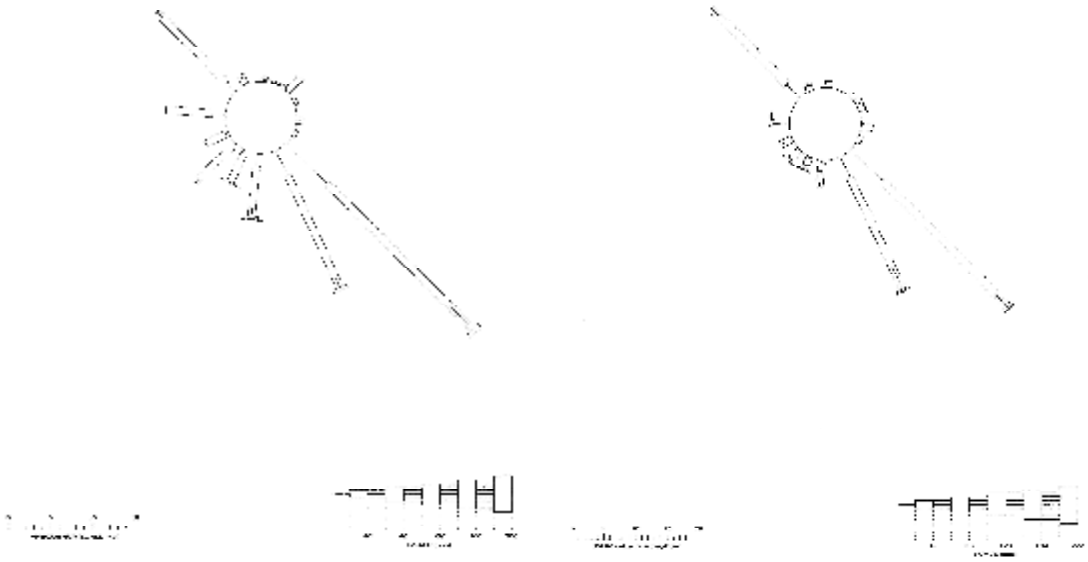
Nitrogen dioxide Pollution Rose For Baltic Wharf Depot

N



Week 1: 25 Aug to 31 Aug 2000 **Week 2: 1 Sep to 7 Sep 2000**

W- **-E**



Week 3: 8 Sep to 14 Sep 2000 **Week 4: 15 Sep to 21 Sep 2000**

S

Figure 2.1 (f)

2.2.2.2 The DETR National Air Quality Strategy Guidelines and air quality bands showed the air pollution due to NO_2 was classified as "low" for 100% of the data.

2.2.2.3 The period mean concentration (28.7 $\mu g\ m^{-3}$) is within the range of annual mean concentrations found for measurements in the East Thames region the UK(1).

2.2.2.4 The levels when compared with EU limit values are not directly comparable as the criteria are based on a year's work of hourly data. However if the monitoring period is considered indicative of the air quality throughout the year then the concentrations are below the relevant standards as can be seen in Table 2.3.

2.2.2.5 The peak hourly mean NO_2 concentration (137 $\mu g\ m^{-3}$) occurred at 20:00 hrs on Monday 4th September. This coincided with peak level of PM_{10}s and a similar level of oxides of nitrogen and road related pollution was noted at the Eltham AUN site. The peak was not that large and the weather conditions consisted of light winds from the W and then changing to the SSE with wind speeds of less than 0.3 m/s.

2.2.2.6 A similar event was noted as stated above at the Eltham Site suggesting that the meteorological conditions were controlling the pollution levels more significantly than any specific local pollution source.

2.2.2.7 Only the 50th Percentile EU Guideline value (50$\mu g\ m^{-3}$) was breached but it should be noted that this is expressed as a 50th Percentile value of 1 hour averages over a yearly period. The monitored value was 53.2 $\mu g\ m^{-3}$ however this represents only just over 27 days compared to 365 days on which the standard is based, and almost certainly the 50th Percentile monitored level would reduce with a lengthened period of monitoring,

2.2.2.8 Pollution roses are a plot of pollutant concentration versus wind direction, the length of the bar shows the frequency of the pollutant in a concentration range whilst the width of the bar is an indicator of that concentration range. Figures 2.1 (e) & (f) show clearly that for both nitric oxide & nitrogen dioxide the highest levels arise from the NW and SE, SSE directions and not from the W and SW which would correspond to the direction of the SELCHP facility. Only during the facility shut down (week 2) was a significant level of nitrogen dioxide detected from that direction, and this clearly arises from another source.

(1) Quality of Urban Air Review Group (1993) Urban Air Quality in the UK - 1st Report, DOE, UK

2.2.3 Sulphur Dioxide

2.2.3.1 Concentrations of SO_2 were low at the Baltic Wharf site and considerably below any EU guidelines or standards. With regard to DETR banding levels, the air pollution was classified as low for all 2548 or 100% of the readings i.e. all levels were below 100 ppb (267 $\mu g\ m^{-3}$). This data is shown in Table 2.4

2.2.3.2 The mean concentration of 3.74 $\mu g\ m^{-3}$ (Table 2.1) is well within the normal range of annual mean concentrations found along the East Thames(1) and is lower than is found at many locations in the UK.

2.2.3.3 As discussed earlier the EU limits are based on a year's worth of daily means, so if the period monitored is indicative of air quality throughout the year then the measured concentrations were 13.5% of the tighter EU limit value. The EU guide value can be compared directly to the measured data - the maximum daily monitored mean (23.5 $\mu g\ m^{-3}$) and represents 24% of the criteria.

2.2.3.4 The maximum measured 15-minute concentration 73 $\mu g\ m^{-3}$ represents 27.4% of the NAQS (National Air Quality Strategy Objective) for the year 2005.

2.2.3.5 The peak 15-minute concentration of 27.5 ppb (73.2 $\mu g\ m^{-3}$) occurred at 18:15 through to 21:00 on Wednesday 30th August 1999 when wind conditions were moderate (1-1.3 ms^{-1}) and from the southeasterly – south southeasterly direction. No other pollutant was elevated with this period and the levels should not be considered of concern. The wind was gusting during this period to 3-4 m/s, minor peaks were also observed at the Eltham site, but at considerably reduced levels 6ppb (16-17 ug $m^{-}3$ at about 16:00 hrs). This would be approximately correct given the wind speed and would suggest that the pollution source was S/SSE and that the Eltham Site was on the edge of a pollution plume/stream. The pollution, however, could not be attributed to the SELCHP facility, as the wind direction would have had to be from a westerly direction. This is substantiated by the sulphur dioxide pollution rose (Figure 2.2 (e)), which again showed a NW & SE source to be the major contributor to pollution.

(1) Quality of Urban Air Review Group (1993) Urban Air Quality in the UK - 1st Report, DOE, UK

Table 2.4

Comparison of Monitored Data (SO_2) at Baltic Wharf Depot 25th August to 21st September 2000 with Standards and Guidelines (ug m^{-3})

Organisation	Standard or Guideline	Monitored Value [a]	Data as % of criterion
EU limit value[b]	80/120	10.8	13.5/9.0
EU limit value[c]	250/350	34.1	13.6/9.7
EU guide value[c]	100-150	23.5	24-16
WHO (10 min)	500	73.2	14.6
WHO (24 hour)	125	23	18.8
NAQS (15-minute)[d,e]	267	73	27.4
EPAQS(99.9%ile)[d,e]	267	70	26.2

DETR Air Quality Banding

			No of 15min periods in band	
Low	<267	<100	2548	100%
Moderate	267-531	100-199	0	0%
High	532-1068	200-399	0	0%
Very High	>1069	>400	0	0%

[a] *The monitored value is expressed statistically in the same way as the standard/guideline.*

[b] *The monitored value is the median of daily means measured over one month; the standard is based on a year of measurements*

[c] *The monitored value is the 98th percentile of hourly means measured over one month, the standard is based on a year of measurements. The guide value is the maximum daily mean.*

[d] *Revised to reflect the current UK National Air Quality Strategy (published July 1997)*

[e] *The monitored value is a 15-minute mean concentration*

alldata.xls Table 3

Measured Concentrations of Sulphur dioxide at Baltic Wharf (25th Aug - 21st Sept 2000)

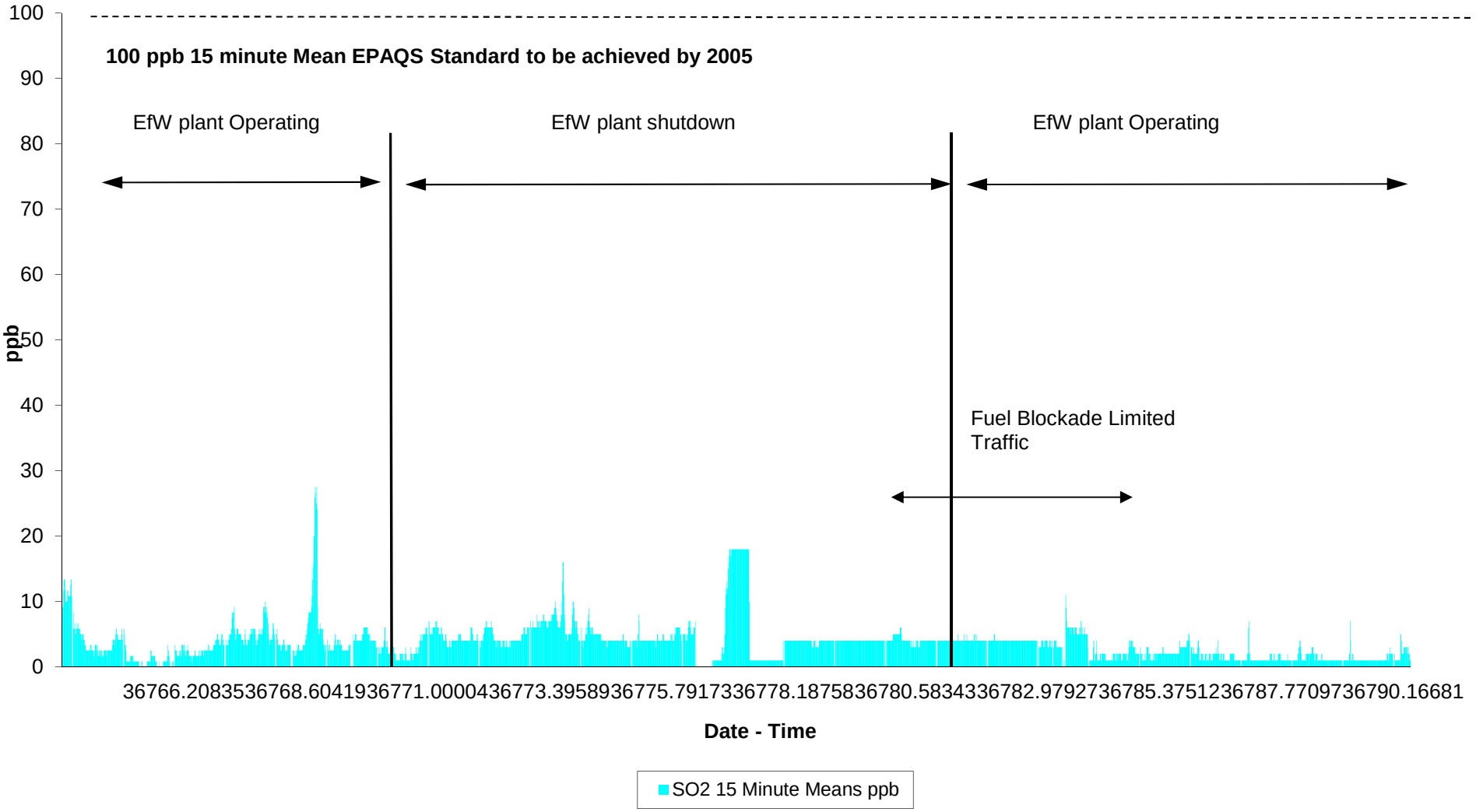


Figure 2.2 (a)

Measured Concentrations of Sulphur dioxide at Baltic Wharf (25th Aug - 31st Aug 2000)

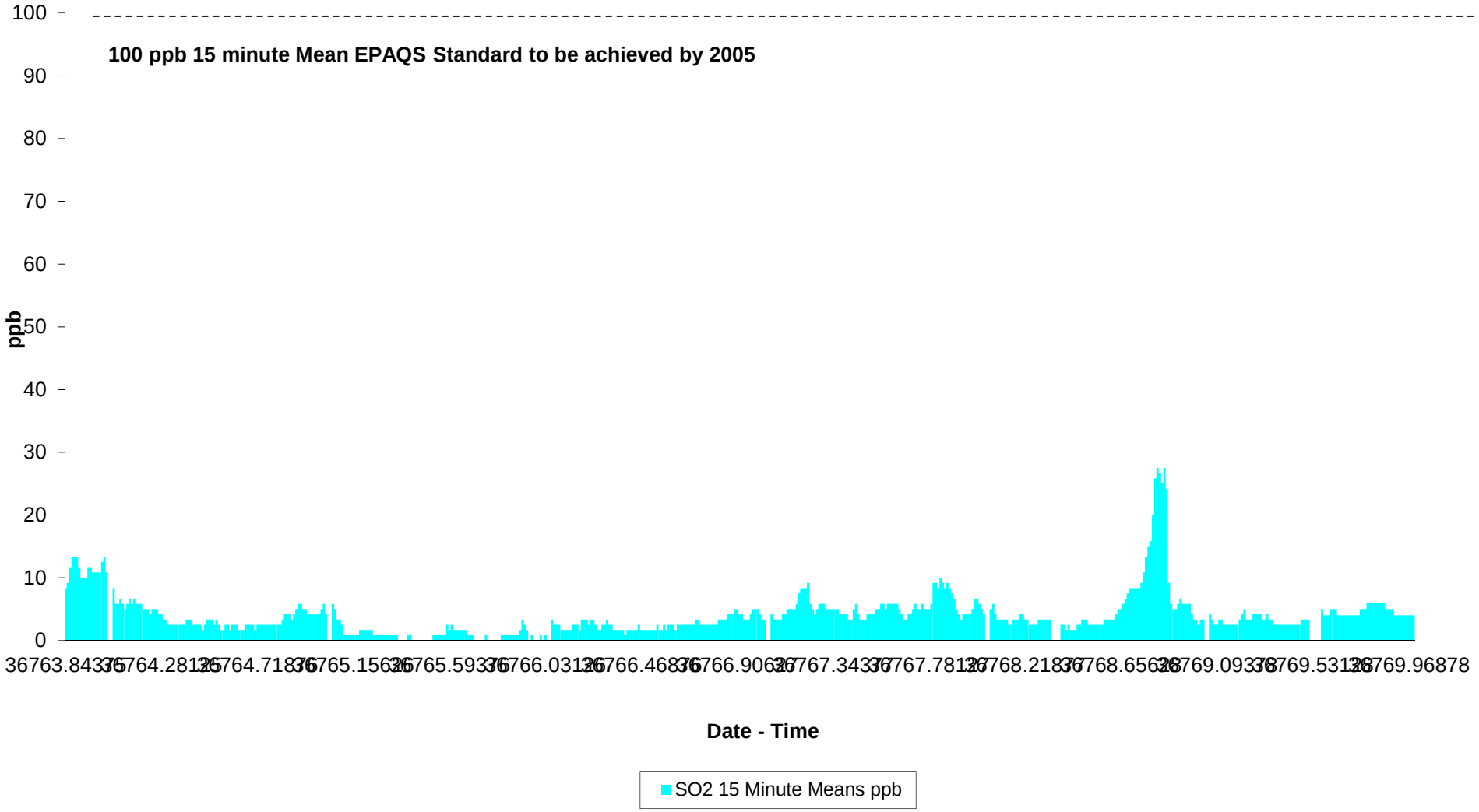


Figure 2.2 (b)

Measured Concentrations of Sulphur dioxide at Baltic Wharf (1st Sept - 11th Sept 2000)

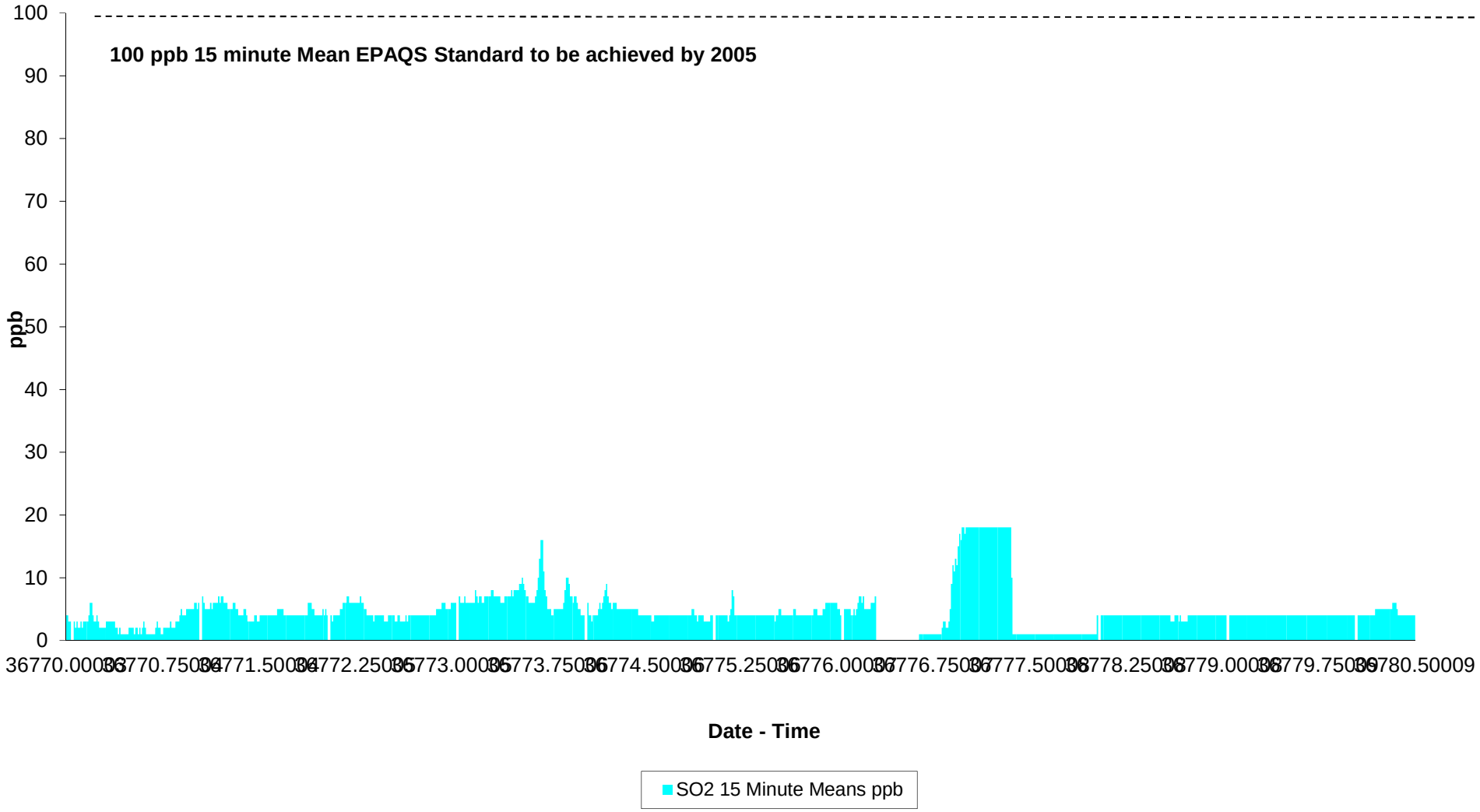


Figure 2.2 (c)

Measured Concentrations of Sulphur dioxide at Baltic Wharf (11th Sept - 21st Sept 2000)

