REPORT ON THE DIFFUSION TUBE MONITORING OF NITROGEN DIOXIDE (NO_2) AT 42 LOCATIONS WITHIN FOWEY OVER A TWO-MONTH PERIOD (9TH MAY – 4TH JULY 2002)

Barbara Parsons and Leo Salter
Cornwall College
TR15 3RD
b.parsons@cornwall.ac.uk

Contents

Tables

Appendix 1

Appendix 2

Plates

Executive Summary

1. In order to evaluate traffic-related air quality impacts passive diffusion tubes were used to monitor nitrogen dioxide levels at 42 sites in Fowey over an 8-week period from the 9th May to the 5th July 2002. The aims of the study were;

- To assess the spatio-temporal distribution of nitrogen dioxide concentrations in Fowey.
- To highlight areas where elevated concentrations of nitrogen dioxide occur, which may need further investigation by automatic monitoring.

2. Results from the survey showed that nitrogen dioxide concentrations did not exceeded the NAQS annual average of 40 $\mu g\ m^{-3}$ (21 ppb) at any monitoring sites.

3. No two-weekly concentrations recorded with diffusion tubes were greater than 50 $\mu g\ m^{-3}$ (26 ppb), hence, NAQS objectives of 200 $\mu g\ m^{-3}$ (104.6) ppb as an hourly mean would not have been exceeded at any of the sites monitored.

4. It is not recommended that any further monitoring is necessary at this stage but at some time in the future a continuous monitor (NO_2) should be used for a limited period at some town centre sites.

Report on the diffusion tube monitoring of nitrogen dioxide (NO_2) at locations within Fowey over a two-month period, 9th May – 4th July 2002.

Barbara Parsons and Leo Salter, Cornwall College, TR15 3RD
(b.parsons@cornwall.ac.uk)

Commissioned by:
Mr G Martin
Principal Environmental Health Officer
Restormel Borough Council
39 Penwinick Road
St Austell
Cornwall PL25 5DR

1. Introduction

Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) together represent the traffic-produced nitrogen oxides (NO_x). Although they are generated in the atmosphere by natural sources, (e.g. lightning), the major man-made source is the combustion of fossil fuels and, in particular, the internal combustion engine. On a national scale, current estimates show that road transport accounts for 46% of the total UK emissions of nitrogen oxides. Most importantly for this study nitrogen dioxide can be used as a marker for traffic-related air pollution.

In the Review of the National Air Quality Strategy (NAQS 1999) the UK Government has proposed a new hourly mean objective for nitrogen dioxide of 200 $\mu g\ m^{-3}$ (104.6 ppb) to be achieved by 2005 and an annual mean of 40 $\mu g\ m^{-3}$ (21 ppb) to be achieved by 2005. The NAQS 2005 objectives (DEFRA., 2000) apply to non-occupational near-ground level outdoor locations where a person might reasonably be expected to be exposed over the relevant averaging period. The annual mean NO_2 objective of 40 $\mu g\ m^{-3}$ (21 ppb) therefore only applies at the facade of buildings where people actually live. Nitrogen dioxide concentrations are expected to fall rapidly as the distance from the road increases reaching levels similar to background at distances greater than 20-30 m (QUARG, 1993).

Although the scale of traffic-related air pollution problems in Cornwall is different from that experienced in other parts of the UK, the limited monitoring that has already taken place indicates that there is the potential for problems to arise. There are a number of locations in Cornwall where slow-moving traffic produces health-damaging levels of pollutants. This is chiefly because under still conditions (high-pressure) in a road system where narrow streets exacerbate pollutant build-up (the 'canyon' effect) the potential exists for pollutants to reach high concentrations. Many towns and villages in Cornwall have houses located directly adjacent to the roadside and consequently, should nitrogen dioxide levels greater than 40 $\mu g\ m^{-3}$ (21 ppb) be reached, the NAQS objectives would be exceeded.

Nitrogen dioxide can cause damage to cell membranes and proteins and may also increase reactivity to natural allergens. Additionally, short-term exposures can have a detrimental affect on the immune cells of the airway in a manner that may cause predisposed people to suffer an increased risk of respiratory infections. Exposure to low levels of nitrogen dioxide may put children at increased risk of respiratory infection and may lead to poorer lung function in later life (Mukala, 1999).

2. Monitoring Programme

2.1. Aim

A nitrogen dioxide diffusion tube survey was undertaken at 42 sites in Fowey with the aim of producing isolevel concentration maps of the pollutant over time. This would provide a good marker for related increases in all traffic-related pollutants (e.g. PM_{10}s, VOCs etc.).

The technique of high resolution spatial monitoring yields detailed information about the distribution of airborne pollutants over an urban territory and supplies Local Authorities with a powerful tool for town planning at a very low cost - a result usually associated with more expensive monitoring techniques.

The primary aims of this survey are

- To assess the distribution of nitrogen dioxide concentrations over time and space in the urban environment.
- To highlight areas where elevated concentrations of nitrogen dioxide occur for further investigation by automatic monitoring.

2.2. Methodology

Nitrogen dioxide diffusion tubes were exposed at 42 sites in Fowey for four two-week periods (see Appendix 1, Figure 1). The sites were distributed as near as possible along the knots of a grid drawn over a town map. Whilst maintaining the number of sampling sites consistent with the available financial resources, the application of the grid enabled the study to cover a wide and varied area of the town and also provided a spread of sampling sites suitable for modelling. One blank tube was allocated for each 2-week programme in order to ensure the integrity of the tube batch.

The 4 two-week programmes ran as detailed in Table 1.

Table 1. Programme dates

Programme No	Date (2002)
1	9th May –23rd May
2	23rd May – 6th June
3	6th June – 20th June
4	20th June – 4th July

2.2.1. Diffusion tubes

Diffusion tubes were supplied by Gradko International Ltd, Winchester, Hants. Gradko International Ltd also analysed the tubes (see Appendix 2)

During the last quarter of 2000 the then Department of the Environment Transport and the Regions, (DETR) commissioned AEA Technology Ltd to investigate the effects of preparation techniques on the performance of nitrogen dioxide diffusion tubes with a view to standardising the method. This work was based on a study at Anglia Polytechnic University (Kirby, 2000) on the behaviour of nitrogen dioxide diffusion tubes prepared by the following three methods:

1. 50% v/v Triethanolamine (TEA) in acetone, with the grids dipped into the solution
2. 20% v/v TEA in deionised water pipetted onto grids
3. 50% v/v TEA in deionised water pipetted onto grids

The results of the AEA investigation showed that the preparation method using 20% TEA in deionised water produced readings with the smallest positive bias and no negative bias. A report has been produced by AEA Technology (AEAT/ENV/R/0563) and is available on the wordwide web, (http://www.environment.detr.gov.uk/airq/aqinfo.htm). The nitrogen dioxide tubes used in the Falmouth study were 20% TEA in deionised water as recommended by the AEA Technology study.

2.2.2. Advantages of using diffusion tubes

- Diffusion tubes can be used for spatial and temporal assessments.
- They are portable, easily sited and cheap.
- Results are directly comparable to the NAQS environmental standard of 40 μg m^{-3} (21 ppb) as an annual objective.

2.2.3. Disadvantages of using diffusion tubes

- There is no standard method of validation for diffusion tubes.
- The results are averaged over the monitoring period and give no indication of short-term peaks.
- The reliability of diffusion tubes and of diffusion tube monitoring has been questioned, (www.Croydon.gov.uk/EHDept/diffsurvey.htm).

2.2.4. Loss of tubes

Over the entire monitoring period 5 tubes (5% of the total) were lost due to theft (see Table 2).

Table 2: Tube losses

	Site no	Location	Site no	Location
Programme 1	1	Tower Park		
Programme 2	1	Tower Park	35	Langurtho Rd
Programme 3	35	Langurtho Rd		
Programme 4	35	Langurtho Rd		

2.3. Sites (Appendix 1, Figure 1 and Table 1)

Using the ArcView Geographical Information Systems (GIS) the diffusion tube data was modelled onto four maps and the results shown as colour contour maps of nitrogen dioxide concentrations.

3.0 Results

3.1 Site data

The highest concentration recorded during the whole monitoring programme was 35 μg m^{-3} (18 ppb) at Site 28, (New Road Hill), during Programme 2, (Appendix 1, Figure 2 and Table 1). Site 28, (New Road Hill), consistently recorded higher levels than other sites throughout the programme and had the highest average value of 30 μg m^{-3} (16 ppb).

As mentioned in Section 2.2.3, one of disadvantages of using diffusion tubes is that results are averaged over the whole of the monitoring period, in this case over a two-week period, hence any hourly peaks of nitrogen dioxide concentrations will not be shown. Using real-time data collected during the Falmouth 2000 Programme, high traffic-flow levels in Falmouth can be shown to occur for only 12 hours of the day, and the levels of nitrogen dioxide recorded reflect this. Therefore it can be postulated that during the hours of daylight the actual nitrogen dioxide concentrations are twice those indicated by the two-weekly average.

None of the two-weekly average diffusion tube concentrations recorded in Fowey were greater than 35 μg m^{-3} (16 ppb) it is therefore unlikely that the NAQS objectives of 200 μg m^{-3} (104.6) ppb as an hourly mean would have been exceeded at any of the sites monitored. It is also unlikely that the recommended maximum annual mean of 40 μg m^{-3} (21 ppb) would be exceeded.

Table 1 (Appendix 1) shows tabulated results for all monitoring sites for all four programmes and site averages.

Isolevel concentration maps of the pollutant over time were produced for each programme, Figures 3– 6, (Appendix 1). Results from all four programmes are shown as an average for the monitoring period, Figure 2, (Appendix 1).