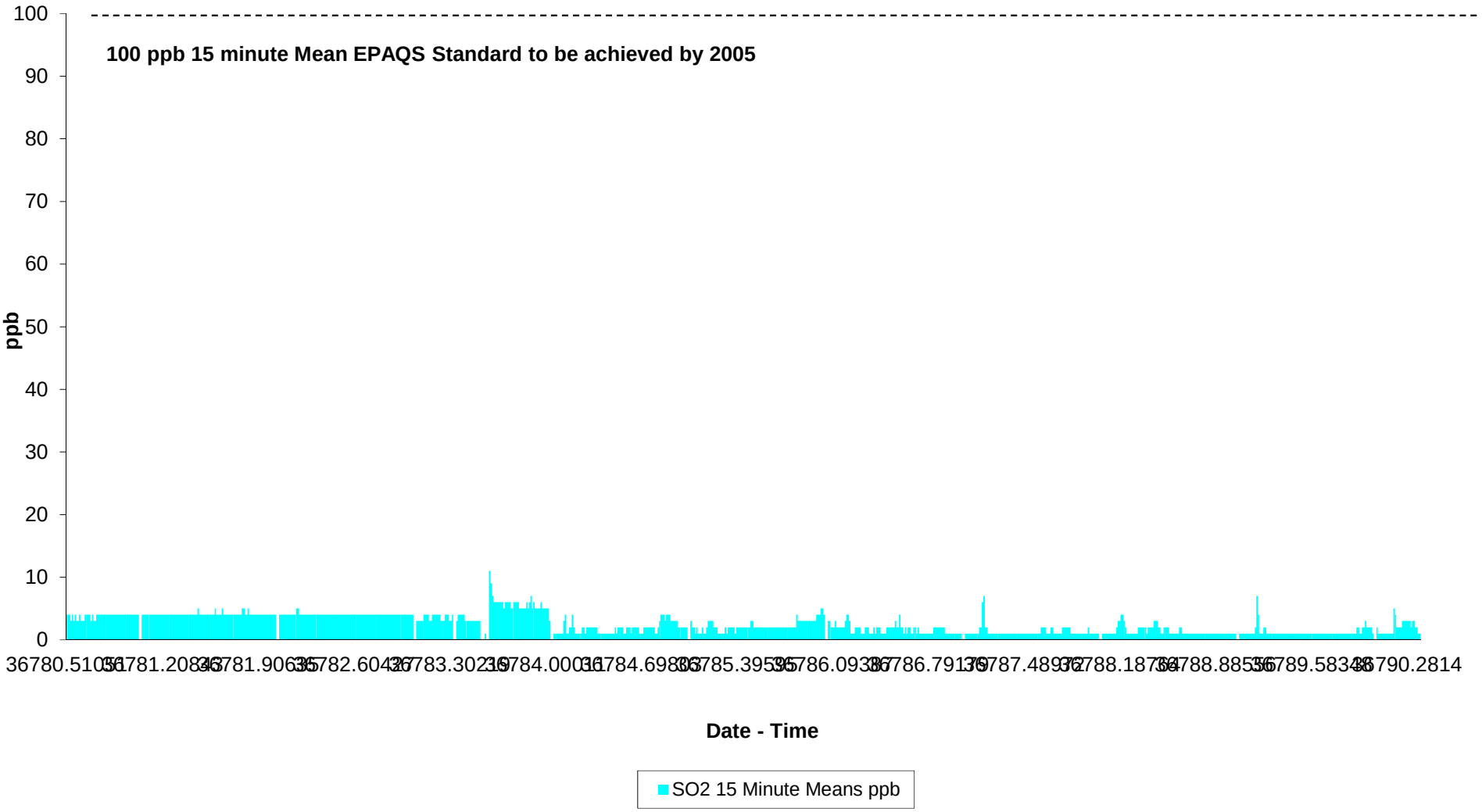
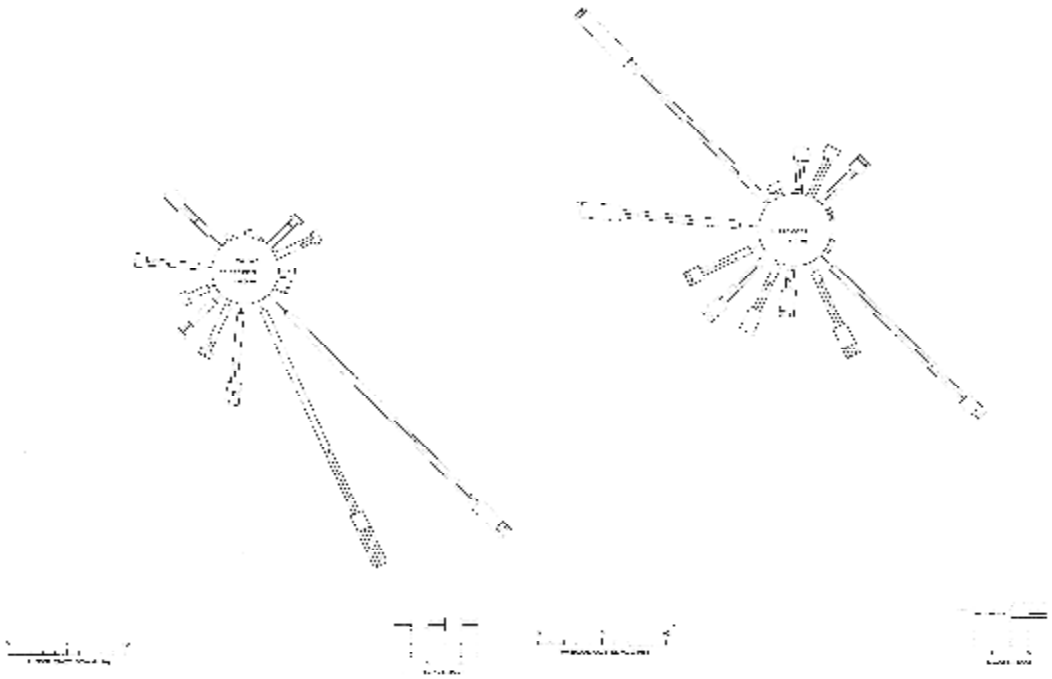


Figure 2.2 (d)

Sulphur dioxide Pollution Rose For Baltic Wharf Depot

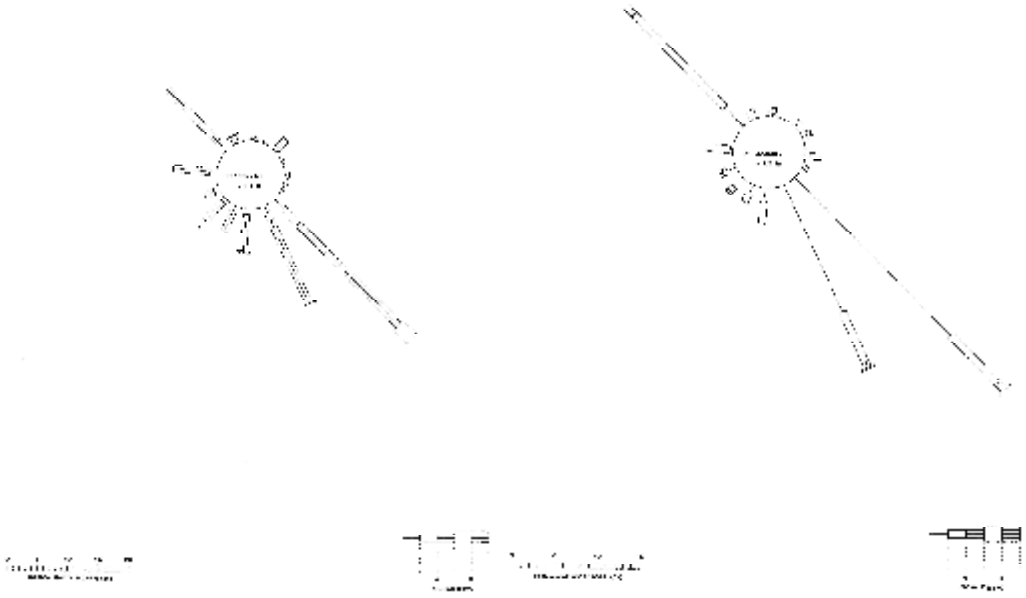
N



Week 1: 25 Aug to 31 Aug 2000

Week 2: 1 Sep to 7 Sep 2000

W- -E



Week 3: 8 Sep to 14 Sep 2000

Week 4: 15 Sep to 21 Sep 2000

S

2.2.4 Fine Particulate Matter (PM_{10})

2.2.4.1 The highest 24 hour running mean concentration (27.4 mg m^{-3}) is below the EPAQS and NAQS standards and guidelines. The highest 1-hour concentrations (59.4 mg m^{-3}) occurred between 08:15 and 09:15 on Monday 11th September. This would correspond to a rush hour period and given slight elevations of other pollutants (NO, NOx, THC, CH_4 and CO) would suggest motor vehicles to be the cause. It should also be noted that a "Shell" Petrol station is less than 300m from the monitoring station, and considerable queues of traffic built up on various days during this period. This was as a result of the hauliers' blockade of refineries that occurred during this campaign. Whenever a fuel delivery was received by the garage a large traffic jam of up to a mile developed outside Baltic Wharf.

2.2.4.2 These episodes also occurred during a period of light winds (<0.3s^{-1}). It should be noted that the peaks also corresponded with peaks observed at the Eltham AUN site, but to a lower extent given the more urban background nature of the Eltham location.

2.2.5 Carbon Monoxide (CO)

2.2.5.1 CO levels were generally moderate during the period with elevated peaks during the period these correspond mainly to rush hour periods and had a diurnal cycle. The levels are probably exacerbated by the large refuse trucks coming and going from the depot where they were maintained, some travelling within 5-10m of the monitoring station, it must be also noted that the trucks are also some of the most environmentally "friendly" units in the London area. The maximum 1 hour mean level was 1.90 mg m^{-3} (1.63 ppm) with a mean level of 0.26 mg m^{-3} (0.22 ppm). The maximum 15-minute concentration was 2.38 mg m^{-3} versus a WHO guideline level of 100 mg m^{-3}. The maximum 8-hour running mean concentration was 1.31 mg m^{-3}, 11% of the NAQS and EPAQS standards (11.7 mg m^{-3}).

Measured Concentrations of Fine Particulates PM_{10}s at Baltic Wharf (25 Aug - 21st Sept 2000)

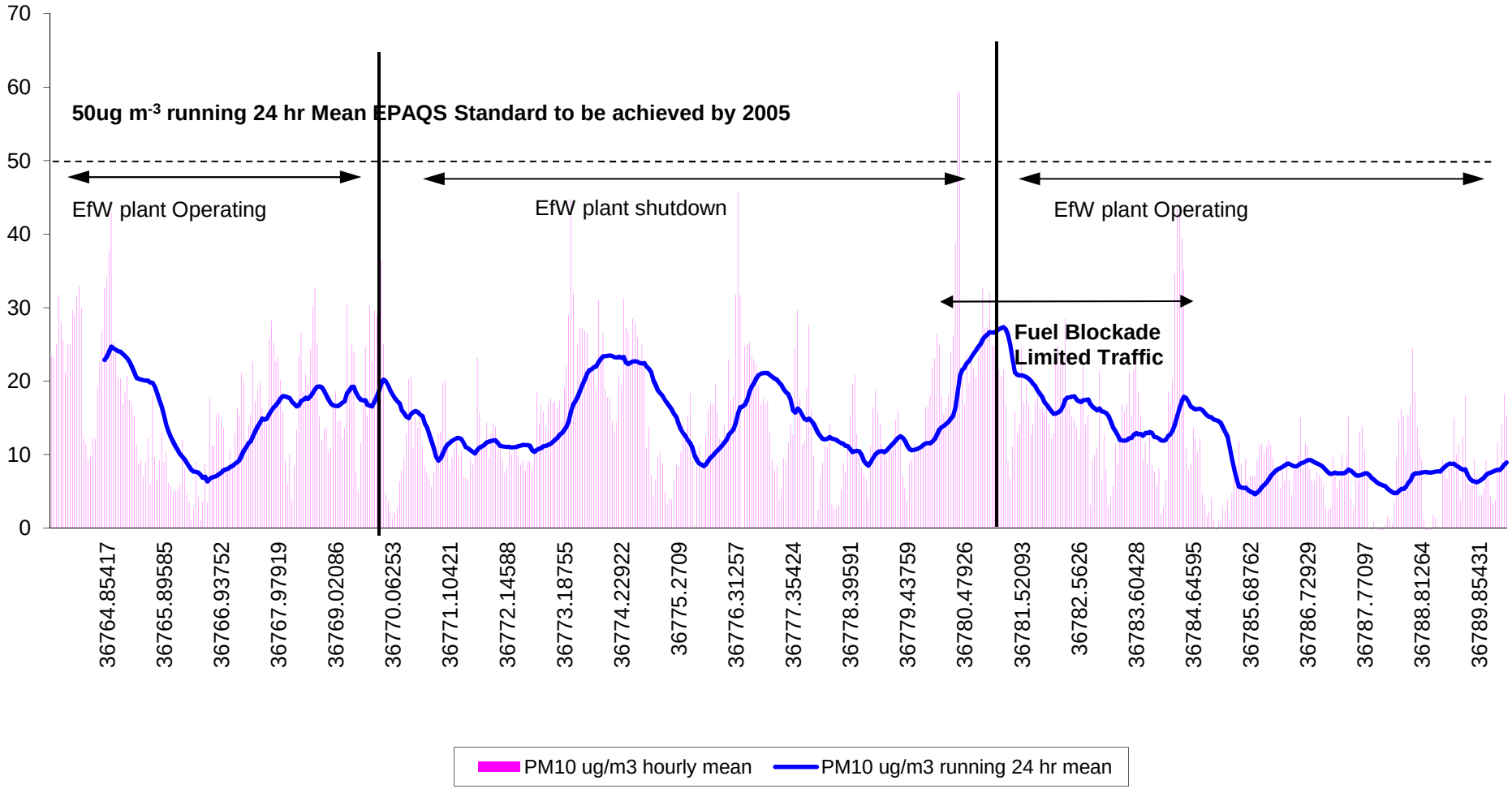


Figure 2.3 (a)

Measured Concentrations of Fine Particulates PM10s at Baltic Wharf (25th Aug - 31st Aug 2000)

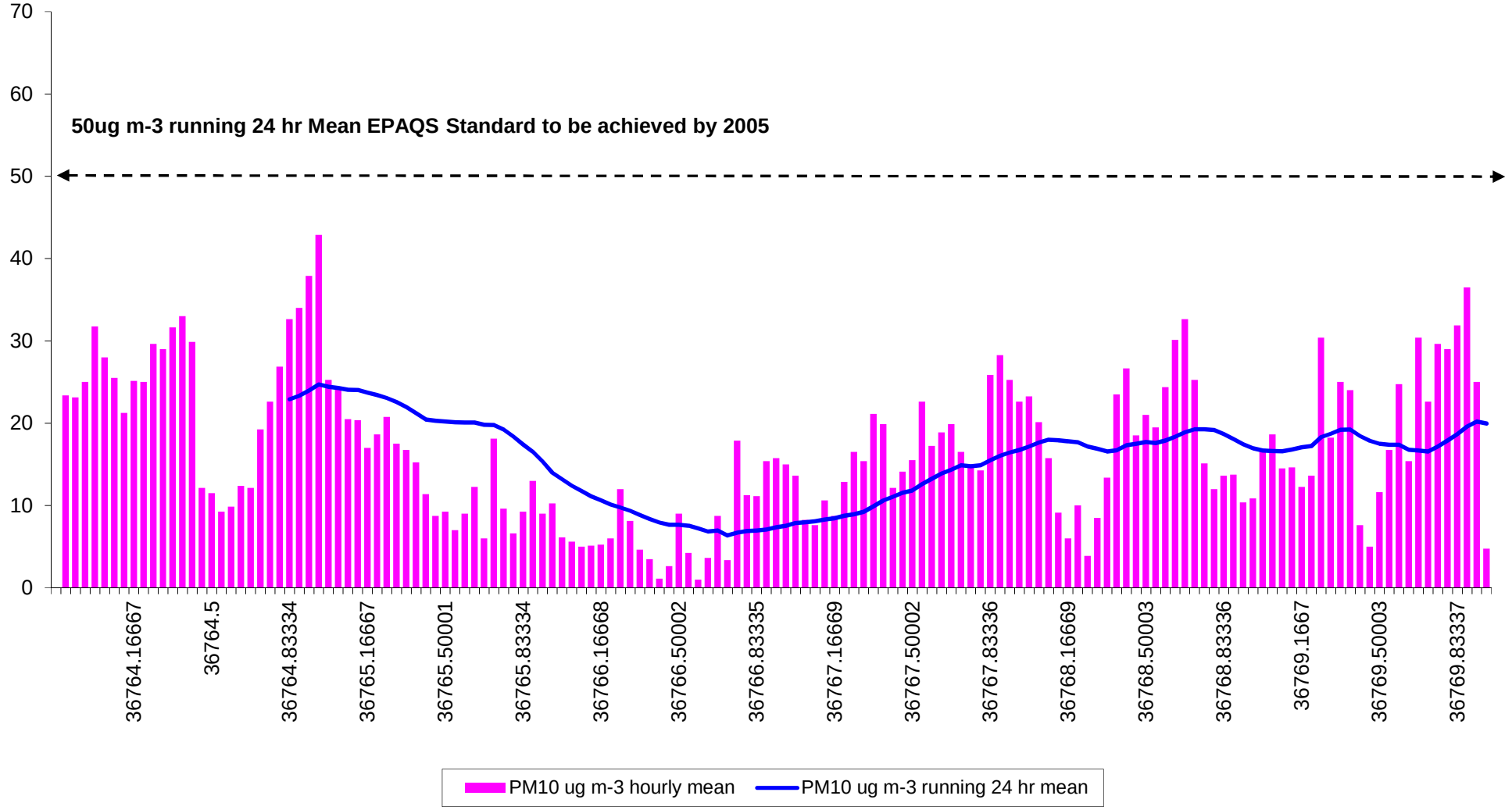


Figure 2.3 (b)

Measured Concentrations of Fine Particulates PM10s at Baltic Wharf (1st Sept - 11th Sept 2000)

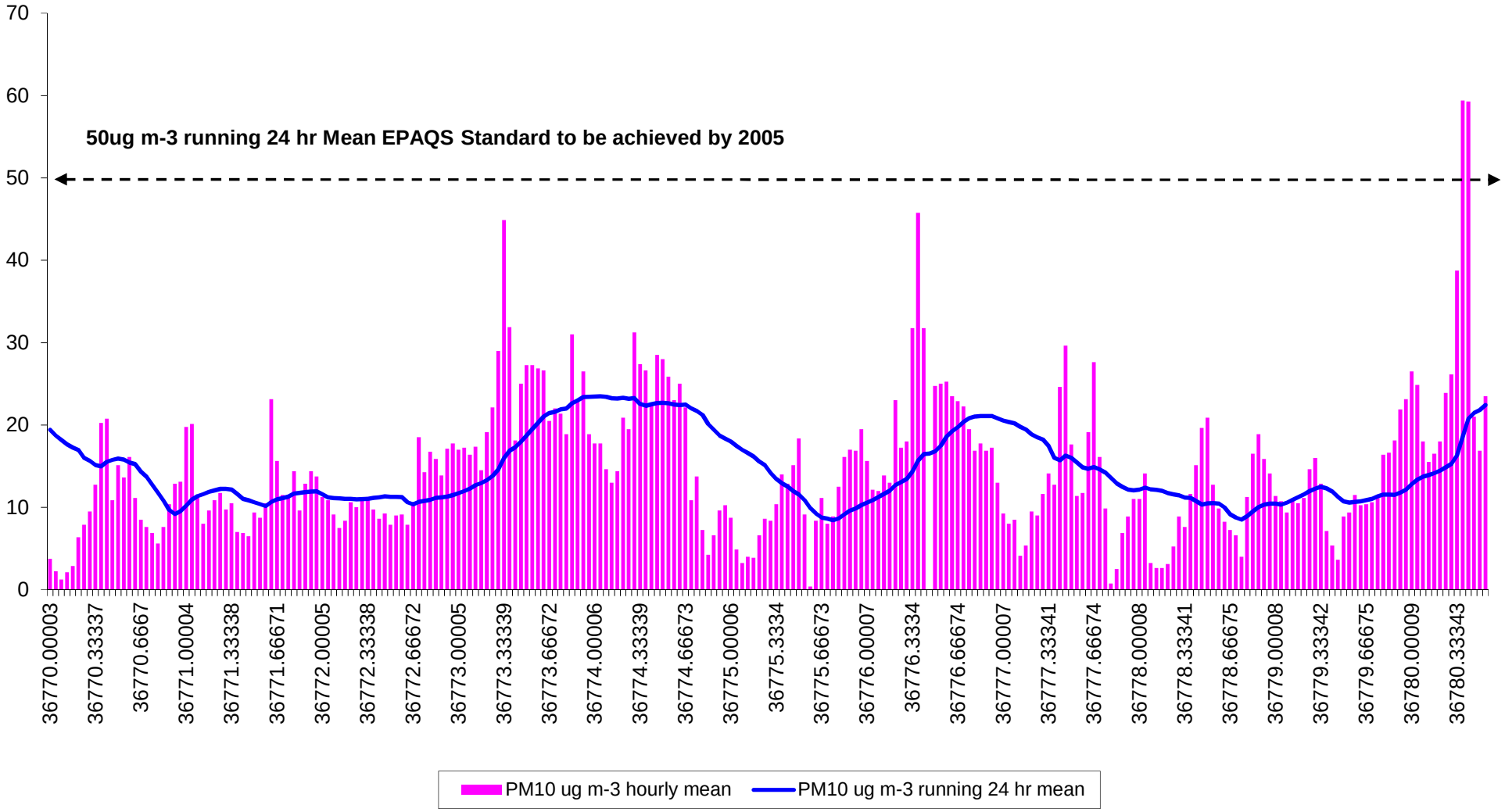


Figure 2.3 (c)

Measured Concentrations of Fine Particulates PM10s at Baltic Wharf (11th Sept - 21st Sept 2000)

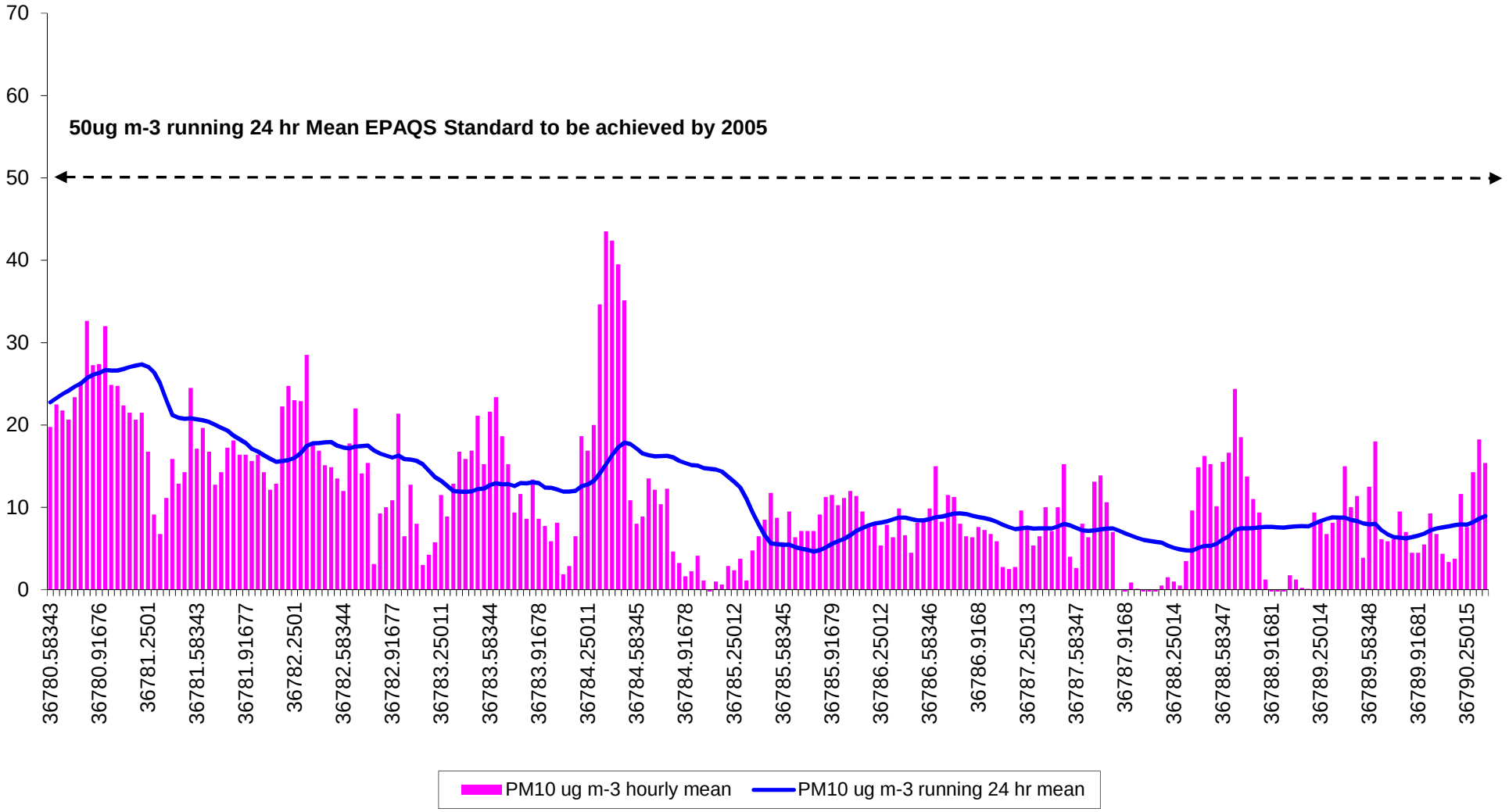
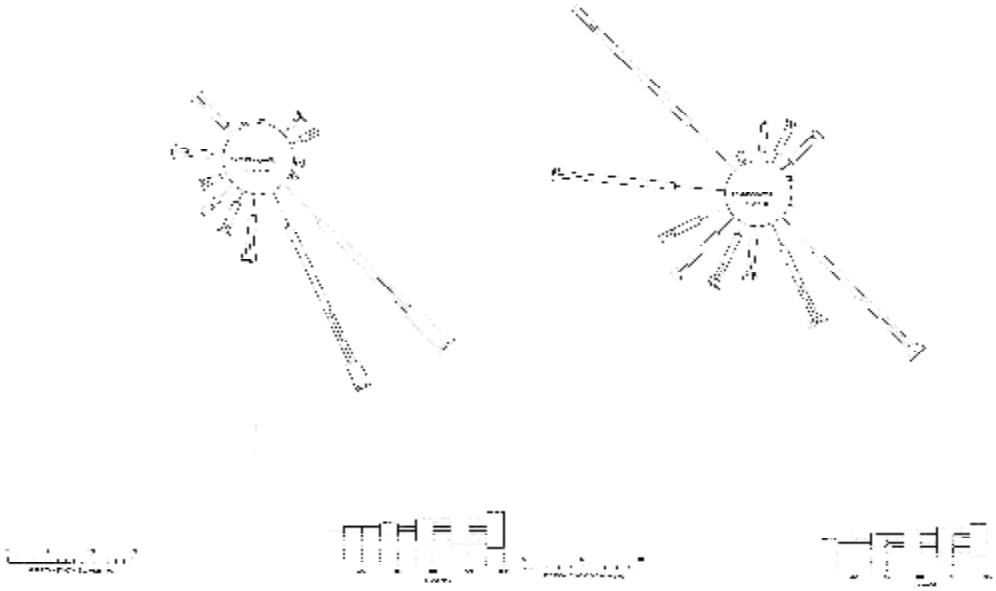


Figure 2.3 (d)

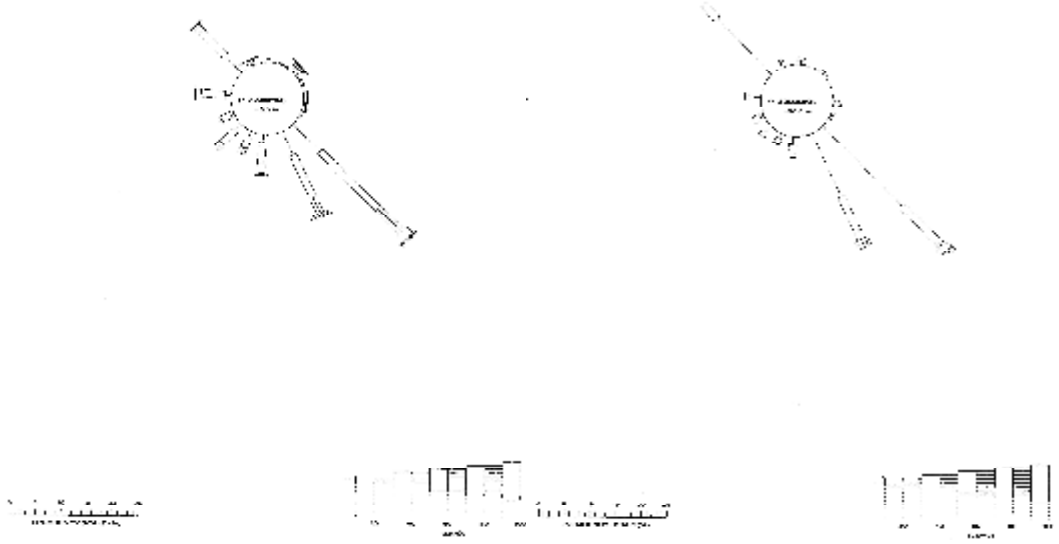
Fine Dust PM_{10} Pollution Rose For Baltic Wharf Depot

N



Week 1: 25 Aug to 31 Aug 2000 **Week 2: 1 Sep to 7 Sep 2000**

W- **-E**



Week 3: 8 Sep to 14 Sep 2000 **Week 4: 15 Sep to 21 Sep 2000**

S

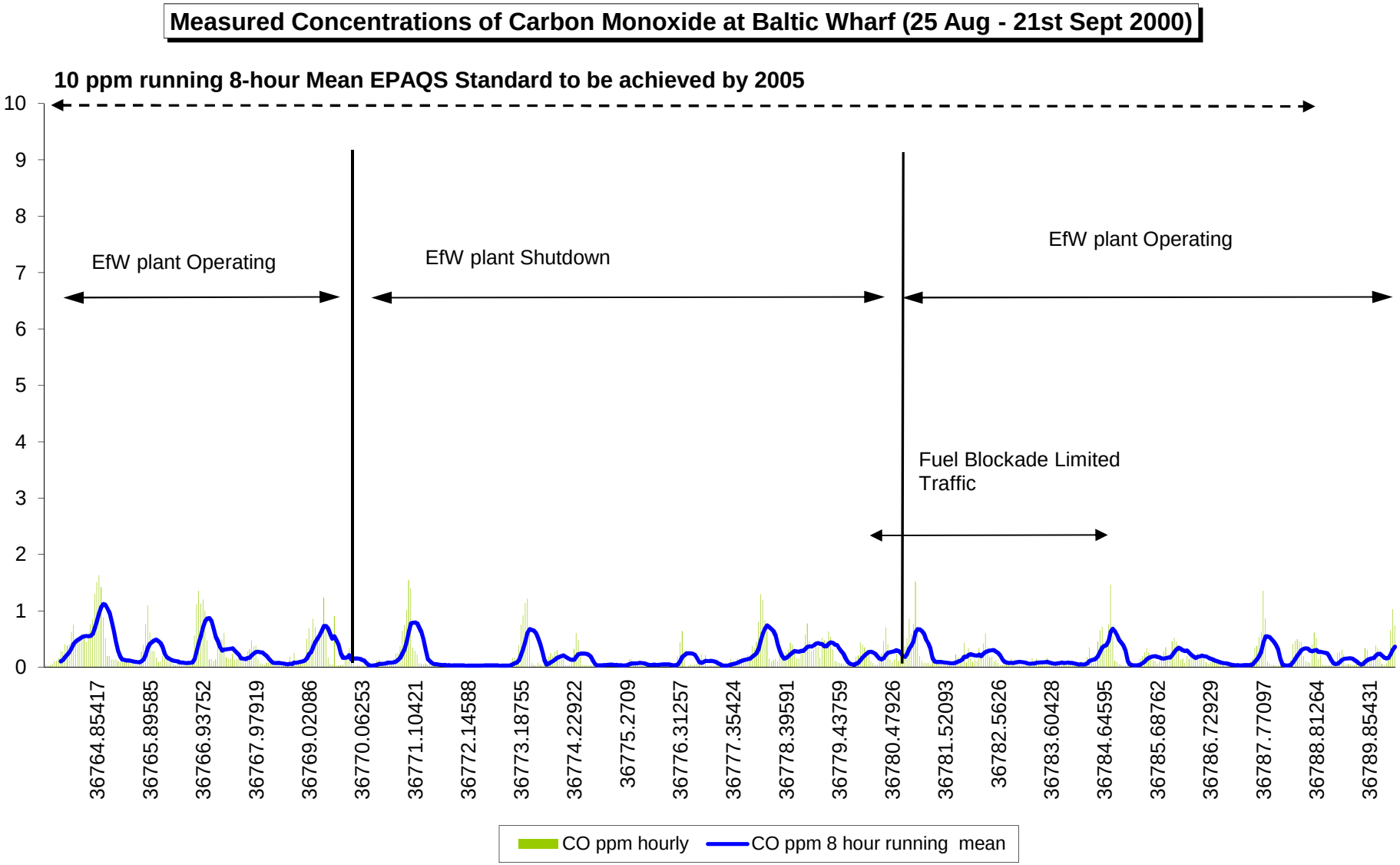

Measured Concentrations of Carbon Monoxide at Baltic Wharf (25 Aug - 21st Sept 2000)
10 ppm running 8-hour Mean EPAQS Standard to be achieved by 2005
EfW plant Operating
EfW plant Shutdown
EfW plant Operating
Fuel Blockade Limited Traffic
10
9
8
7
6
5
4
3
2
1
0
36764.85417
36765.89585
36766.93752
36767.97919
36769.02086
36770.06253
36771.10421
36772.14588
36773.18755
36774.22922
36775.2709
36776.31257
36777.35424
36778.39591
36779.43759
36780.47926
36781.52093
36782.5626
36783.60428
36784.64595
36785.68762
36786.72929
36787.77097
36788.81264
36789.85431
CO ppm hourly
CO ppm 8 hour running mean

Figure 2.4 (a)

Measured Concentrations of Carbon Monoxide at Baltic Wharf (25th Aug - 31st Aug 2000)

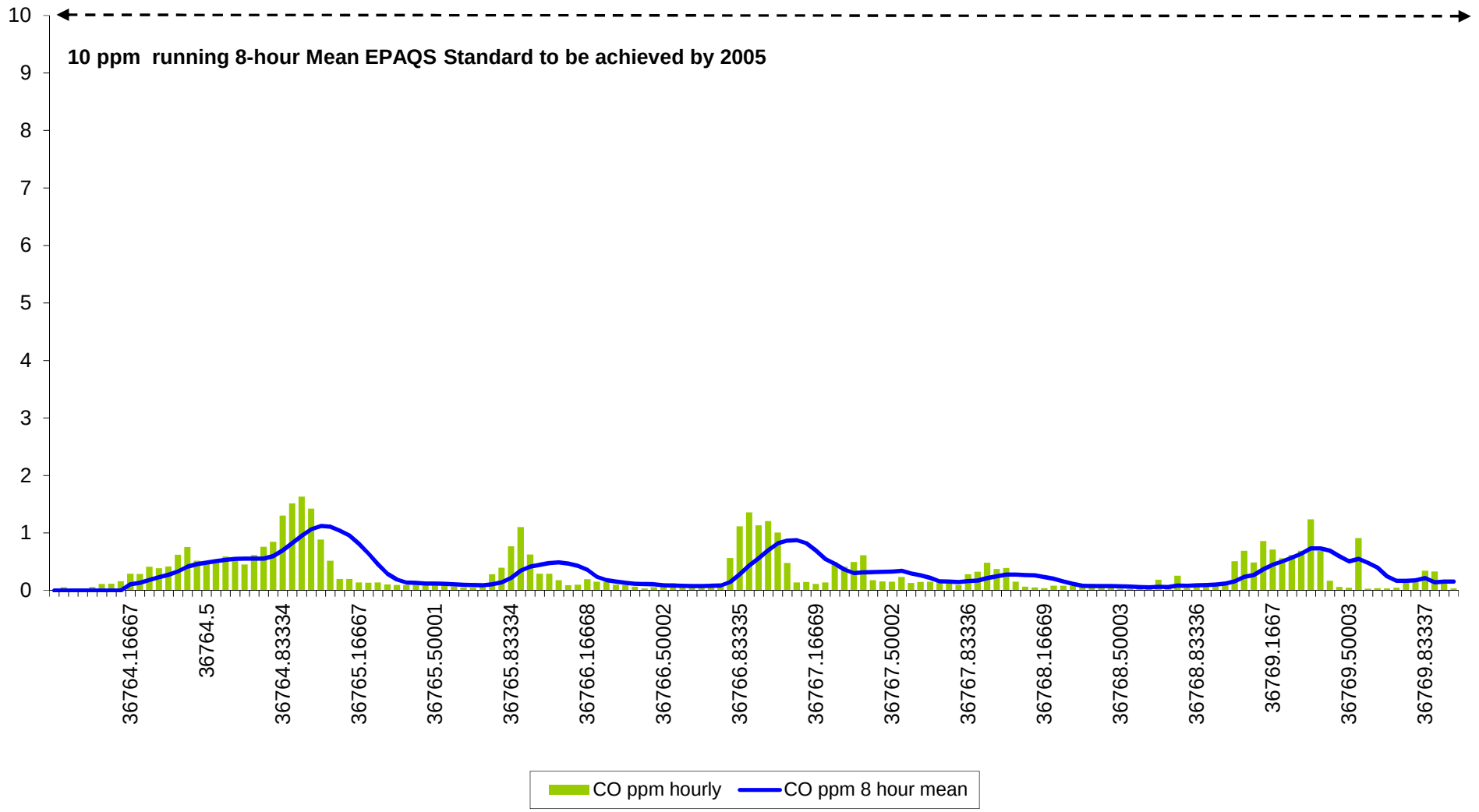


Figure 2.4 (b)

Measured Concentrations of Carbon Monoxide at Baltic Wharf (1st Sept - 11th Sept 2000)

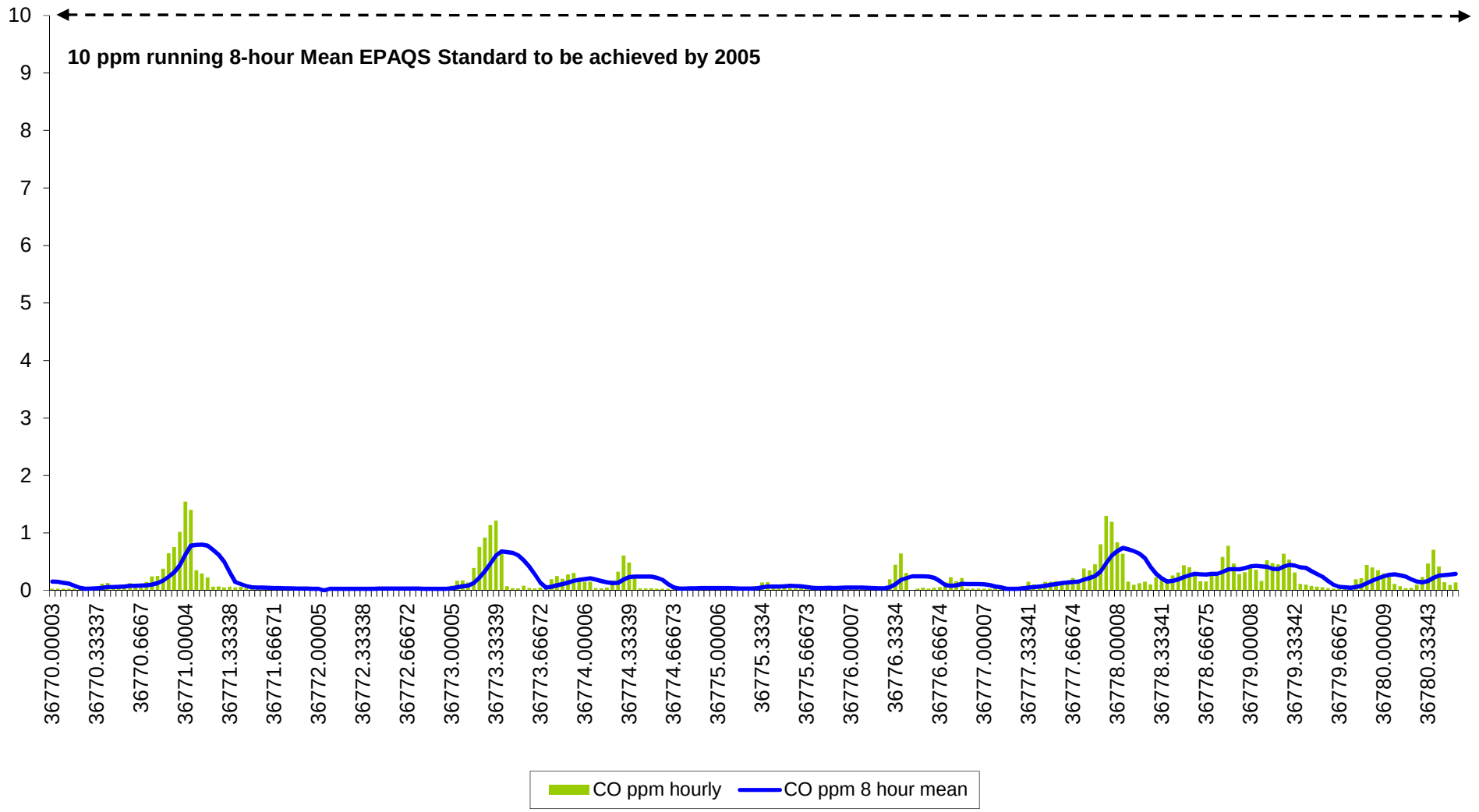


Figure 2.4 (c)

Measured Concentrations of Carbon Monoxide at Baltic Wharf (11th Sept - 21st Sept 2000)