Figures 7 & 8 (Appendix 1) show all four-programme results for Fowey as bar charts.

Inspection of Table 1 (Appendix 1) and Figures 7 & 8 show that similar concentrations of nitrogen dioxide occurred at the same sites for all four programmes, illustrating the representational consistency of the tubes.

Over the course of the programmes concentrations of nitrogen dioxide > 20 μg m^{-3} (11ppb) were recorded at 6 separate sites with some of the sites showing levels > 20 μg m^{-3} more than once (Table 3). These levels occurred at sites of relatively low traffic-flow and specifically at sites on an incline, sites where traffic is slow moving or is stationary or where narrow streets and high buildings prevent dispersion of the pollutant, (the "canyon" effect). This suggests that not only is traffic-related pollution responsible for higher concentrations at sites of high traffic density but that traffic flow-rates and the topography of the area are also influential in determining pollution levels.

Table 3: Fowey sites with nitrogen dioxide concentrations > 20 μg m^{-3}.

Site No	Location
7	Fore Street
10	Station Road
17	Rawlings Lane
28	New Road Hill
30	Fore Street
33	Station Road

Average values recorded at background sites range from 4 – 10 μg m^{-3} as opposed to an average value of 30 μg m^{-3} recorded at Site 28. This difference in values over relatively short distances demonstrates the influence that traffic emissions and traffic routing have on local air quality.

3.2 Discussion of Fowey programme

Table 4 shows the total nitrogen dioxide levels for all sites for the four programmes. As shown by the isolevel maps (Figures 3 – 6) higher values were recorded for programmes 1 and 3 than for programmes 2 and 4. There was very little variation in total concentrations between the four programmes.

Table 4: Total nitrogen dioxide levels for each Fowey programme

Site 4	NO_2 (μg m^{-3})
Programme 1	355
Programme 2	445
Programme 3	474
Programme 4	369

3.3 Traffic data

Traffic data was collected by the County Highways Department for the period 9th May – 27th May 2002 on the A3082 and the B3269, (Appendix 1, Table 2). Approximately 600 more cars per day exit Fowey via the B3269 than enter on it and approximately 600 cars per day enter via the A3082 than exit on it. This suggests that approximately 600 cars per day travel through the center of Fowey.

4.0 Conclusions

Over the whole monitoring period the highest average value of 30 μg m^{-3} (16 ppb) was recorded at Site 28 (New Road Hill). This value is well below the NAQS objective of 40 μg m^{-3} (21 ppb) as an annual mean and it is unlikely that either annual or hourly objectives would be exceeded.

The relatively low nitrogen dioxide concentrations recorded at all Fowey sites reflect the low traffic values. However, the average value of 21 μg m^{-3} recorded for Site 7 (Fore St) is higher than might be expected from an average of 600 cars per day. The nitrogen dioxide values are probably due to the topography of the narrow streets and high buildings. Residential properties are directly exposed to any traffic-related pollution but levels do not exceed the NAQS objectives, (Plate 1).

Plate 1: Site 7, Fore Street

It is not recommended that any further monitoring is necessary at this stage but at some time in the future a continuous monitor (NO_2) should be used for a limited period at Site 28.

References

CAQF (Cornwall Air Quality Forum). (2002): http://www.cornwall-airquality.org.uk/truro no2.asp

DEFRA. (2000). The United Kingdom National Air Quality Strategy, The Stationery Office Limited, London.

Heal, M.R., O'Donoghue, M.A. & Cape, J.N. (1999). Overestimation of urban nitrogen dioxide by passive diffusion tubes: a comparative exposure and model study. *Atmospheric Environment.* **33**, 513 – 524.

Kirby, C., Fox, M. & Waterhouse, J. (2000). Reliability of nitrogen dioxide passive diffusion tubes for ambient measurement: in situ properties of the triethanolamine absorbent. *Environmental Monitoring*. **2,** 307-312.