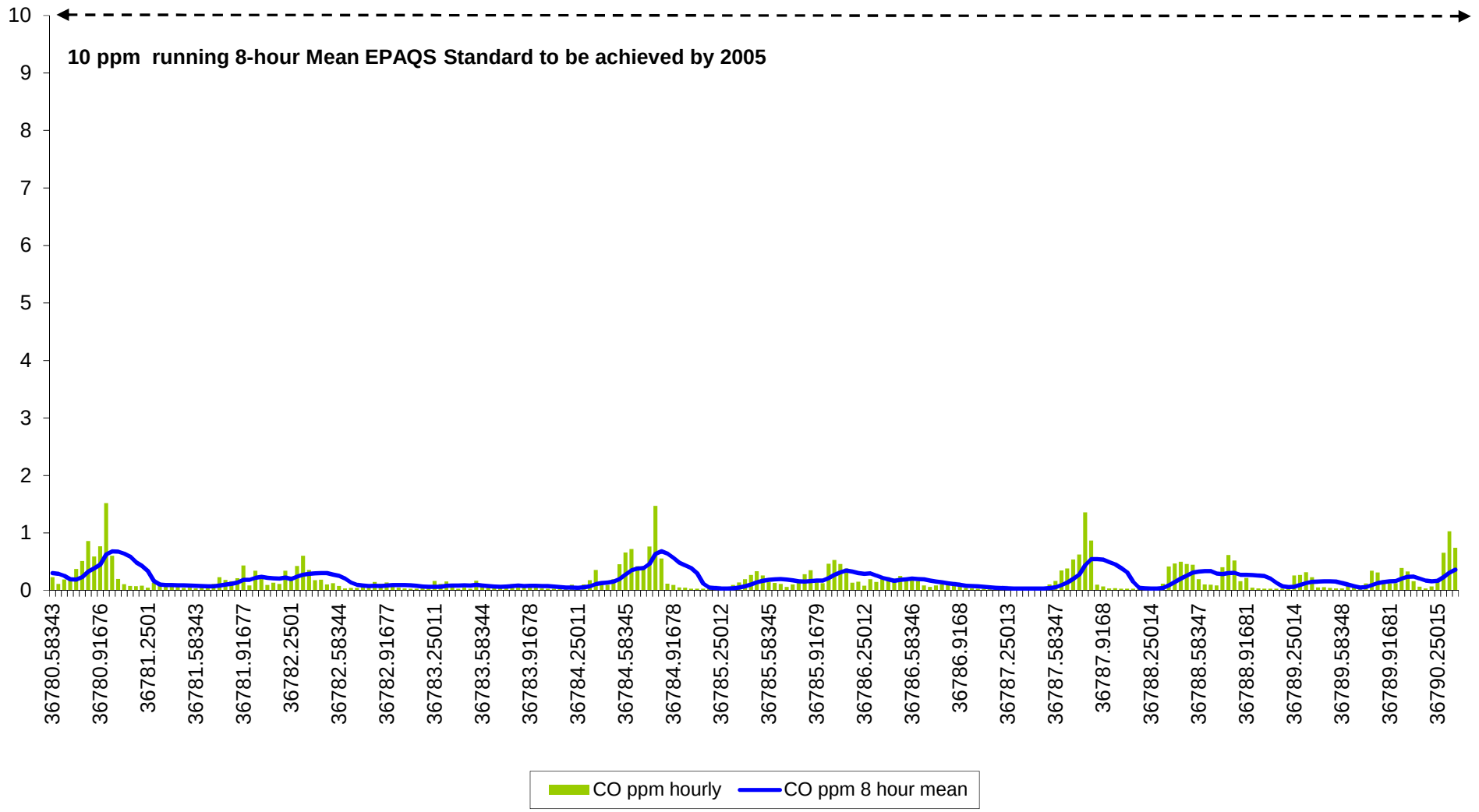
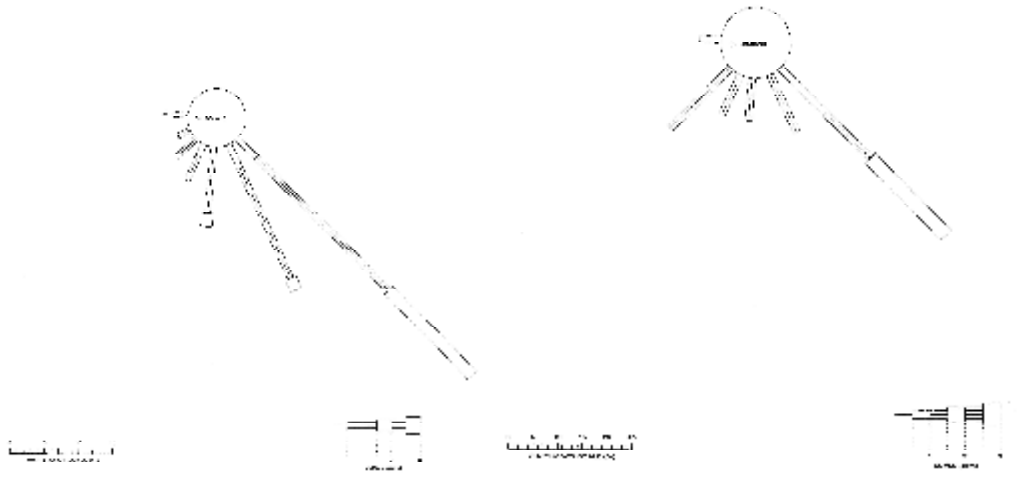


Figure 2.4 (d)

Carbon Monoxide Pollution Rose For Baltic Wharf Depot

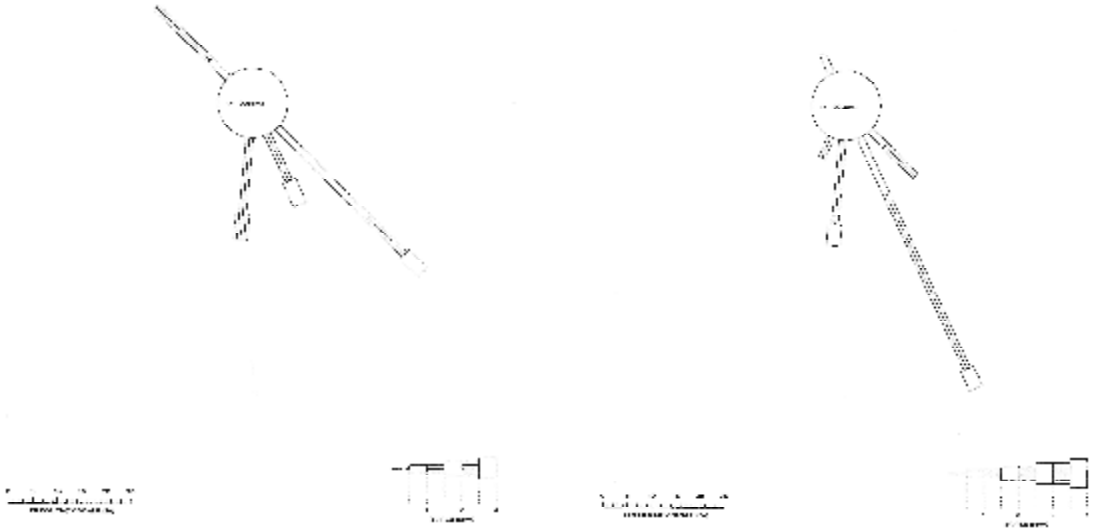
N
|



Week 1: 25 Aug to 31 Aug 2000

Week 2: 1 Sep to 7 Sep 2000

W- **-E**



Week 3: 8 Sep to 14 Sep 2000

Week 4: 15 Sep to 21 Sep 2000

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S

2.2.6 Methane and Non Methane Hydrocarbons (NMHCs)

2.2.6.1 The period mean concentrations for methane and NMHC were 1.50 ppm and 0.18 ppm respectively. The peak levels occurred during a period of from 21:15 on the 10th September 2000 to 08:15 on the 11th September. This corresponded to a period of low wind speed typically <0.3 m/s, with occasional winds from the SSE. The background methane levels were typical of those found worldwide and the increases in NMHC coincided with the increase of traffic related pollution. The pollution source is probably very local to the monitoring location. It is also possible that they arose from the adhesives and paints used in the adjacent building, where a theatrical scenery-manufacturing workshop was situated.

2.2.7 Hydrogen Chloride (HCl)

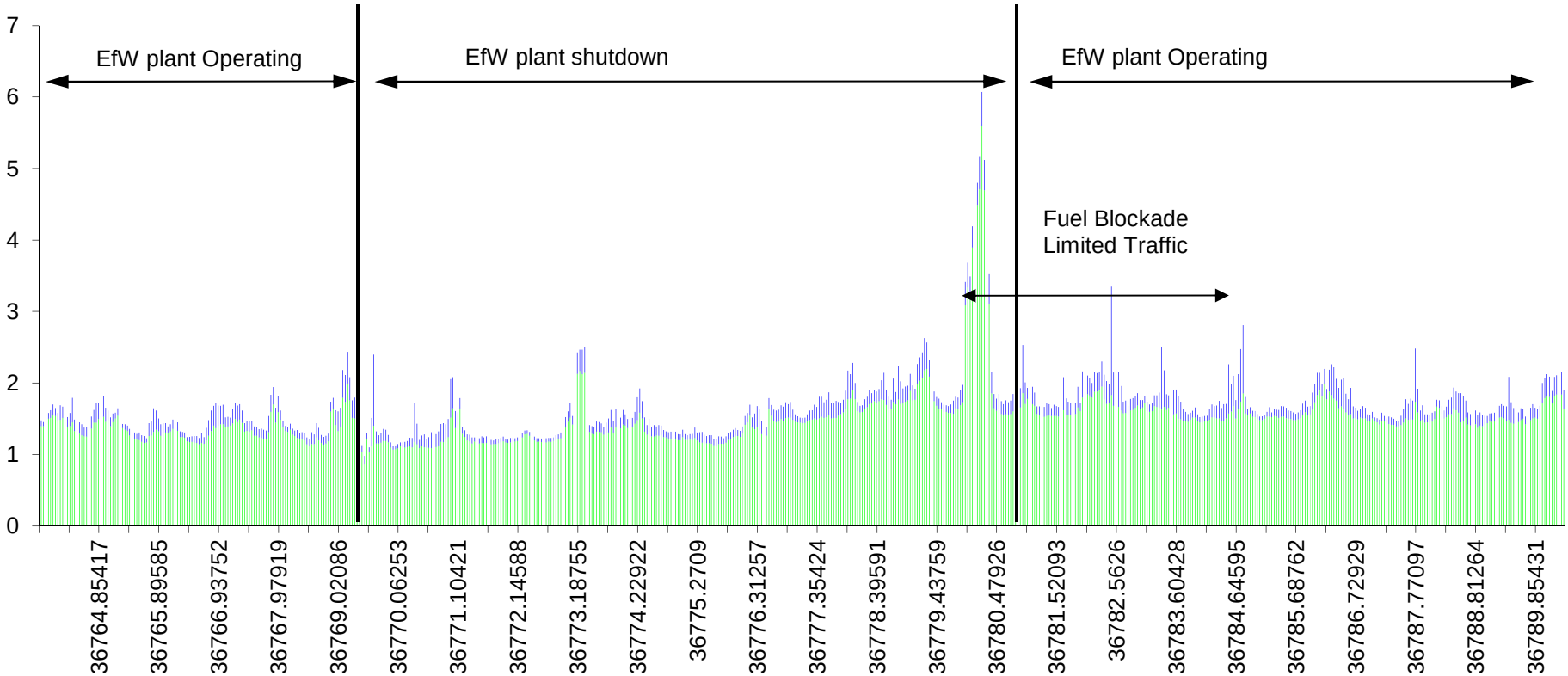
2.2.7.1 Concentrations of HCl measured at the site varied from 0.20 to 0.33 mg m^{-3} and the four-week mean was 0.27 mg m^{-3}. The concentrations were well within the EAL of 7 mg m^{-3} and comparable to background [(1)] levels recorded in Essex (0.3 to 1.1 mg m^{-3}).

2.2.8 Total Suspended Particulates (TSPs)

2.2.8.1 The mean total suspended particulate concentration over the four weeks (46 mg m^{-3}) was well within the EU directive of 150 mg m^{-3}. The mean PM_{10} concentration was 14.0 mg m^{-3}, measured using an automated TEOM instrument and represents approximately 30% of the TSP concentration.

(1) Harrison R M and Allen A G (1990) measurements of atmospheric HNO_3, HCl and associated species on a small network in Eastern England; Atmospheric Environment vol 24 p 369-376.

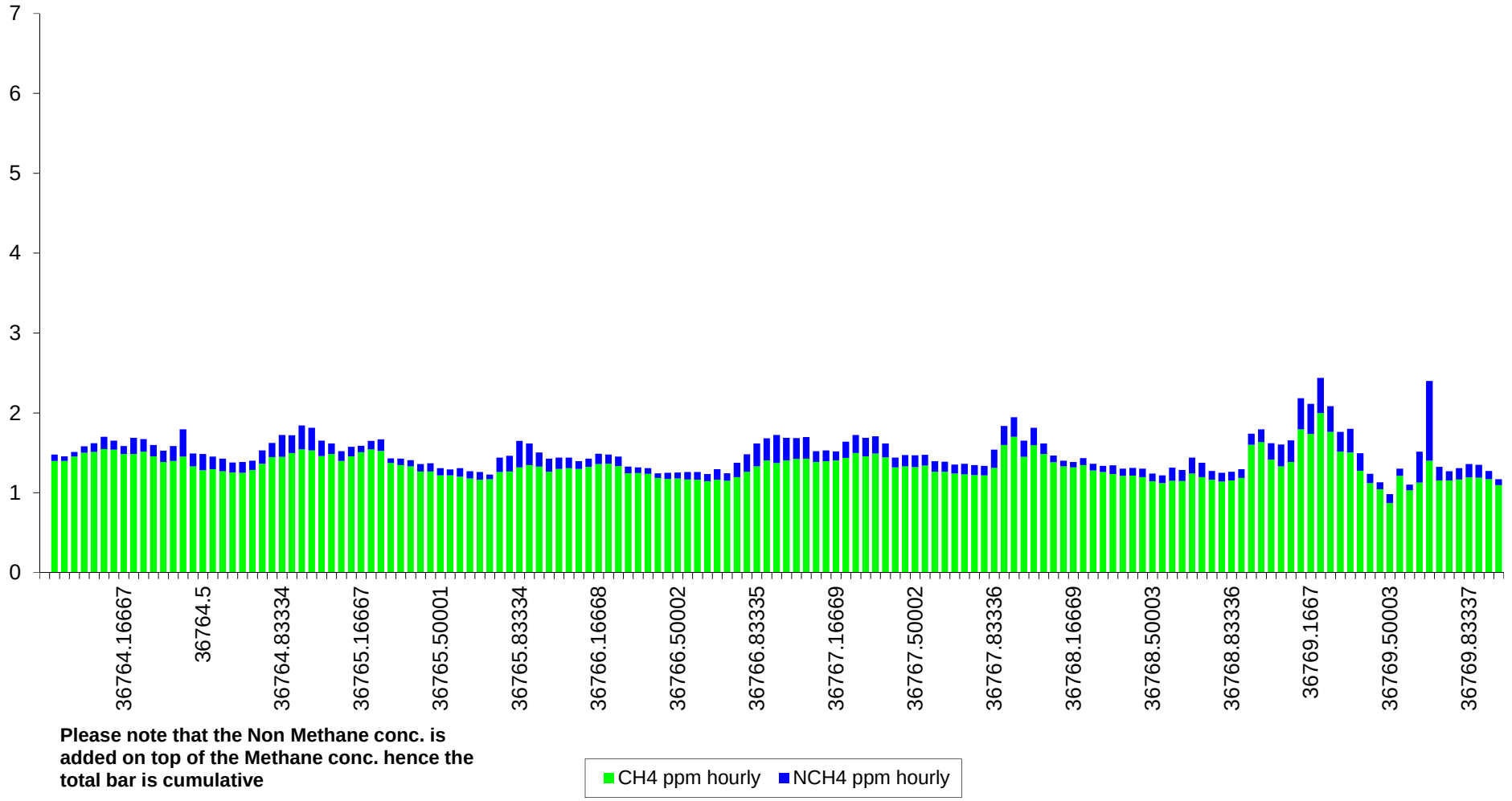
Measured Concentrations of Methane & Non Methane Hydrocarbons at Baltic Wharf (25 Aug - 21st Sept 2000)



Please note that the Non Methane conc. is added on top of the Methane conc. hence the total bar is cumulative

Figure 2.5 (a)

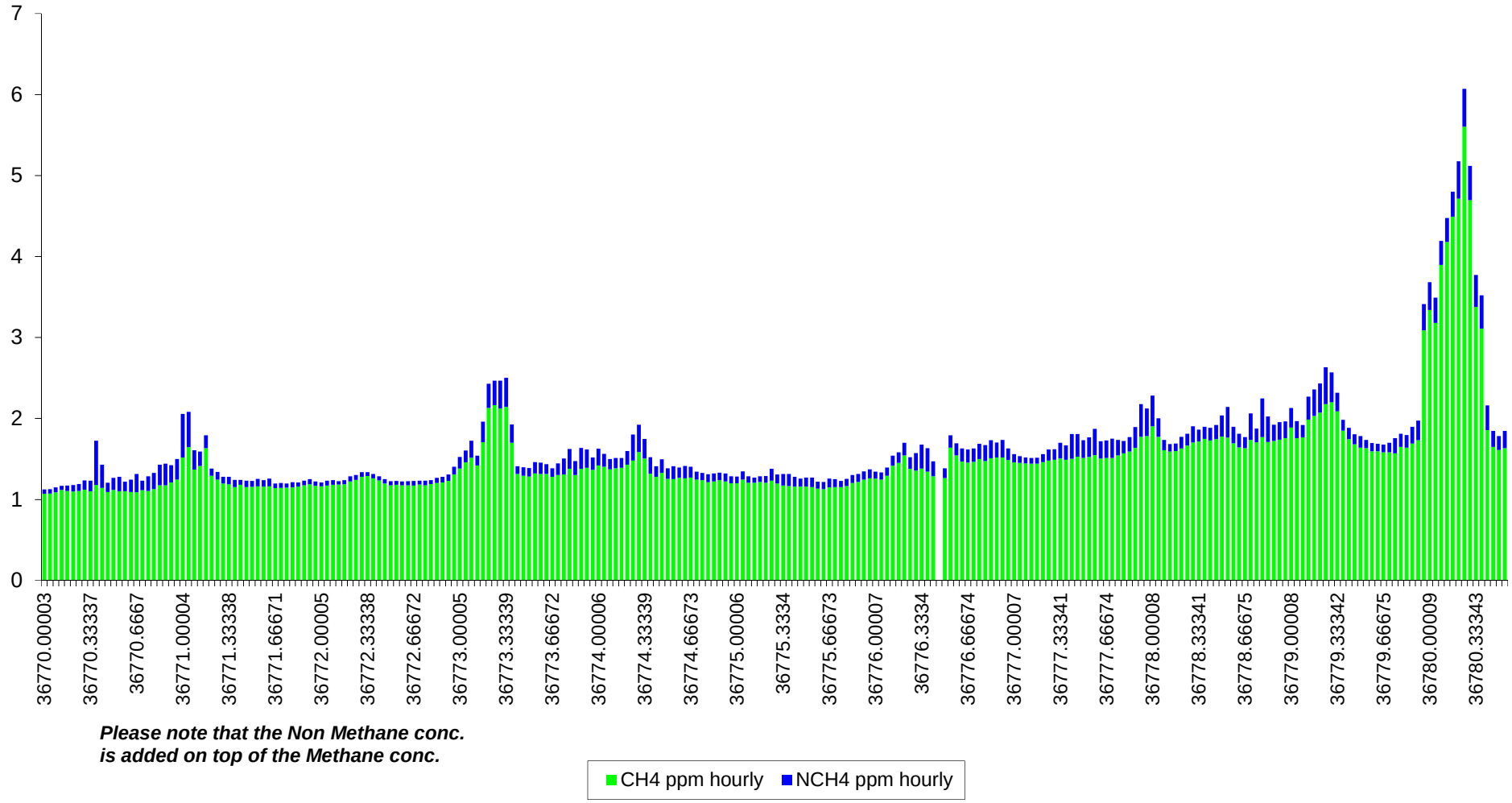
Measured Concentrations of Methane & Non Methane Hydrocarbons at Baltic Wharf (25th Aug - 31st Aug 2000)



Please note that the Non Methane conc. is added on top of the Methane conc. hence the total bar is cumulative

Figure 2.5 (b)

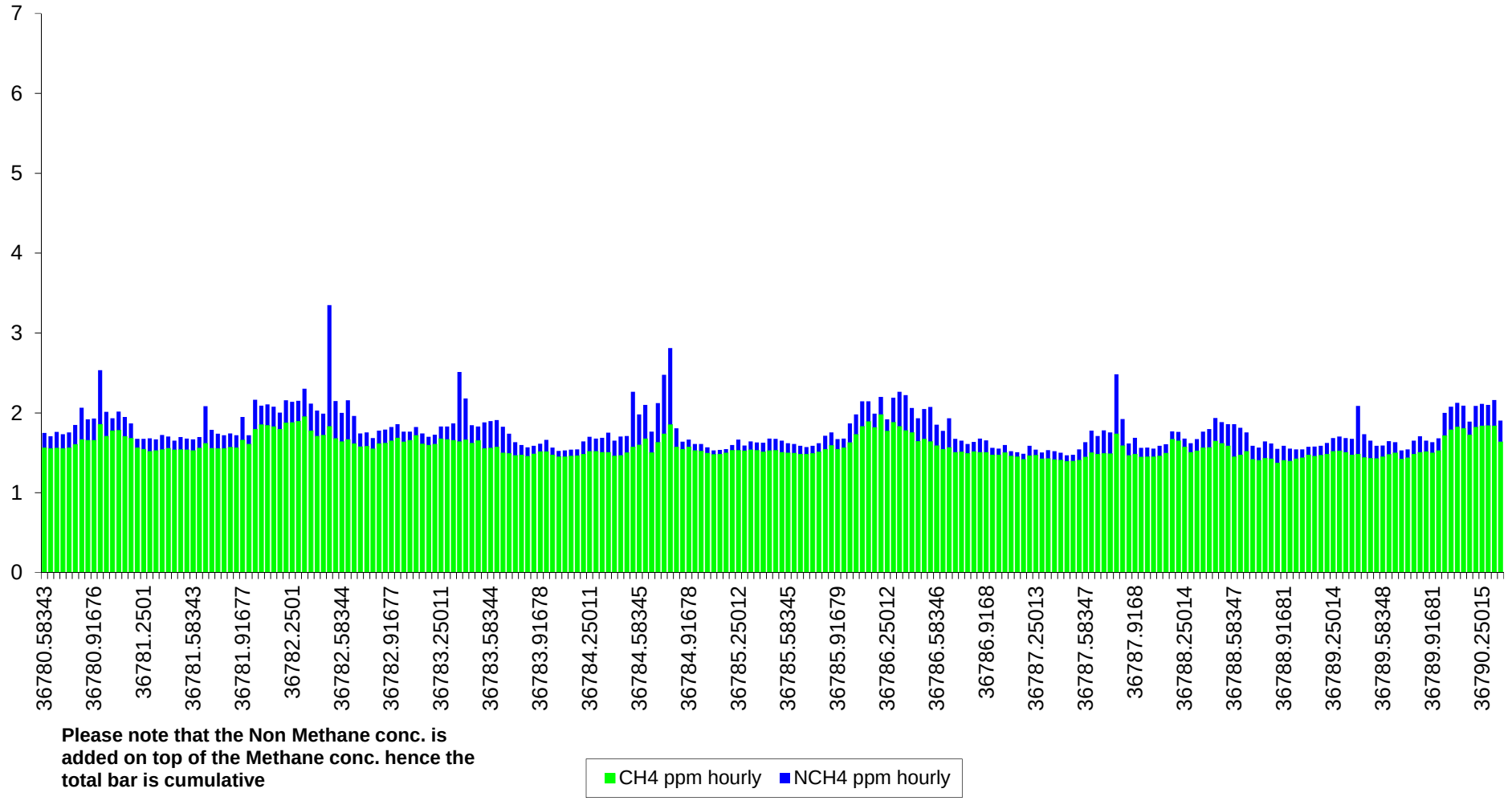
Measured Concentrations of Methane & Non Methane Hydrocarbons at Baltic Wharf (1st Sept - 11th Sept 2000)



Please note that the Non Methane conc. is added on top of the Methane conc.