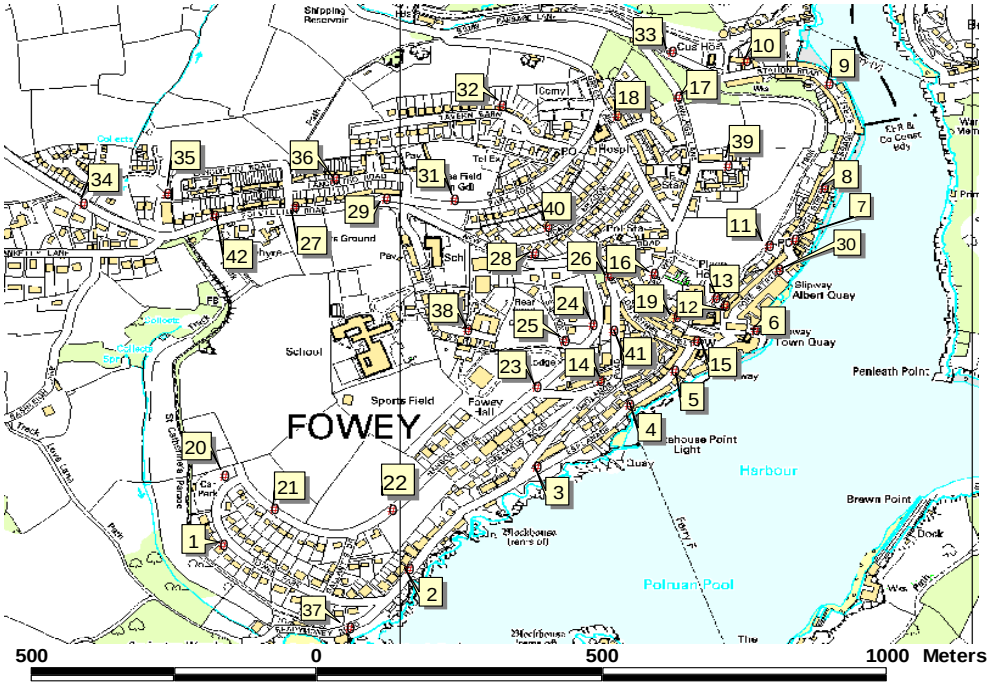
Lebret, E., Briggs, D. & Van Reeuwijk, H. (2000). Small variations in ambient NO_2 concentrations in four European areas. *Atmospheric Environment*. **34**, 177 – 185.

Mukala, K., Pekkanen, J. & Tiittanen, P. (1999). Personally measured weekly exposure to NO_2 and respiratory health among pre-school children. *European Respiratory Journal.* **13**, 1411-1417.

QUARG, (1993). Second Report of the Quality of Urban Air Review Group: Diesel Vehicle Emissions and Urban Air Quality. Department of the Environment.

Figure 1 Appendix 1

Fowey nitrogen dioxide diffusion tube survey 2002. Location Map



Fowey nitrogen dioxide diffusion tube survey. Average values 9th May - 5th July 2002