Figure 2.5 (c)

Measured Concentrations of Methane & Non Methane Hydrocarbons at Baltic Wharf (11th Sept - 21st Sept 2000)

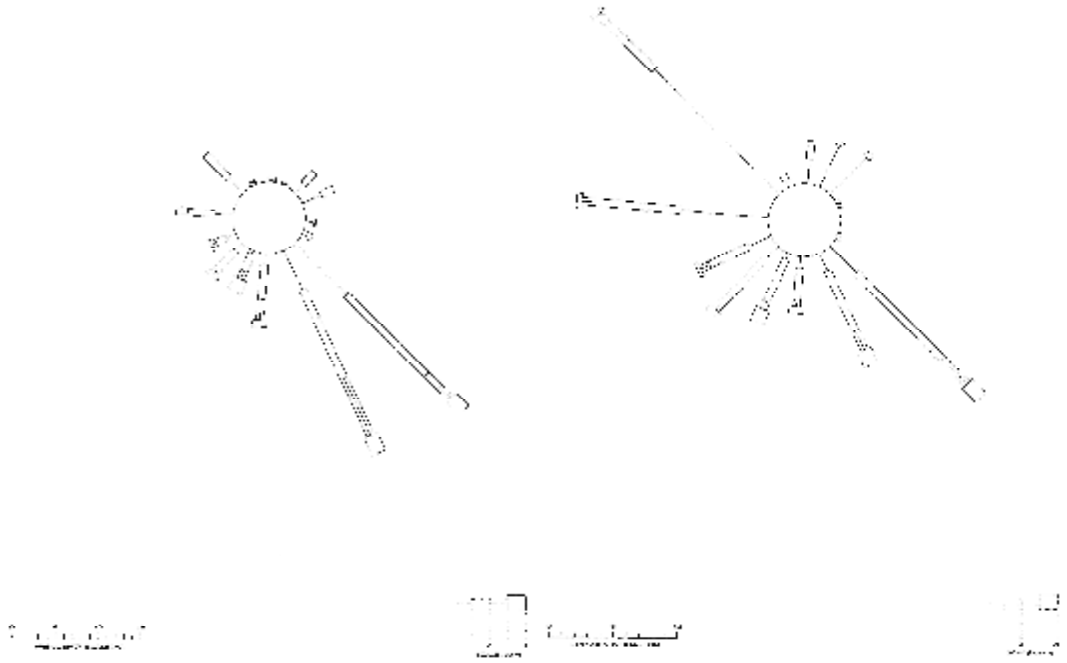


Please note that the Non Methane conc. is added on top of the Methane conc. hence the total bar is cumulative

Figure 2.5 (d)

Non Methane Hydrocarbon Pollution Rose For Baltic Wharf Depot

N



Week 1: 25 Aug to 31 Aug 2000 **Week 2: 1 Sep to 7 Sep 2000**

W- -E

Week 3: 8 Sep to 14 Sep 2000 **Week 4: 15 Sep to 21 Sep 2000**

S

2.2.9 Trace Metals

2.2.9.1 Concentrations of trace metals-in-air measured over the four week period are all within relevant air quality guidelines presented in Table C1.5 in Annex C. Except for copper, all trace metal concentrations were less than or in the range of those measured at other sites in the UK (see table C2.5 in Annex C). Concentrations of copper were approximately 5 times those measured at other UK locations.

2.2.10 Polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans PCDD/Fs

2.2.10.1 The mean concentration of total PCDDs/Fs at the Baltic Wharf Depot was 18 fg I-TEQm^{-3} over the four-week period. This is approximately 25% lower than those concentrations measured in London since 1996 (3½ year mean of 26.4 fg I-TEQ m^{-3} see Table C2.6 in Annex C)[(2)].

(2) AEA Technology - NETCEN Website

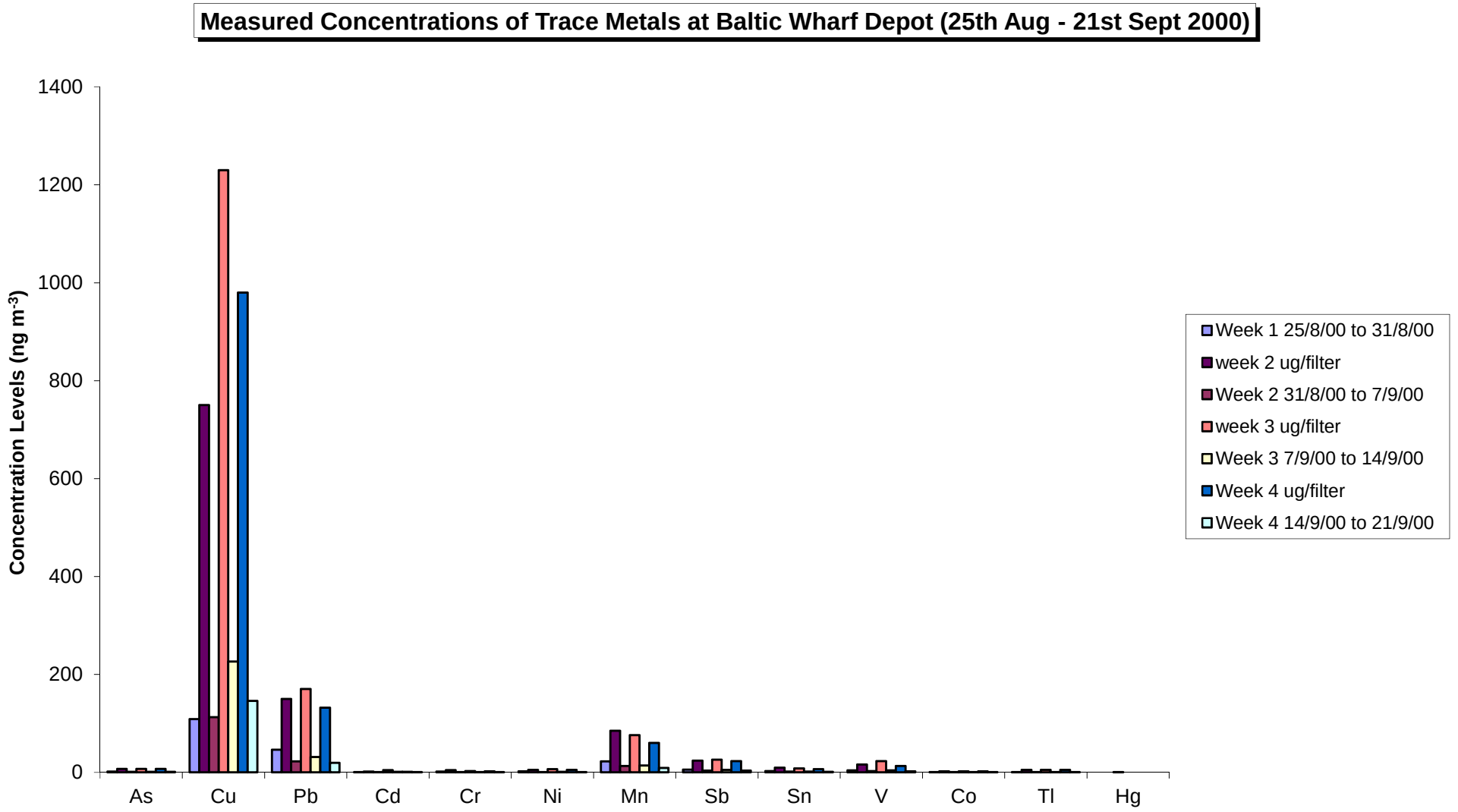

Measured Concentrations of Trace Metals at Baltic Wharf Depot (25th Aug - 21st Sept 2000)
Concentration Levels (ng m-3)
1400
1200
1000
800
600
400
200
0
As
Cu
Pb
Cd
Cr
Ni
Mn
Sb
Sn
V
Co
Tl
Hg
Week 1 25/8/00 to 31/8/00
week 2 ug/filter
Week 2 31/8/00 to 7/9/00
week 3 ug/filter
Week 3 7/9/00 to 14/9/00
Week 4 ug/filter
Week 4 14/9/00 to 21/9/00

Figure 2.6

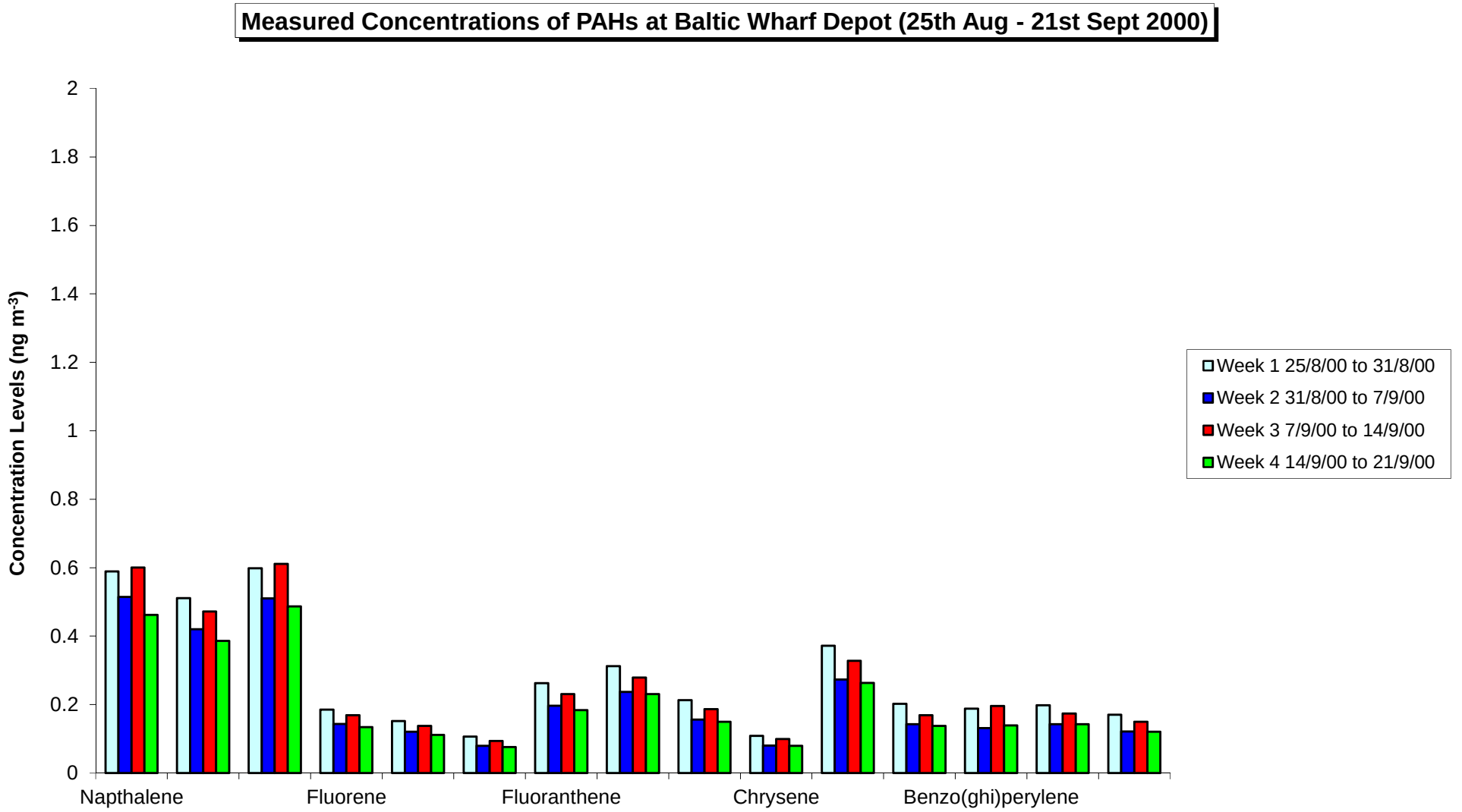

Measured Concentrations of PAHs at Baltic Wharf Depot (25th Aug - 21st Sept 2000)
Concentration Levels (ng m-3)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Napthalene
Fluorene
Fluoranthene
Chrysene
Benzo(ghi)perylene
Week 1 25/8/00 to 31/8/00
Week 2 31/8/00 to 7/9/00
Week 3 7/9/00 to 14/9/00
Week 4 14/9/00 to 21/9/00

Figure 2.7

2.2.11 PAHs

2.2.11.1 Concentrations of individual PAHs measured over the four week period were well within the range of annual mean concentrations measured at a background urban site in London(1) in 1998 (see Table C2.7 in annex C). The levels were at the low end of the ranges observed in the UK, whilst benzo[*a*]pyrene was typical of other UK cities. The level of benzo[a]pyrene was always below the EPAQS recommendation of 0.25ng m^{-3}, with levels ranging from 0.14-0.20 ng m^{-3}.

2.2.12 Meteorological Data

2.2.12.1 This report does not attempt to understand the meteorological data rather to utilise it to demonstrate the direction and fluxes of pollution in the study area. Figures 2.8 (c) & 2.9(a) & (b) show that during the project the wind blew from predominately the south east and north west directions at the monitoring point, although a sufficient occurrence of winds from the south and south westerly and westerly directions occurred to investigate pollution fluxes from these directions. Approximately 30% of the wind blew from these areas during the study. The accompanying pollution roses show the collective pollution fluxes plotted against wind direction at the monitoring location. Almost universally the air pollution arose from the NW & SE directions.

(1) AEA Technology - NETCEN Website

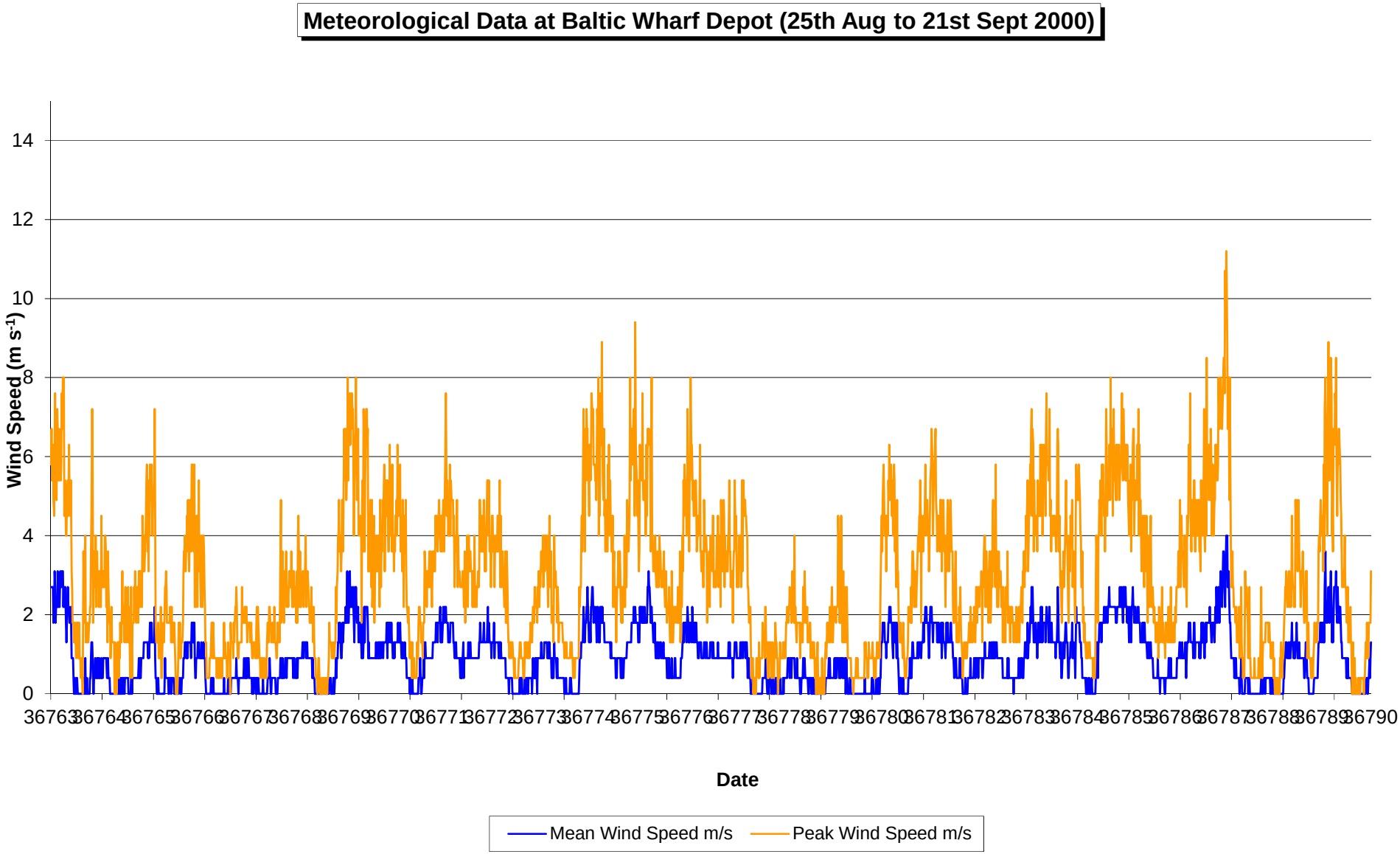

Meteorological Data at Baltic Wharf Depot (25th Aug to 21st Sept 2000)
Wind Speed (m s-1)
0
2
4
6
8
10
12
14
36763
36764
36765
36766
36767
36768
36769
36770
36771
36772
36773
36774
36775
36776
36777
36778
36779
36780
36781
36782
36783
36784
36785
36786
36787
36788
36789
36790
Date
Mean Wind Speed m/s
Peak Wind Speed m/s

Figure 2.8 (a)

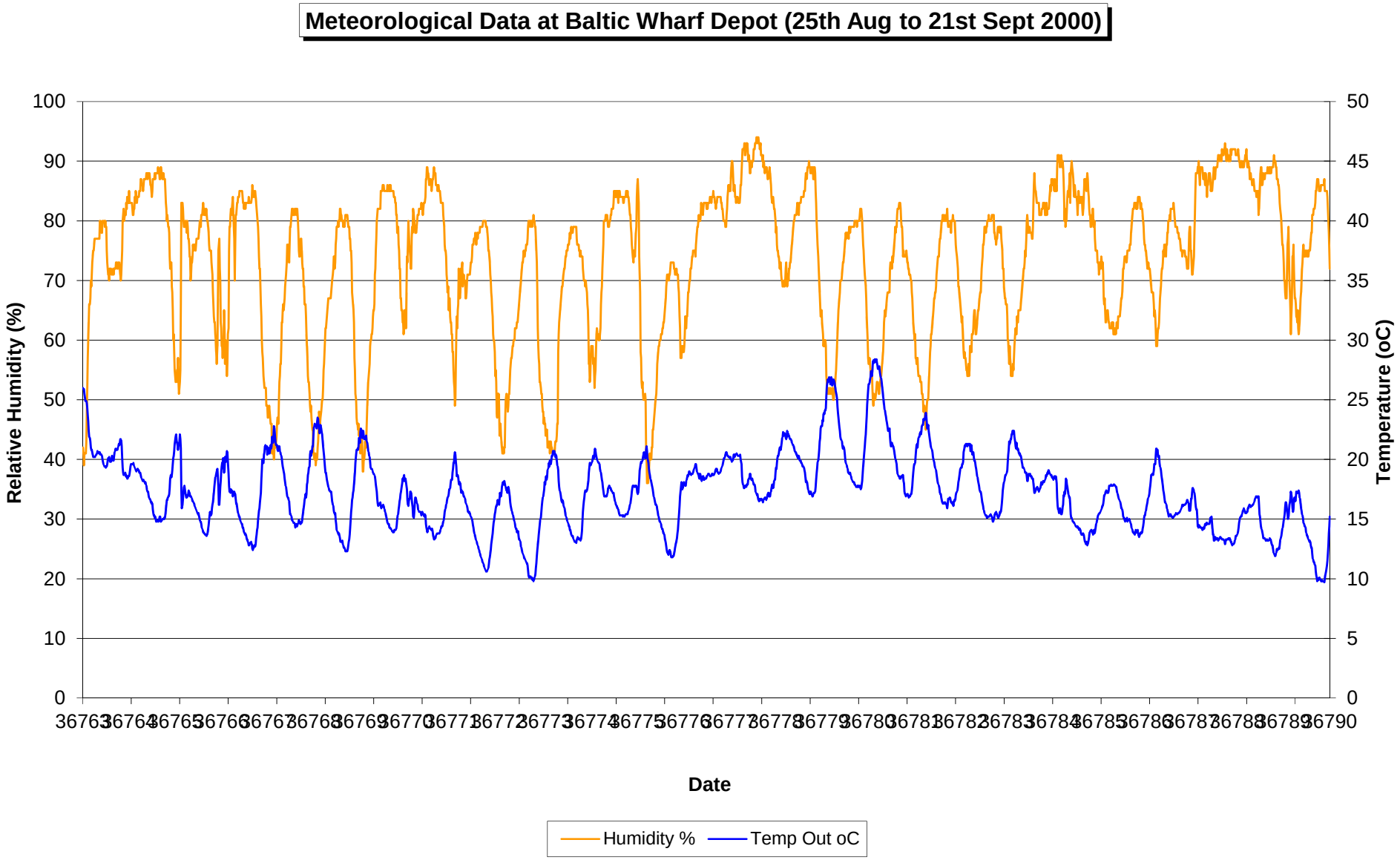
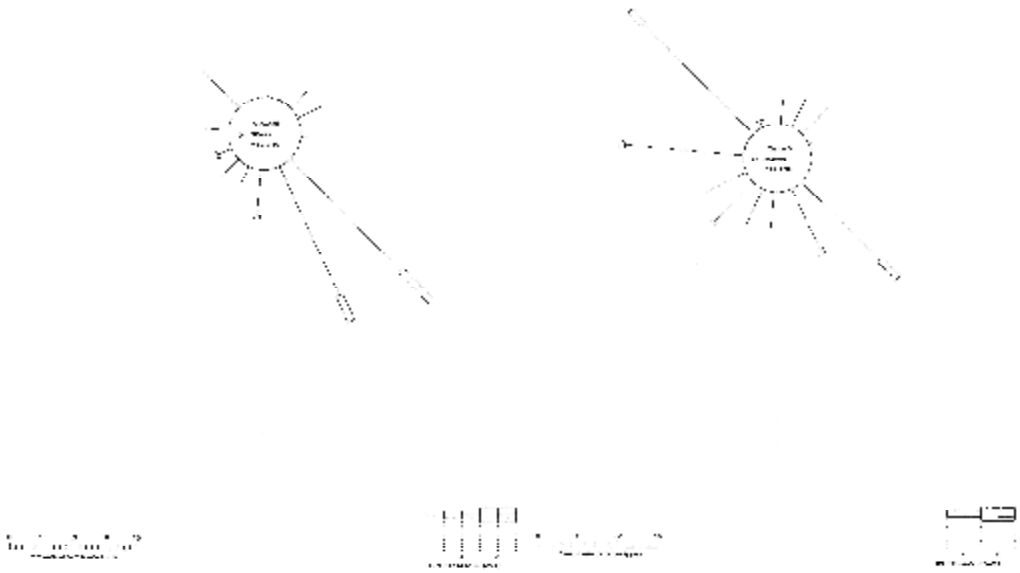

Meteorological Data at Baltic Wharf Depot (25th Aug to 21st Sept 2000)
Relative Humidity (%)
Temperature (oC)
Date
Humidity %
Temp Out oC
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0
36763
36764
36765
36766
36767
36768
36769
36770
36771
36772
36773
36774
36775
36776
36777
36778
36779
36780
36781
36782
36783
36784
36785
36786
36787
36788
36789
36790

Figure 2.8 (b)

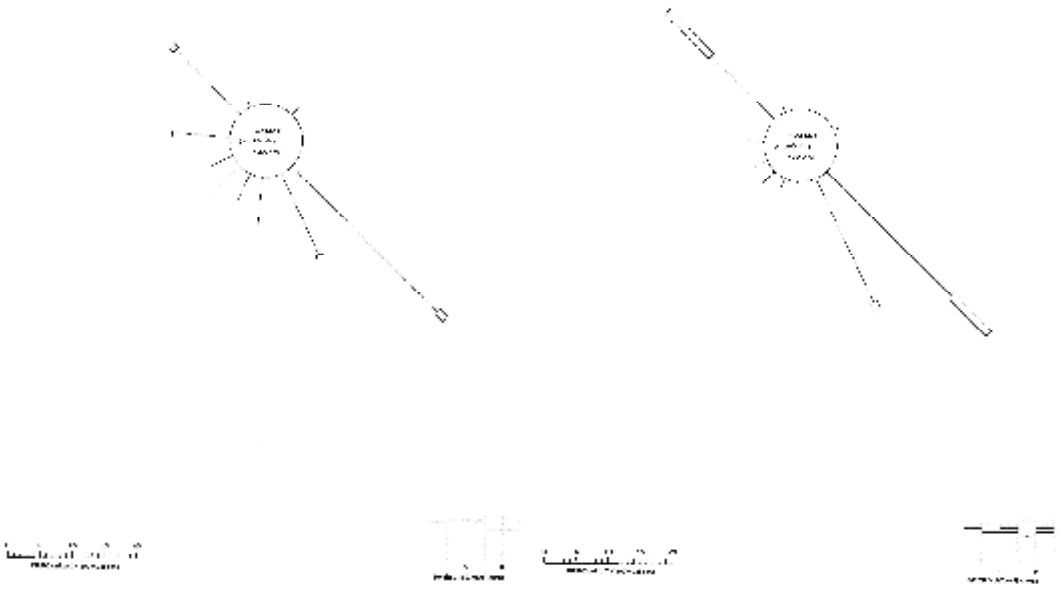
Wind Rose For Baltic Wharf Depot

N



Week 1: 25 Aug to 31 Aug 2000 Week 2: 1 Sep to 7 Sep 2000

W- -E

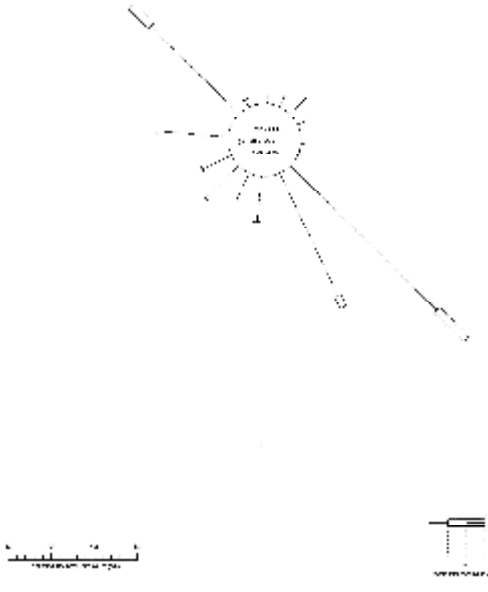


Week 3: 8 Sep to 14 Sep 2000 Week 4: 15 Sep to 21 Sep 2000

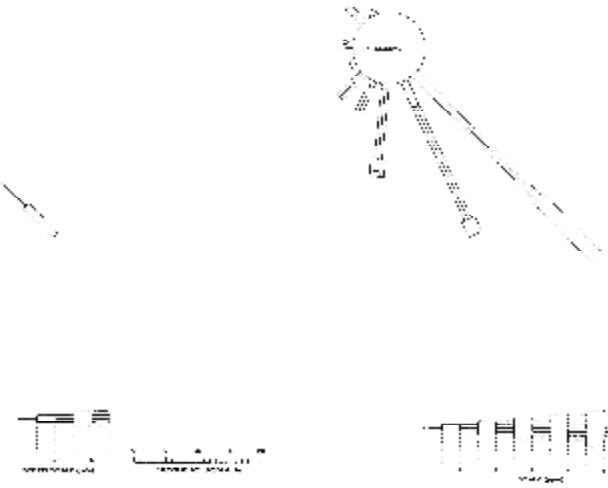
S

Pollution Roses For Baltic Wharf Depot from 25-Aug to 21-Sep 2000

N
|

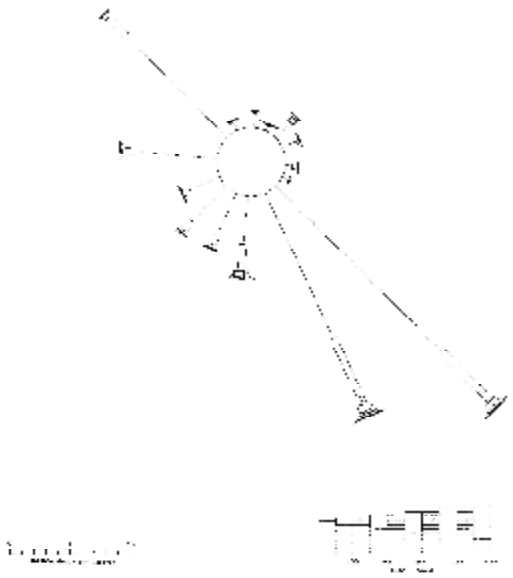


Wind Rose



Carbon Monoxide

W- **-E**



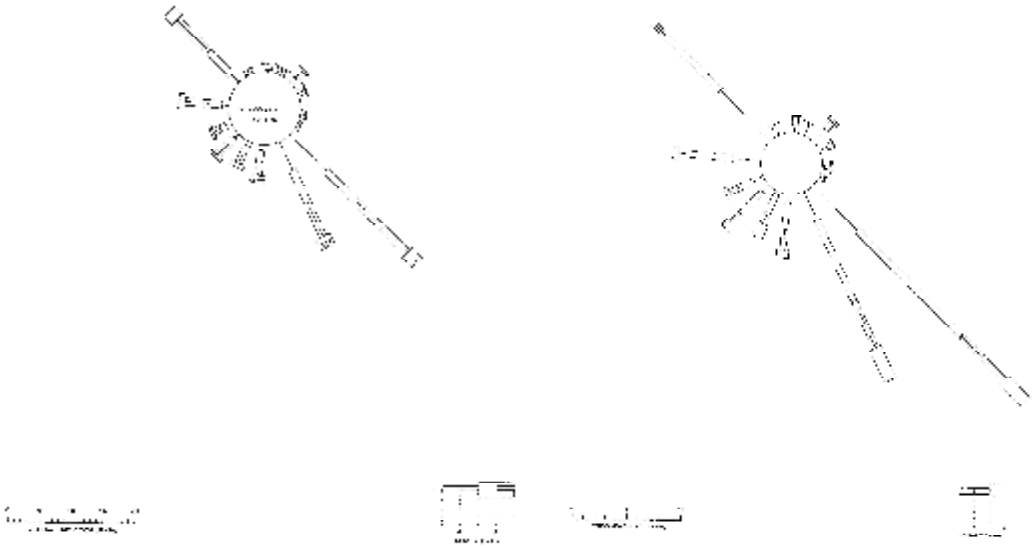
Nitric Oxide

Nitrogen Dioxide

|
S

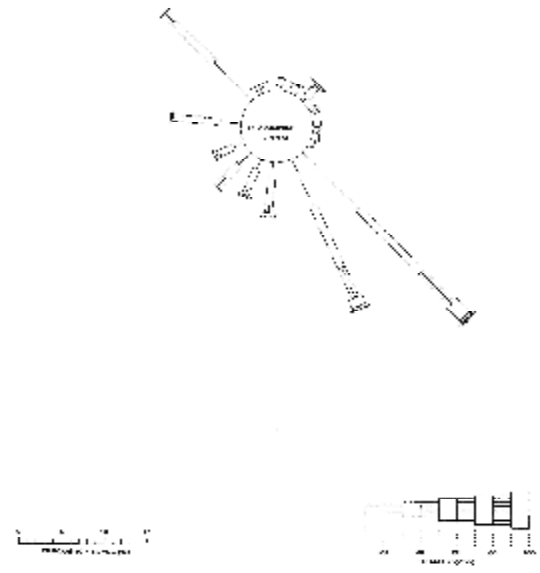
Pollution Roses For Baltic Wharf Depot from 25-Aug to 21-Sep 2000

N



Sulphur Dioxide **Non Methane Hydrocarbons**

W- **-E**



Fine Particulates (PM_{10})

S

3. COMPARISON OF MEASURED DATA AT BALTIC WHARF WITH THAT RECORDED AT THE ELTHAM AUTOMATIC URBAN NETWORK (AUN) SITE

3.1 Concentrations of NOx, SO_2, CO and PM_{10} are automatically measured at a site at Eltham. These data sets have been downloaded from the Internet for comparison with the data recorded at the Baltic Wharf site. The Eltham Site is located about 4 miles (7 Km) south east of Baltic Wharf. Good agreement between the data sets indicates that regional/national/continental sources and/or meteorological conditions were influencing air quality. Conversely, where the two data sets do not show agreement suggests that local sources had a greater influence on air quality at the monitoring sites.

3.2 Concentrations of NO_2, SO_2, and PM_{10} measured at the Eltham site and the Baltic Wharf site are shown as time series plots in Figures E1 to E3 in Annex E. The agreement between the data sets is generally very good, with poorer data capture at the Eltham site. It should be noted that the data at the Eltham site is un-validated and the data was of poorer quality with a number of zero levels suggesting a zero drift problem with the analysers. The Eltham site is an Urban Background site operated as part of the London Air Quality Network.

3.3 As discussed earlier, both sites showed consistent air pollution levels throughout the monitoring period.

3.4 NO_2 showed very good agreement although the Baltic Wharf Depot site showed higher levels of 10-15ppb throughout the campaign reflecting its proximity to a busy road and an industrialised area over the background urban site at Eltham.

3.5 Carbon monoxide is not monitored at the Eltham site, but the levels observed at Baltic Wharf were typical of an urban roadside area, and could be compared to any London site with good agreement.

3.6 The data for PM_{10} was excellent if we consider trends and levels with the PM_{10} levels very slightly higher at the Baltic Wharf Depot site than at Eltham.

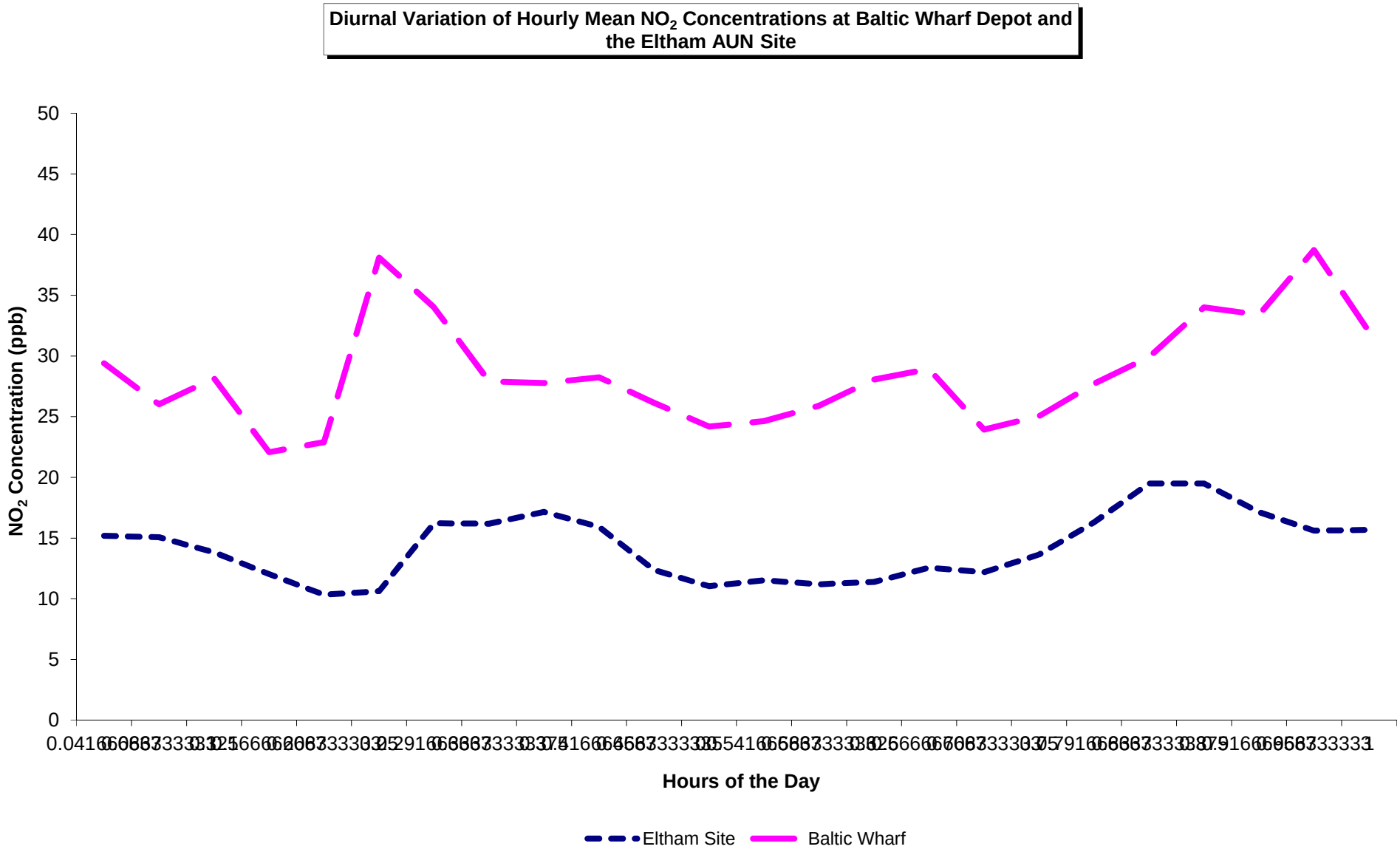
3.7 The sulphur dioxide agreement was less good, with apparently the Baltic Wharf site showing slightly higher levels (by 3 ppb), however closer inspection of the Eltham data shows levels typically below the level of detection suggesting that the datum

zero for the analyser was set too low, and, as this data is un-validated it is reasonable to assume that the analyser may have needed maintenance.

3.8 The daily diurnal cycle for NO_2 was plotted for both sites and is shown in Figure 2.10. This graph is the result of averaging the concentrations of each day at a set time.

3.9 The shape is typical with a double peak increasing across the day, followed by a steady decline over the night time period, the AUN site showing consistently slightly higher levels of NO_2. This suggests that climatic and meteorological conditions are the greatest influence on the effects of traffic pollution throughout the study period.

- The time series of hourly mean concentrations of NO_2 at both sites are similar.
- The hourly mean concentrations of both sites for SO_2 are both characterised by a low datum zero with coincidental peaks.
- PM_{10} levels at both sites are similar although the levels at Eltham were slightly lower. The coincident peaks suggest that the greatest influence is probably pollution in the South East of England rather than specific local influences and meteorological conditions.



RPT FIGURES.xls Figure 2.10 p54

Figure 2.10

ANNEX A

International Toxic Equivalent Factors for PCDD/Fs

Table A1 International Toxic Equivalent Factors (I-TEFs) for PCDDs and PCDFs

Congener	I-TEF
2,3,7,8-TCDD	1.0
1,2,3,7,8-PeCDD	0.5
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.001

ANNEX B

Monitoring Site Information

Table B1 Selected Monitoring Site

Site Code	Site Name	Monitoring Period
Baltic Wharf - BW	Onyx Depot Baltic Wharf	Weekly & Online samples 25 August to 21st September 2000 (4 weeks)

ANNEX C

Air Quality Standards and Existing Air Quality

C1 AIR QUALITY STANDARDS

C1.1 SOURCES OF STANDARDS AND GUIDELINES

There are a number of standards and guidelines relevant to the UK including:

- the European Union (EU);
- the World Health Organisation (WHO)[1][2];
- the Department of the Environment's Expert Panel on Air Quality Standards (EPAQS); and
- the United Kingdom National Air Quality Strategy.

Where no other source of air quality standards or guidelines is available for a pollutant, Environmental Assessment Levels (EALs) provided by HMIP/EA[3] can be used as guidelines. Alternatively, guidelines can be derived from Occupational Exposure Limits (OELs)[4]. OELs are exposure limits prepared by the Health and Safety Executive (HSE) and are designed to protect workers. There are two main types of workplace standards; short term exposure limits (STEL values), which are intended to protect exposed individuals against the acute effects of a brief exposure, and longer term 'shift' occupational exposure limits (LTEL values). In the absence of suitable alternative approaches, occupational exposure limits provide a reasonable basis for calculating safe ground level air concentration standards, called Short-term Air Quality Standards (SAQS) and Long-term Air Quality Standards (LAQS).

(1) WHO (1987) Air Quality Guidelines for Europe, WHO Regional Publications European Series Number 23.

(2) WHO (1995) Update and Revisions of the Air Quality Guidelines for Europe Meeting of the Working Group, 'Classical Air Pollutants' Bilthoven, The Netherlands 11-14 October 1994.

(3) HMIP Technical Guidance Note (Environmental) E1-Draft Report, Environmental, Economic and BPEO Assessment Principle for Integrated Pollution Control Volume II: Technical Data.

(4) HSE (1996) EH40/99 Occupation Exposure Limits.

The conversion of OELs to SAQS and LAQS is carried out by dividing the OEL by an arbitrary safety factor, defined as follows:

- the SAQS may be derived by dividing the STEL value by a factor of 10;
- for a compound having a maximum exposure limit (MEL), the SAQS is defined as the MEL divided by 50;
- for long-term exposure to compounds a LAQS is derived which is 1/100th of the OEL for a compound not having a maximum exposure limit; and
- for a compound having a MEL, the LAQS is defined as the MEL divided by 500.

EU Directives adopted into UK legislation are the only legal standards in the UK; others are advisory guidelines, although some are increasingly being used as assessment criteria.

Guidelines and standards for each pollutant are based on their individual effects on humans and are stated in a variety of different ways, based on averaging periods ranging from 15 minutes to one year. A summary of the relevant legal and advisory air quality standards are presented in Sections C1.2 to C1.10. Some of the organisations cited specify a variety of guidelines or standards based on different averaging periods.