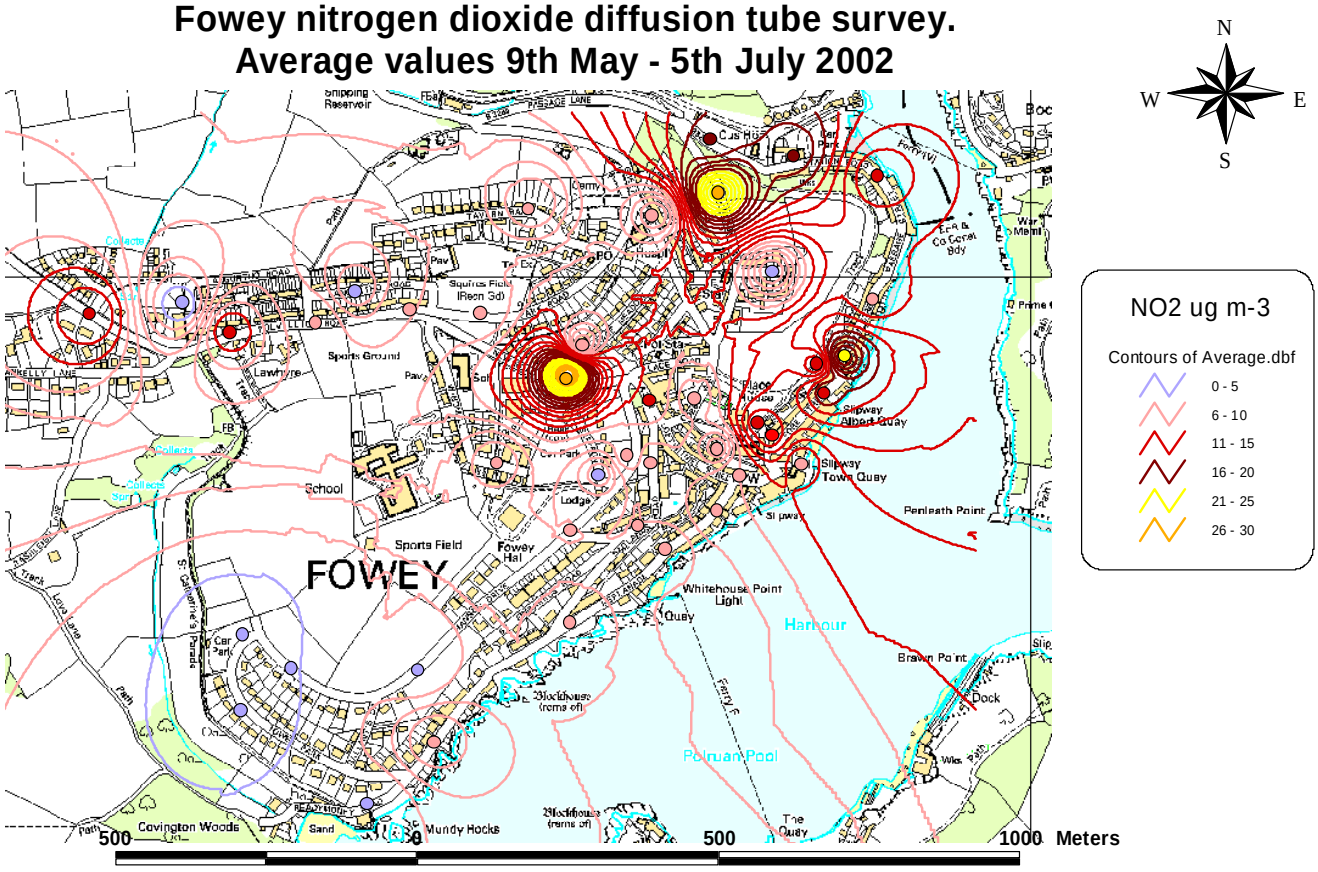
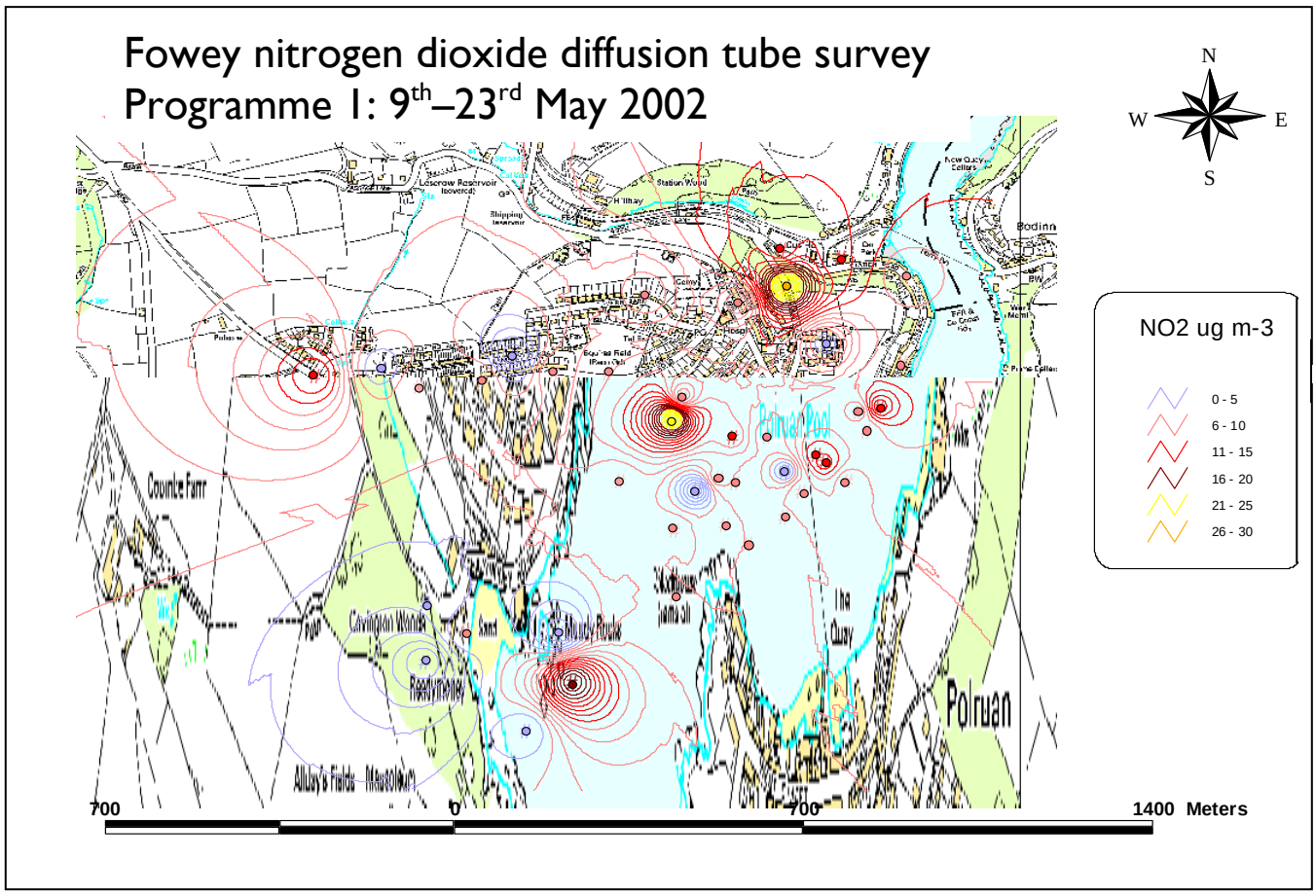


Figure 2

Figure 3 Appendix 1



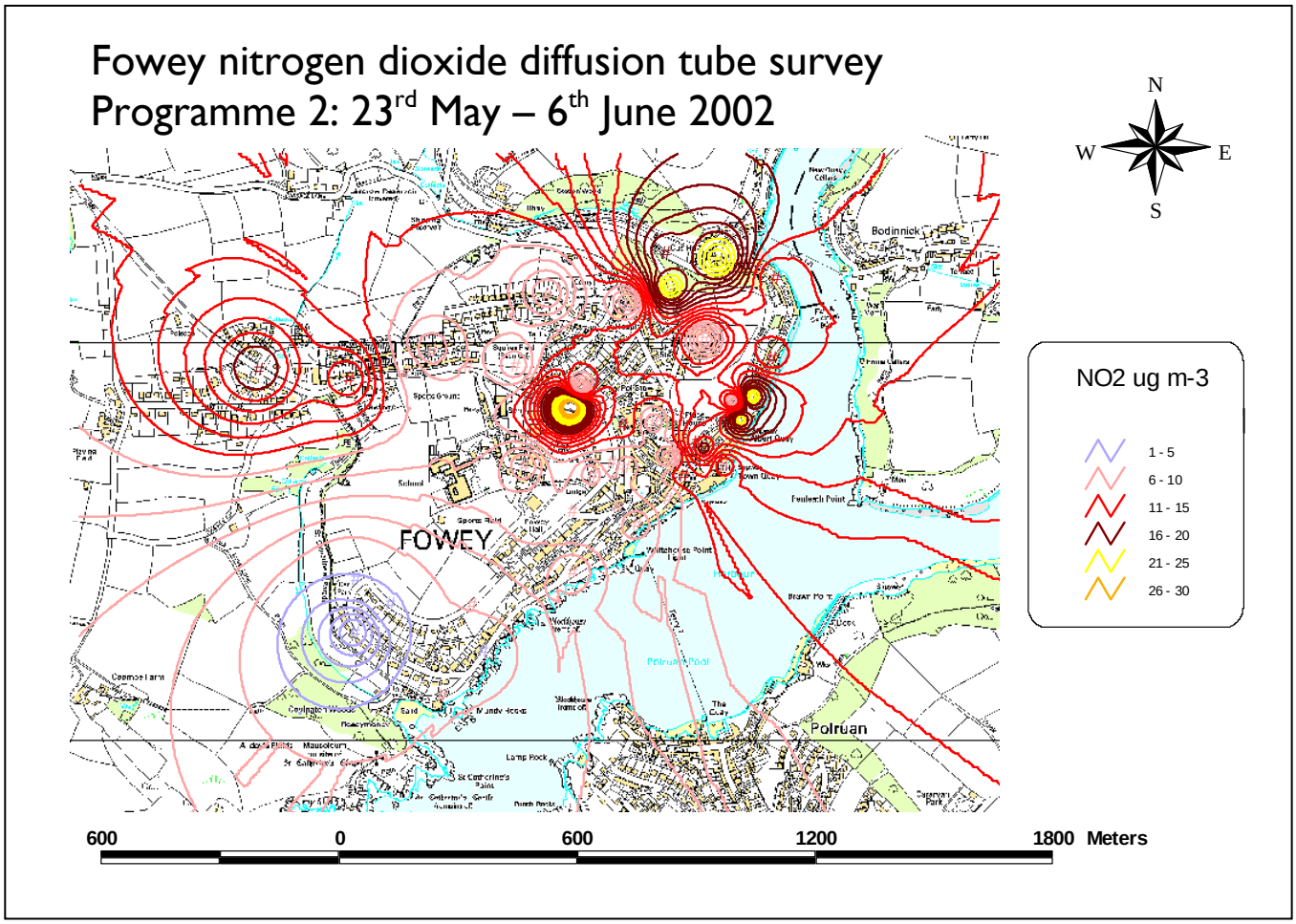