C1.2 NITROGEN DIOXIDE, SULPHUR DIOXIDE, CARBON MONOXIDE AND PM_{10}S

The standards and guidelines for the above species are drawn from the EU, WHO, EPAQS and NAQS. They are constantly being revised and the information below reflects both past, current and future standards.

The EPAQS consists of largely medical and air pollution experts. It has made a number of recommendations, which concern the data recorded, and these recommendations are then further reflected in the standards and objectives set down in the NAQS.

The EPAQS recommendations are that the following levels or lower be achieved:

Nitrogen dioxide	*150 ppb (287 mg m^{-3}) measured as an hourly average (1996)*
Sulphur dioxide	*100 ppb (267 mg m^{-3}) measured over a 15 minute averaging period (1995)*
Particles (PM_{10})	*50mg measured as a 24 hour running average (1995)*
Carbon monoxide	*10 ppm (11.7 mg m^{-3}) measured as a running 8 hour average (1994)*

As a result the following National Air Quality Standard and Objectives have been set:

Table C1.1

Pollutant	Concentration	Standard Measured as	Objective to be achieved by 2005
Nitrogen dioxide (NO_2)	150 ppb 21 ppb	1 hour mean annual mean	150 ppb hourly mean 21 ppb annual mean
Sulphur dioxide (SO_2)	100 ppb	15 minute mean	100 ppb as a 99.9th percentile
Fine particulates (PM_{10})	50 mg m^{-3}	running 24 hour mean	50 mg m^{-3} measured as a 99th percentile
Carbon monoxide (CO)	10 ppm	running 8 hour mean	10ppm

The European Union has the following EU Limits Currently In Force, and these were specified in the EU Directive 80/779/EEC and 85/203/EEC.

Table C1.2

Pollutant	Concentration	Standard/ Guideline	Measured as
NO_2	200 mg m^{-3} (104.6 ppb)	S	hourly means 98th percentile of yearly data
NO_2	50 mg m^{-3} (26.2 ppb)	G	hourly means 50th percentile of yearly data
NO_2	135 mg m^{-3} (7.6 ppb)	G	hourly means as a 98th percentile of yearly data
SO_2*	80 mg m^{-3} (30 ppb)	S	median of daily means measured over a year
SO_2*	120 mg m^{-3} (45 ppb)	S	median of daily means measured over a year
SO_2*	350 mg m^{-3} (131 ppb)	S	98th percentile of daily means measured over a year
SO_2*	250 mg m^{-3} (94 ppb)	S	98th percentile of daily means measured over a year
SO_2	100-150 mg m^{-3}	G	24 hour mean
SO_2	40-60 mg m^{-3}	G	one year mean

** dependent on the smoke density with which it is accompanied*

The standards have been revised this year. The new NAQS are harmonised with the EU standards from COM(98) 386 as shown in the following table. The year that objectives must be met are also stated in the table.

Table C1.3 New Standards For NAQS And EU Directive And Daughter Directives

Agency Pollutant	Standard (S)/ Guideline (G)	Concentration	Period of Reporting	Date of Objective
NAQS NO_2	S	200 $\mu g\ m^{-3}$ (104.6 ppb)	hourly mean	2005
NAQS NO_2	G	40 $\mu g\ m^{-3}$ (21 ppb)	annual mean	2005 (provisional)
NAQS NO_2	G	30 $\mu g\ m^{-3}$ (15.7 ppb)	annual mean (rural sites) for vegetation protection	2000
EU NO_2	S	250 $\mu g\ m^{-3}$ (132 ppb)	hourly limit value not to be exceeded more than 18 times per year	1.1.10
EU NO_2	S	40 $\mu g\ m^{-3}$ (21 ppb)	Annual limit	1.1.10
EU NO_2	S	30 $\mu g\ m^{-3}$ (15.7 ppb)	Annual limit for vegetation protection	2 years after directive comes into force
EU PM_{10}	S	50 $\mu g\ m^{-3}$	24 hour mean not to be exceeded more than 35 times	2005
EU PM_{10}	S	40 $\mu g\ m^{-3}$	Annual mean for human protection	2005
EU PM_{10}	G	50 $\mu g\ m^{-3}$	Indicative daily limit not to be exceeded more than 7 times per year	2010
EU PM_{10}	G	20 $\mu g\ m^{-3}$	Annual limit	2010

In keeping with the EU, the DETR has set a number of Air Pollution Information bands.

The table below presents the various thresholds and the basis on which they were decided.

Table C1.4

Description	Low	Standard Threshold Moderate	Information Threshold High	Alert Threshold Very High
Sulphur dioxide (ppb, 15 min average)	<100	100-199	200-399	>400
Carbon Monoxide (ppm 8 hr running average)	<10	10-14	15-19	>20
Nitrogen dioxide (ppb, hourly average)	<150	150-299	300-399	>400
PM_{10} (fine particulates mg m^{-3}, 24hr running average)	<50	50-74	75-99	>100

Low: Effects unlikely to be noticed even by individuals who are sensitive to air pollutants.
Moderate: Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
High: Significant effects may be noticed by sensitive individuals and action to avoid or reduce the effects may be needed.
Very High: The effects on sensitive individuals described for "high" levels of pollutants may worsen.

C1.3 TOTAL SUSPENDED PARTICULATE MATTER (TSP)

EU Directive 80/779/EEC specifies limit values for suspended particulate matter measured by the gravimetric method as follows:

- 300 mg m^{-3} for the 95th percentile of daily mean values over a year; and
- 150 mg m^{-3} for the arithmetic mean of daily mean values over a year.

C1.4 METHANE AND NON-METHANE HYDROCARBONS

There are no guidelines for total hydrocarbons, non-,methane hydrocarbons or methane.

C1.5 HYDROGEN CHLORIDE

The short-term exposure limit defined by the Occupational Exposure Limits for HCl is 7.6 mg m^{-3} (5 ppm). Therefore, the short-term air quality standard (SAQS) derived from the STEL is 760 mg m^{-3} (500 ppb). The HMIP Technical Guidance Note (Environmental) E1[(1)] provides both short term and long term environmental assessment levels (EALs) for HCl of 700 mg m^{-3} (460 ppb) and 7 mg m^{-3} (4.6 ppb) respectively.

C1.6 TRACE METALS

The current EU Directive limit value for annual mean concentrations of lead is 2 mg m^{-3} although the EU in COM(98)386 has recommended that the annual limit for the protection of human health be set at 0.5 mg m^{-3} with a target date of 2005. This has been adopted by the UK NAQS. Statutory limits do not exist for the other trace metals, but guidelines are available from the WHO for some and others can be derived from occupational Exposure Limits (as detailed in Section C1.1). The WHO guideline is used where one exists otherwise a guideline is derived from the OEL. Therefore, the guidelines applicable to the trace metals monitored in this study are presented in Table C1.5.

Table C1.5 Air Quality Guidelines for Trace Metals Derived from Occupational Exposure limits

Species	WHO Annual Mean Guideline (mg m^{-3})	OEL (mg m^{-3})	LAQS (ng m^{-3})
Arsenic (As)	1.5×10^{-3} (a)	0.1 (h)	200
Cadmium (Cd)	0.005 (b)	-	10
Cobalt (Co)	-	0.1 (h)	200
Chromium (Cr)	(c)	0.5	5000
Copper (Cu)	-	1.0	10000
Mercury (Hg)	1.0 (d)	0.025	250
Manganese (Mn)	1.0	-	1000
Nickel (Ni)	(e)	0.5 (h)	1000
Antimony (Sb)	-	0.5	5000
Tin (Sn)	-	2.0 (g)	20000
Thallium (Tl)	-	0.1 (i)	1000
Vanadium (V)	1.0 (f)	-	1000

(a) Over a whole lifetime.
(b) Annual.
(c) No threshold given; 1mg m^{-3} of CrVI gives a 4×10^{-2} lifetime risk.
(d) Indoor annual mean only so LAQS derived from OEL.
(e) No threshold given; 1mg m^{-3} gives a 4×10^{-4} lifetime risk.
(f) Expressed as a 24 hour mean.
(g) No OEL is given for tin; the number presented refer to inorganic tin compounds, with the exception of SnH_4.
(h) Substance having a maximum exposure limit (MEL).
(I) No OEL is given for thallium; the guideline presented refers to soluble thallium compounds.

C1.7 PCDD/Fs

There are no standards or guidelines for concentrations of PCDD/Fs in air.

C1.8 PAHs

The EPAQS committee has recommended that benzo[a]pyrene be used as a marker for the total mixture of PAHs in air. In 1999 the panel recommended that an air quality standard of 0.25ng m^{-3} be adopted.

C2 EXISTING AIR QUALITY

C2.1 INTRODUCTION

Measurements of concentrations of air pollutants in London are regularly made through a variety of monitoring networks. This section presents the most readily available monitoring results, where available, from these networks, for locations in the vicinity of the sites of interest to this study. For the continuously monitored data, measurements for 1996 through to 1998 were obtained via the AEA Technology site on the Internet.

C2.2 NITROGEN DIOXIDE

Concentrations of nitrogen dioxide are measured at the Automatic Monitoring Stations sponsored by the Department of the Environment Transport and Regions. Data from the network are reported by the National Environment Technology Centre (NETCEN). Monitoring commenced at a site in the Ecology Centre, at Eltham in April 1996, it is situated in a suburban area, near a golf course, and school on the north side of the Bexley Rd. The most recent years for which an annual summary of the data is available are 1996, 1997 and 1998.

The summary statistics for 1996 to 1998 are presented in Table C2.1

Table C2.1 Summary of Nitrogen Dioxide Concentrations Recorded at the Eltham LAQN Site During 1996 to 1998

	Concentrations ppb		
Statistical Parameter	1996[(a)]	1997	1998
98th percentile of hourly means	48	56	41
Maximum hourly mean	117	259	
50th percentile of hourly means	17	18	15
Annual mean	16	16	17
Data capture	75	99	86.2

(a) April to December 1996

- Concentrations of NO_2 recorded at the Eltham site were significantly below the EU Directive limit and guide values for the 98th percentile of hourly means presented in Table C1.2.

- The 50th percentile of hourly man NO_2 concentrations at ELTHAM site did not exceed the EU guide value.

- According to the UK DETR air quality descriptive bands for hourly mean NO_2 concentrations, the air pollution at Eltham site was always low to moderate between 1996 and 1998.

C2.3 SULPHUR DIOXIDE

Sulphur dioxide concentrations have been measured since January 1996 at the Eltham site. Summary statistics are available for median and 98th percentile of daily mean SO_2 concentrations for only two complete pollution years for comparison with the EU standards presented in Table C1.2. The available statistics for the pollution years 1996, 1997 and 1998 are presented in Table C2.2.

Table C2.2 Summary of Sulphur Dioxide Concentrations Recorded at the Eltham LAQN Site from 1996 to 1998 ppb

	Concentration ppb		
Statistical Parameter	1996[(a)]	1997	1998
Maximum hourly mean	134	101	107
Maximum daily mean	40	24	17
Maximum 15 minute mean	161	143	150
Number of 15 minute means >266 mg m^{-3}	19	9	7
Annual mean	4	4	3
Data capture	74	99	86.8

(a) April to December 1996

The monitoring data for sulphur dioxide concentrations in Eltham presented in Table C2.2 can be summarised as follows:

- Concentrations of SO_2 recorded at the Eltham site were low compared to the EU Directive limit values for the median and 98th percentile of daily means presented in Table C1.2.

- The EU guide value for the maximum daily mean of 100-150 mg m^{-3} (38-56 ppb) was not exceeded at the Eltham site.
- The maximum hourly mean concentration of SO_2 at the Eltham site was 101, 107 & 134 ppb, for 1998 1997 & 1996 respectively. However the site suffered some exceedances and air quality deteriorated from low air pollution to moderate on these occasions.

C2.4 PARTICULATE MATTER (PM_{10})

Particulate matter (PM_{10}) concentrations were measured at the Southampton AUN site from 1994 to 1998 and onwards. These data are presented in Table C2.3

Table C2.3 Summary of Particulate Matter (PM_{10}) Concentrations at the Eltham LAQN Site

Statistical Parameter	1996	1997	1998
Maximum daily average mg m^{-3}	52	81	53
24 hour running average mg m^{-3}	57	92	61
No of exceedances > 50 mg m^{-3} (days)	71	218	35
Data capture	66	91	85.8

The air pollution with respect to PM_{10}s overall has been gradually improving at the Eltham site since 1996 to 1998 although pollution episodes in 1996 and 1997 had an increased number of days which exceeded the EPAQS criteria of 50 mg m^{-3}. These episodes were due to national air pollution events.

C2.5 CARBON MONOXIDE

Carbon monoxide concentrations are not measured at the Eltham Site. Hence, another site namely the Tower Hamlets Roadside station was used for the comparison. The available statistics for 1996 to 1998 are presented in table C2.4

Table C2.4 Summary of Carbon Monoxide Concentrations Recorded at Tower Hamlets Roadside Site from 1996 to 1998

	Concentrations ppm		
Statistical Parameter	1996	1997	1998
Maximum 8 hour running mean	9.9	9.9	6.8
Maximum hourly mean	12.6	12.8	7.5
Data capture	74	98.6	96

The levels of CO for a roadside were as might be expected consistently higher than those observed at the Baltic Wharf Site.

C2.6 HYDROGEN CHLORIDE

Measurements of atmospheric concentrations of HCl in the study area are not regularly undertaken. However, concentrations have been measured at sites in Essex over two 2-month monitoring periods [(1)]. The two-monthly mean concentrations recorded at the sites were in the range 0.3-1.1 $\mu g\ m^{-3}$ (0.2-0.7 ppb).

C2.7 TRACE METALS

No published data are available on atmospheric concentrations of heavy metals in the study area. However, heavy metal concentrations have been measured at many UK locations over a number of years and the available data are presented in Table C2.5.

C2.8 PCDD/Fs

Measurements of PCDD/F concentrations in air in the UK & London area are reported in the Toxic Organic Micropollutants (TOMPS) report [(2)], and available from the AEA NETCEN Website. The data as ITEQ equivalents is presented in Table C2.6.

(1) *Harrison R M and Allen A G (1990)* ***Measurements of Atmospheric HNO_3, HCl and Associated Species on a Small Network in Eastern England*** *Atmospheric Environment* ***24A*** *pp369-376.*

(2) *Air Pollution Abatement Review Group (APARG)(1995)* ***Report on the Abatement of Toxic Organic Micropollutants (TOMPS) from Stationary Sources (1995)*** *prepared at the request of the Air Quality Division, Department of the Environment under contract PECD 7/12/138.*

Table C2.5 Measured Annual Mean Concentrations of Trace Metals in Air in the UK (ng m^{-3})

Year	1980-1998

Species

	Min	Max	Average	Notes
Arsenic	6.5	7.7		*b,c*
Cadmium	0.5	4.7	1.6	*a*
Chromium	2.0	15.8	6.4	*a*
Copper	6.0	48.5	25.2	*a*
Iron	38.0	1102.5	793.3	*a*
Manganese	<1	31.6	19.9	*a*
Nickel	2.8	15.3	9.4	*a*
Lead	45.2	561.7	256.9	*a*
Zinc	20.4	201.6	94.8	*a*
Vanadium	0.6	32.0	14.4	*a*
Cobalt	<0.1	2.2	0.8	*a*
Mercury			3	*d*
Antimony			<7.5	*a*
Tin	170	280		*b,c*
Thallium	25	26		*e*

(a) Data from the AEA NETCEN Website from 1980 to 1998
(b) AEQ Technology (1970-1989) National Survey
(c) Multi-element National Survey; Mean recorded in 1990-1994 at 5 sites
(d) WSL study (1975-1979); measured at Cottered, Herts
(e) WSL Multi-element National Survey; measured at only 2 sites

Table C2.6 Annual Mean PCDD/PCDF Concentrations at 4 sites from 1991 to 1998 as ITEQ fg m^{-3}

Year	1991	1992	1993	1994	1995	1996	1997	1998	Average
City									
Cardiff	150(260)	140(210)	n/a	n/a	n/a	n/a	n/a	n/a	145(235)
London	140(200)	120(200)	73(170)	47(67)	130(130)	27(29)	n/a	n/a	90(133)
Manchester	300(385)	290(370)	230(330)	62(86)	170(180)	75(78)	91(91)	28(29)	156(194)
Hazelrigg	n/a	n/a	71(150)	25(29)	22(26)	10(11)	n/a	2.6(3.7)	26(44)

non detect is assumed at zero
( ) non detect is set at detect limit

Quarterly Mean PCDD/PCDF Concentrations in London from 1996 to 1999 as ITEQ fg m^{-3}

Q1(96)	Q2/Q3(96)	Q4(96)/Q1(97)	Q2/Q3(97)	Q4(97)/Q1(98)	Q3(98)	Q4(98)	Q1(99)	Q2(99)	Average
17 (99)	16 (19)	37 (39)	7.1 (8)	11 (12)	5.7 (7.6)	33 (34)	3.5 (11)	6.8 (8)	15.2 (26.4)

non detect is assumed at zero
( ) non detect is set at detect limit

C2.10 PAHs

Measurements of speciated particulate PAH concentrations have been made in and around the London area from an urban background site, this data are presented in Table C2.7.

Table C2.7 Annual Average Concentrations of Total Particulate PAHs Measured at an urban background site around London in ng m^{-3}

		Annual Means						
Location	Compound	1991	1992	1993	1994	1995	1996	1997
London	Benzo[a]pyrene	1.1	0.6	0.8	0.3	0.4	0.3	0.6
	Benz[a]anthracene	1.8	0.8	0.4	0.4	0.3	0.5	0.8
	Dibenz[ah]anthracene-Dibezo[ac]anthracene	0.3	0.3	0.2	0.1	0.1	0.1	0.2
	Benzo[b]fluranthene	1.7	1.2	2.8	0.9	1.1	0.8	1.2
	Benzo[k]fluranthene	1.8	1.0	2.3	0.7	0.8	0.6	1.1
	Indeno[1,2,3-cd]pyrene	2.1	1.7	0.7	0.5	0.6	0.7	1.2
	Chrysene	3.1	1.5	0.9	0.6	0.6	1.1	1.4

(a) Data from the AEA NETCEN Website

ANNEX D

Weekly Measurements of HCl, TSP, Trace Metals, PCDD/Fs and PAHs at Baltic Wharf Depot

Table D1 Weekly Mean Ambient Concentrations of HCl and TSP Measured in Air at Baltic Wharf (μg m^{-3})

	Week 1 25/8/00 to 31/8/00	**Week 2** 1/9/00 to 7/9/00	**Week 2** 7/9/00 to 14/9/00	**Week 4** 14/9/00 to 21/10/00	Four Week Mean
HCl	0.32	0.33	0.25	0.20	0.27
TSP	62.6	49.3	42.9	29.0	45.9

Table D2 Weekly Mean Ambient Concentrations of Trace Metals Measured in Air at Baltic Wharf (ng m^{-3})[(a)(b)]

Species	**Week 1** 25/8/00 to 31/8/00	**Week 2** 1/9/00 to 7/9/00	**Week 3** 7/9/00 to 14/9/00	**Week 4** 14/9/00 to 21/9/00	Four Week Mean
Arsenic	1.60	1.05	1.29	1.04	1.24
Copper	108	113	227	146	148
Lead	46	23	31	20	30
Cadmium	0.48	0.24	0.85	0.13	0.43
Chromium	1.48	0.66	0.46	0.30	0.73
Nickel	1.91	0.75	1.16	0.74	1.14
Manganese	22	13	14	9	15
Antimony	5.4	3.6	4.8	3.4	4.3
Tin	2.4	1.4	1.5	1.0	1.6
Vanadium	4.1	2.4	4.2	1.9	3.2
Cobalt	0.38	[0.15]	[0.18]	[0.15]	0.22
Thallium	[0.40]	[0.38]	[0.46]	[0.37]	[0.40]
Total Mercury	[0.032]	[0.020]	[0.022]	[0.017]	[0.023]

(a) ng is equivalent to 1 x 10^{-9} grams.
(b) Values in [square] parentheses are at the detection limit of the analysis and have been assumed to be half the analysis detection limit.

Table D3 Weekly Mean Ambient Concentrations of PCDD/Fs Measured in Air at Baltic Wharf (fg m^{-3})[(a)(b)(c)]

Congener	**Week 1** 25/8/00 to 31/8/00	**Week 2** 1/9/00 to 7/9/00	**Week 3** 7/9/00 to 14/9/00	**Week 4** 14/9/00 to 21/9/00	Four Week Mean
2,3,7,8-TCDD	[2.7]	[1.5]	[1.7]	[1.7]	[1.8]
1,2,3,7,8-PeCDD	7.7	2.0	1.7	1.4	3.2
1,2,3,4,7,8-HxCDD	[7.7]	18	20	11	14
1,2,3,6,7,8-HxCDD	23	[2.9]	14	[2.7]	11
1,2,3,7,8,9-HxCDD	39	[2.9]	6.8	16	16
1,2,3,4,6,7,8-HpCDD	[12]	23	34	22	23
OCDD	100	70	34	33	59
2,3,7,8-TCDF	[7.7]	[1.5]	[1.7]	[1.4]	[3.1]
1,2,3,7,8-PeCDF	[7.7]	5.8	4.7	5.4	5.9
2,3,4,7,8-PeCDF	[2.7]	[1.5]	1.7	1.4	1.8
1,2,3,4,7,8-HxCDF	23	[1.5]	3.4	11	9.7
1,2,3,6,7,8-HxCDF	[3.9]	18	14	11	11
1,2,3,7,8,9-HxCDF	[3.9]	[2.9]	3.4	[2.7]	3.2
2,3,4,6,7,8-HxCDF	23	[2.9]	20	[2.7]	12
1,2,3,4,6,7,8-HpCDF	39	23	20	22	26
1,2,3,4,7,8,9-HpCDF	[3.9]	[12]	6.8	11	8.3
OCDF	93	29	34	33	47
Total (fg I-TEQ m^{-3})[(d)]	28	14	18	13	18
Total (fg I-TEQ m^{-3})[(e)]	16	4.4	7.6	5.7	8.5

(a) Only the total concentration is expressed as a toxic equivalent.
(b) fg is equivalent to 1 x $1o^{-15}$ grams.
(c) Values in [square] parenthesis are at the detection limit of the analysis
(d) Total PCDD/F concentration including non-detected levels at the analysis detection limit.
(e) Total PCDD/F concentration with non-detected levels assumed to be zero.