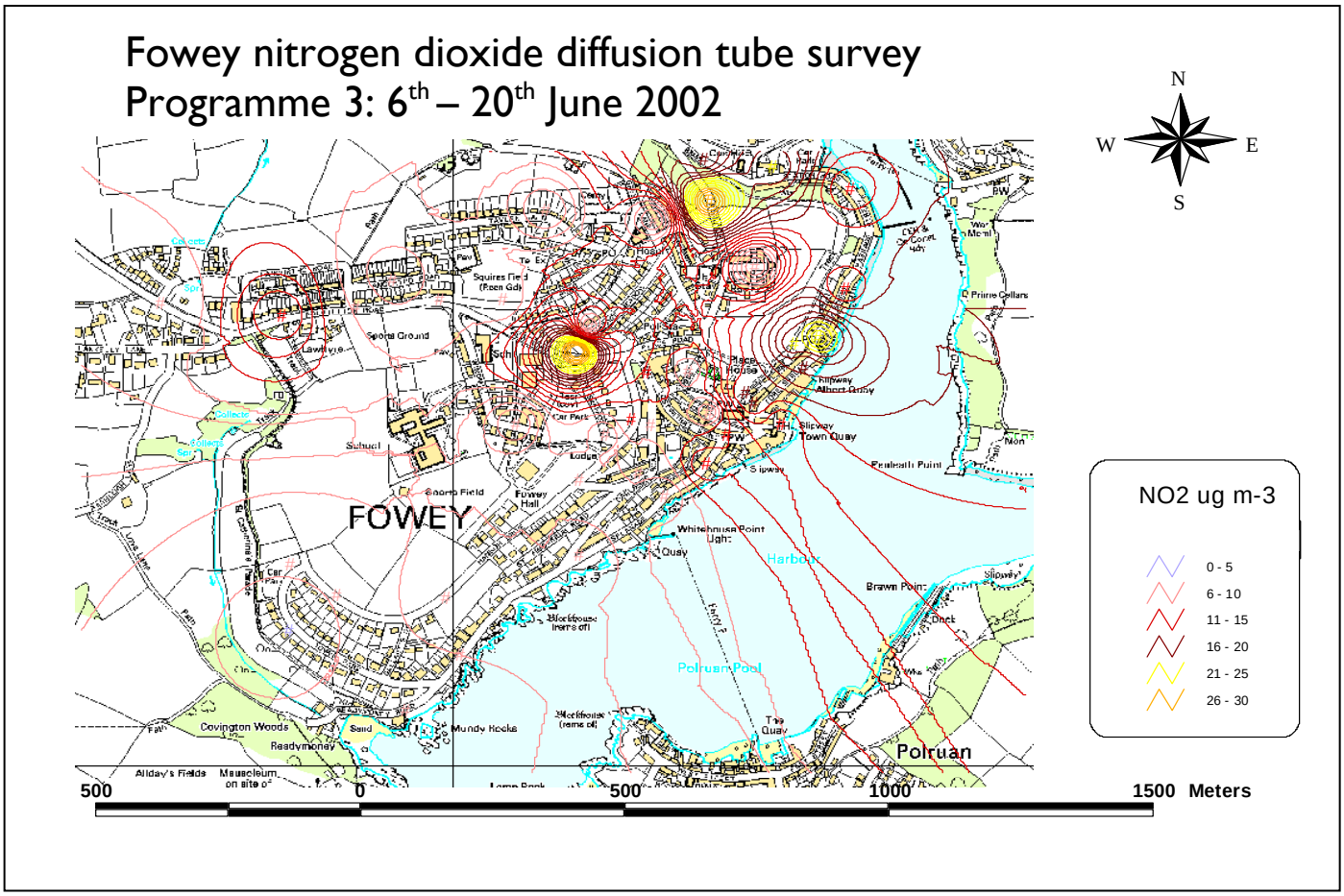