Table D4 Weekly Mean Ambient Concentrations of PAHs Measured in Air at Baltic Wharf (ng m^{-3})[(a)]

Species	**Week 1** 25/8/00 to 31/8/00	**Week 2** 1/9/00 to 7/9/00	**Week 3** 7/9/00 to 14/9/00	**Week 4** 14/9/00 to 21/9/00	Four Week Mean
Naphthalene	0.59	0.51	0.60	0.46	0.54
Acenaphthylene	0.51	0.42	0.47	0.39	0.45
Acenaphthene	0.60	0.51	0.61	0.49	0.60
Fluorene	0.19	0.14	0.17	0.13	0.16
Phenanthrene	0.15	0.12	0.14	0.11	0.13
Anthracene	0.11	0.08	0.09	0.08	0.09
Fluoranthene	0.26	0.20	0.23	0.18	0.22
Pyrene	0.31	0.24	0.28	0.23	0.26
Benzo[*a*]anthracene	0.21	0.16	0.19	0.15	0.18
Chrysene	0.11	0.08	0.10	0.08	0.09
Benzo[*b/k*]fluoranthene	0.37	0.27	0.33	0.26	0.31
Benzo[*a*]pyrene	0.2	0.14	0.17	0.14	0.16
Benzo[*ghi*]perylene	0.19	0.13	0.20	0.14	0.16
Indeno[*123-cd*]pyrene	0.20	0.14	0.17	0.14	0.16
Dibenzo[*ah*]anthracene	0.17	0.12	0.15	0.12	0.14
Total PAH	4.2	3.3	3.9	3.1	3.6

(a) ng is equivalent to 1 x 10^{-9} grams.

ANNEX E

Comparison of ELTHAM AUN Data with Data from Baltic Wharf

Comparison of Nitrogen dioxide Concentrations measured at Eltham AUN Site 25-Aug to 21-Sep-2000 and Baltic Wharf Depot

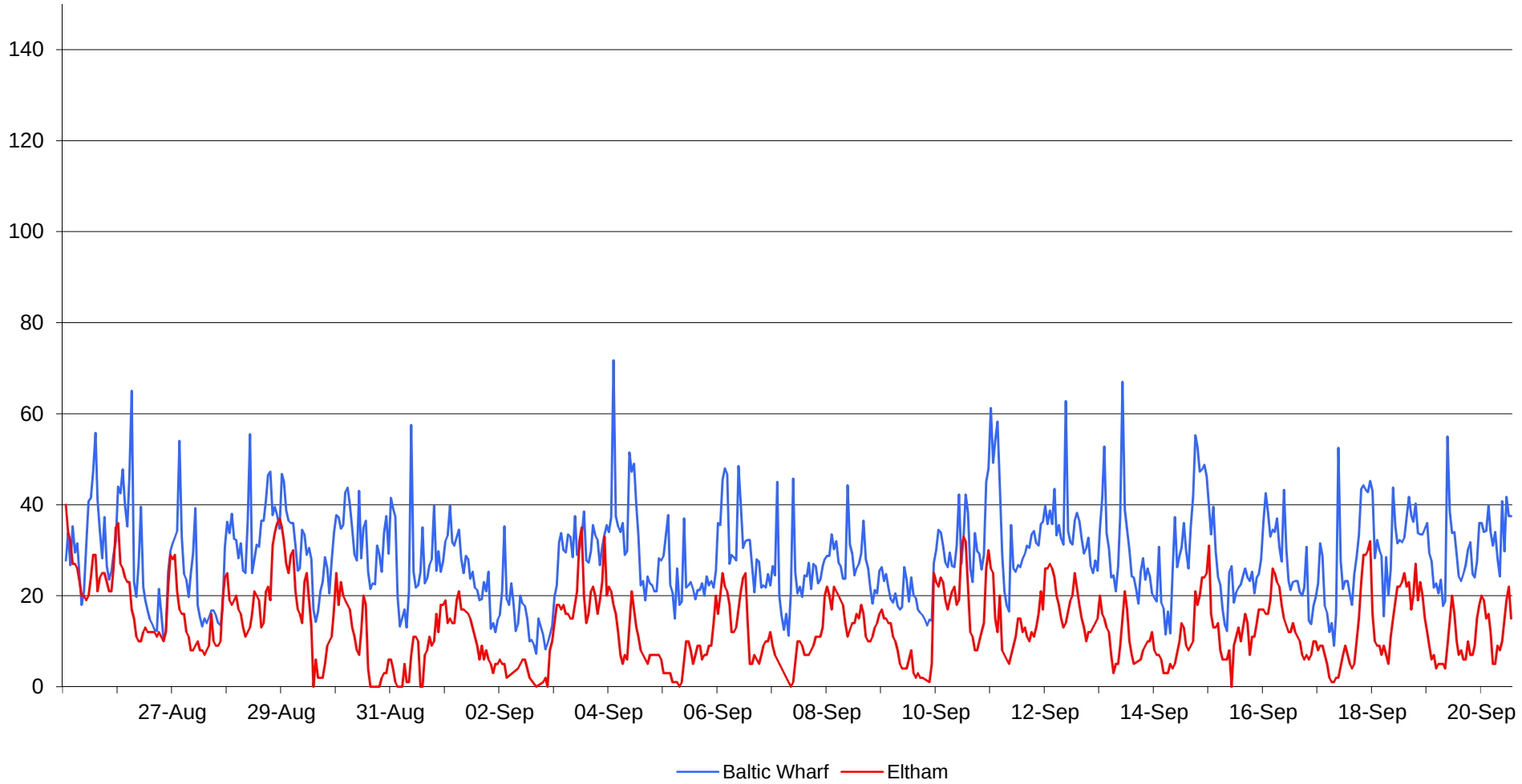


Figure E1

Comparison of Sulphur dioxide Concentrations measured at Eltham AUN Site 25-Aug to 21-Sep-2000 and Baltic Wharf Depot

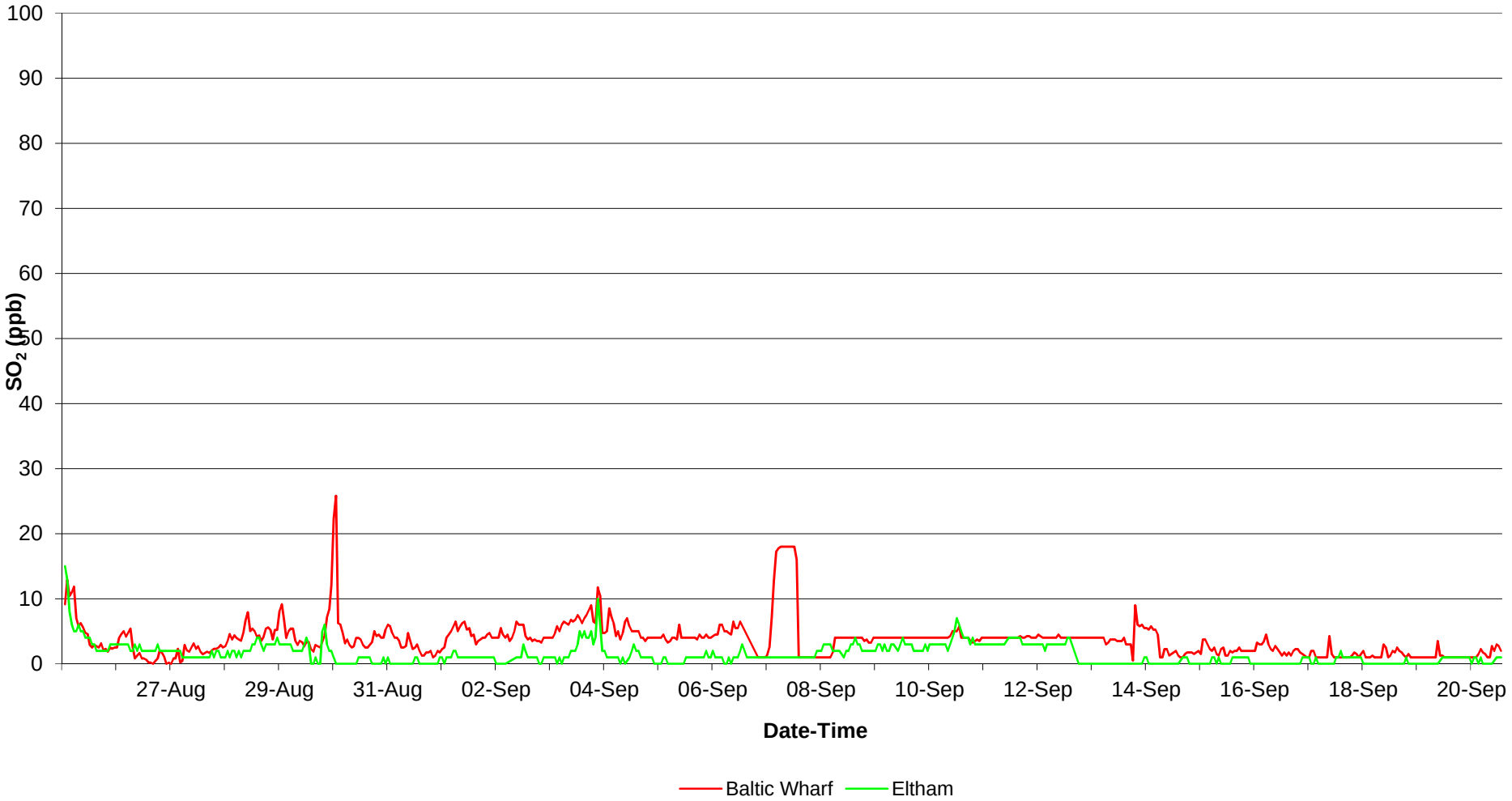


Figure E2

Comparison of PM_{10} Fine Dust Concentrations measured at Eltham AUN Site 25-Aug to 21-Sep-2000 and Baltic Wharf Depot

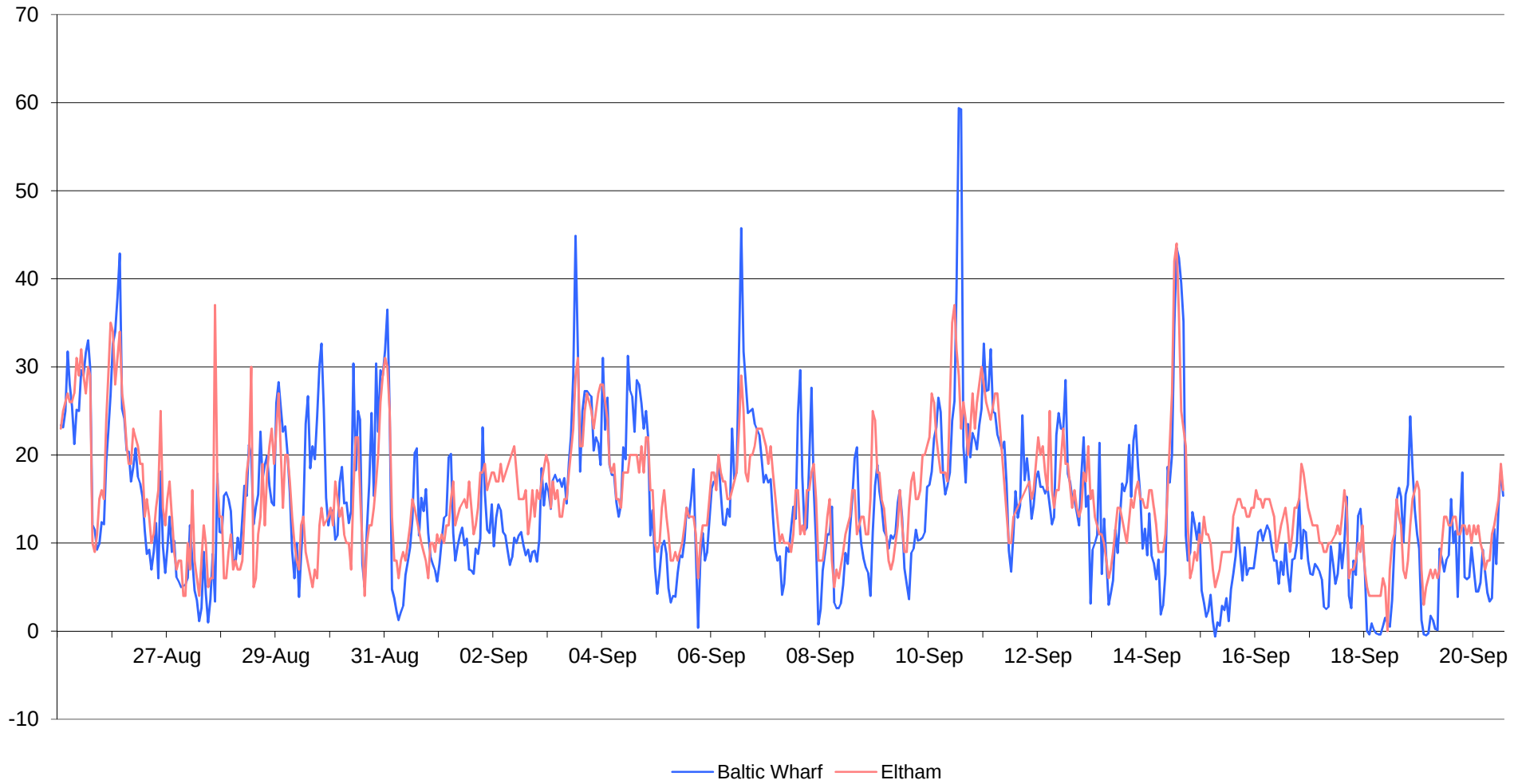


Figure E3

ANNEX F

Definition of Units and Conversion Factors

Air Volume Units

ppb = parts per billion

ppm = parts per million

Air Mass Units

mg m^{-3} = milligrams (10^{-3} grams) per cubic metre of air

mg C m^{-3} = milligrams of carbon per cubic metre of air

µg m^{-3} = micrograms (10^{-6} grams) per cubic metre of air

ng m^{-3} = nanograms (10^{-9} grams) per cubic metre of air

pg m^{-3} = picograms (10^{-12} grams) per cubic metre of air

fg m^{-3} = femtograms (10^{-15} grams) per cubic metre of air

Air Volume to Mass Conversion Factors (at 20ºC)

Inorganic Gases

NO	1 ppb = 1.25 µg m^{-3}
NO_2	1 ppb = 1.91 µg m^{-3}
SO_2	1 ppb = 2.66 µg m^{-3}
CO	1 ppb = 1.17 µg m^{-3}
HCl	1 ppb = 1.52 µg m^{-3}

Hydrocarbons

Methane	1 ppm (as C) = 0.50 mg C m^{-3}
Non-methane hydrocarbons	1 ppm (as C) = 0.50 mg C m^{-3}
Total methane	1 ppm (as C) = 0.50 mg C m^{-3}

Trace Metals

Arsenic	1 ppb = 3.12 µg m^{-3}
Antimony	1 ppb = 5.08 µg m^{-3}
Cadmium	1 ppb = 4.66 µg m^{-3}
Cobalt	1 ppb = 2.46 µg m^{-3}
Chromium	1 ppb = 2.16 µg m^{-3}
Copper	1 ppb = 2.66 µg m^{-3}
Mercury	1 ppb = 8.37 µg m^{-3}
Lead	1 ppb = 8.62 µg m^{-3}
Manganese	1 ppb = 2.29 µg m^{-3}
Nickel	1 ppb = 2.46 µg m^{-3}
Tin	1 ppb = 4.95 µg m^{-3}
Thallium	1 ppb = 8.49 µg m^{-3}
Vanadium	1 ppb = 2.12 µg m^{-3}

Dioxins and Furans

TCDD	1 ppb = 13.4 mg m^{-3}
PeCDD	1 ppb = 14.8 mg m^{-3}
HxCDD	1 ppb = 16.3 mg m^{-3}
HpCDD	1 ppb = 17.7 mg m^{-3}
OCDD	1 ppb = 19.1 mg m^{-3}
TCDF	1 ppb = 12.7 mg m^{-3}
PeCDF	1 ppb = 14.2 mg m^{-3}
HxCDF	1 ppb = 15.6 mg m^{-3}
HpCDF	1 ppb = 17.0 mg m^{-3}
OCDF	1 ppb = 18.5 mg m^{-3}

PAHs

Naphthalene	1 ppb = 5.3 mg m^{-3}
Acenaphthylene	1 ppb = 6.3 mg m^{-3}
Acenaphthene	1 ppb = 6.4 mg m^{-3}
Fluorene	1 ppb = 6.9 mg m^{-3}
Phenanthrene	1 ppb = 7.4 mg m^{-3}
Anthracene	1 ppb = 7.4 mg m^{-3}
Fluoranthene	1 ppb = 8.4 mg m^{-3}
Pyrene	1 ppb = 8.4 mg m^{-3}
Benz[*a*]anthracene	1 ppb = 9.5 mg m^{-3}
Chrysene	1 ppb = 9.5 mg m^{-3}
Benzo[*b*]fluoranthene	1 ppb = 10.5 mg m^{-3}
Benzo[*k*]fluoranthene	1 ppb = 10.5 mg m^{-3}
Benzo[*a*]pyrene	1 ppb = 10.5 mg m^{-3}
Benzo[*ghi*]perylene	1 ppb = 11.5 mg m^{-3}
Indeno[*123-cd*]pyrene	1 ppb = 11.5 mg m^{-3}
Dibenzo[*ah*]anthracene	1 ppb = 11.6 mg m^{-3}

Air Mass to Volume Conversion Factors (at 20ºC)

Inorganic gases

NO	1 mg m^{-3} = 0.80 ppb
NO_2	1 mg m^{-3} = 0.52 ppb
SO_2	1 mg m^{-3} = 0.38 ppb
CO	1 mg m^{-3} = 0.85 ppm
HCl	1 mg m^{-3} = 0.66 ppb

Hydrocarbons

Methane	1 mg C m^{-3} = 2.0 ppm (as C)
Non-methane hydrocarbons	1 mg C m^{-3} = 2.0 ppm (as C)
Total methane	1 mg C m^{-3} = 2.0 ppm (as C)

Trace Metals

Arsenic	1 mg m^{-3} = 0.32 ppb

Antimony	1 mg m^{-3} = 0.20 ppb
Cadmium	1 mg m^{-3} = 0.21 ppb
Cobalt	1 mg m^{-3} = 0.41 ppb
Chromium	1 mg m^{-3} = 0.46 ppb
Copper	1 mg m^{-3} = 0.38 ppb
Mercury	1 mg m^{-3} = 0.12 ppb
Lead	1 mg m^{-3} = 0.12 ppb
Manganese	1 mg m^{-3} = 0.44 ppb
Nickel	1 mg m^{-3} = 0.41 ppb
Tin	1 mg m^{-3} = 0.20 ppb
Thallium	1 mg m^{-3} = 0.12 ppb
Vanadium	1 mg m^{-3} = 0.47 ppb

Dioxins and Furans

TCDD	1 mg m^{-3} = 0.075 ppb
PeCDD	1 mg m^{-3} = 0.068 ppb
HxCDD	1 mg m^{-3}= 0.061 ppb
HpCDD	1 mg m^{-3} = 0.056 ppb
OCDD	1 mg m^{-3} = 0.052 ppb
TCDF	1 mg m^{-3} = 0.079 ppb
PeCDF	1 mg m^{-3} = 0.070 ppb
HxCDF	1 mg m^{-3} = 0.064 ppb
HpCDF	1 mg m^{-3} = 0.059 ppb
OCDF	1 mg m^{-3} = 0.054 ppb

PAHs

Naphthalene	1 mg m^{-3} = 0.19 ppb
Acenaphthylene	1 mg m^{-3} = 0.16 ppb
Acenaphthene	1 mg m^{-3} = 0.16 ppb
Fluorene	1 mg m^{-3} = 0.14 ppb
Phenanthrene	1 mg m^{-3} = 0.14 ppb
Anthracene	1 mg m^{-3} = 0.14 ppb
Fluoranthene	1 mg m^{-3} = 0.12 ppb
Pyrene	1 mg m^{-3} = 0.12 ppb
Benz[*a*]anthracene	1 mg m^{-3} = 0.11 ppb
Chrysene	1 mg m^{-3} = 0.11 ppb
Benzo[*b*]fluoranthene	1 mg m^{-3} = 0.095 ppb
Benzo[*k*]fluoranthene	1 mg m^{-3} = 0.095 ppb
Benzo[*a*]pyrene	1 mg m^{-3} = 0.095 ppb
Benzo[*ghi*]perylene	1 mg m^{-3} = 0.087 ppb
Indeno[*123-cd*]pyrene	1 mg m^{-3} = 0.087 ppb
Dibenzo[*ah*]anthracene	1 mg m^{-3} = 0.086 ppb

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