Figure 4

Figure 5 Appendix I



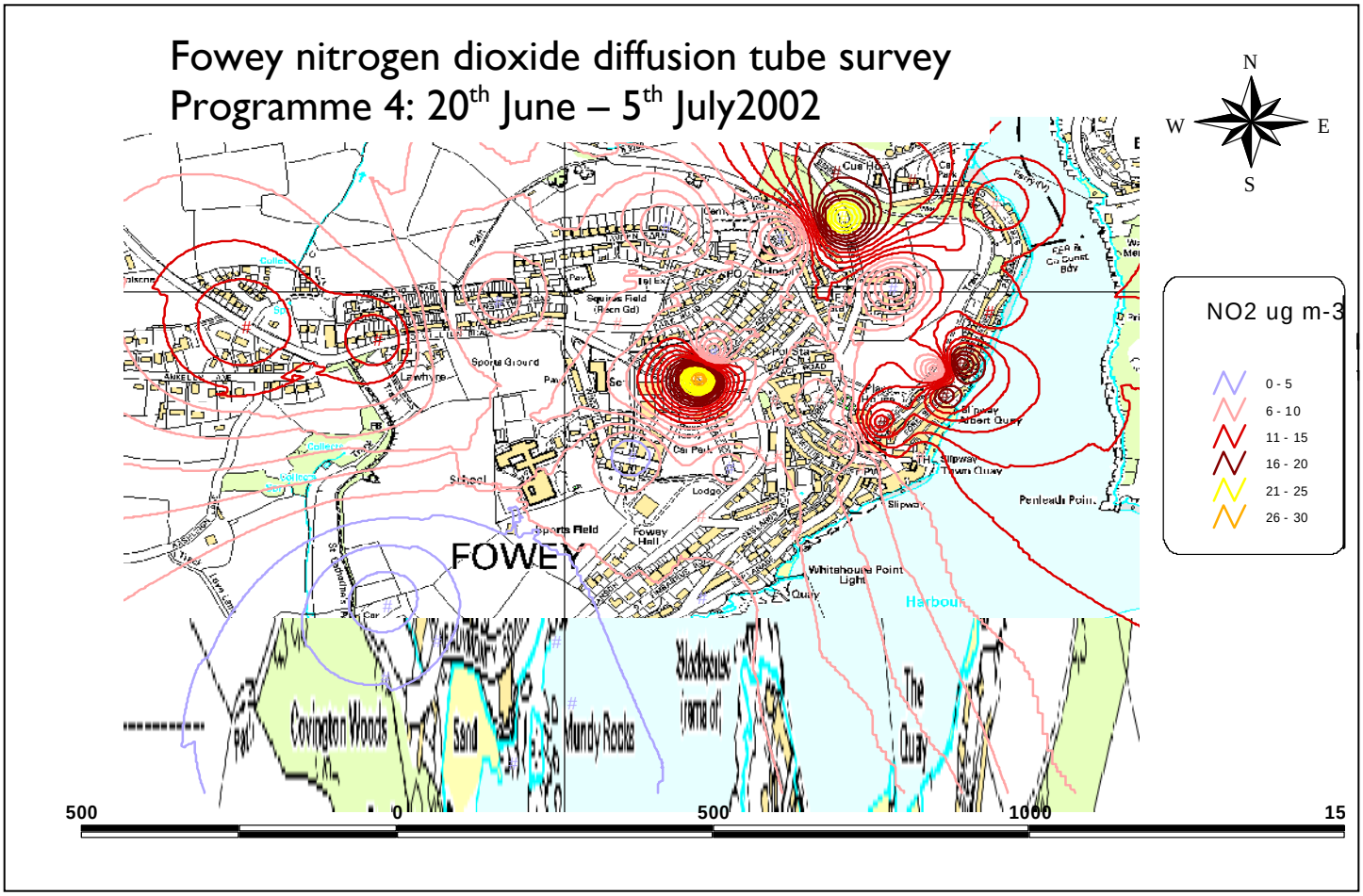
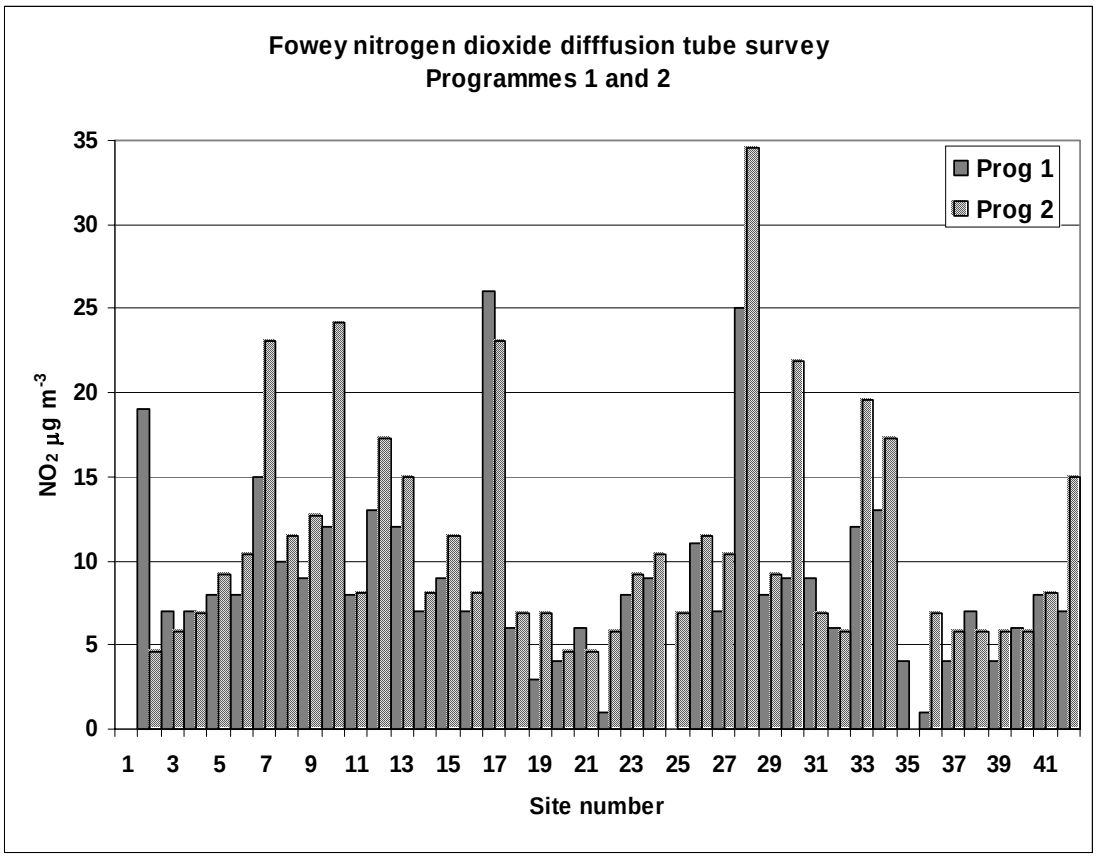


Figure 6

Figure 7



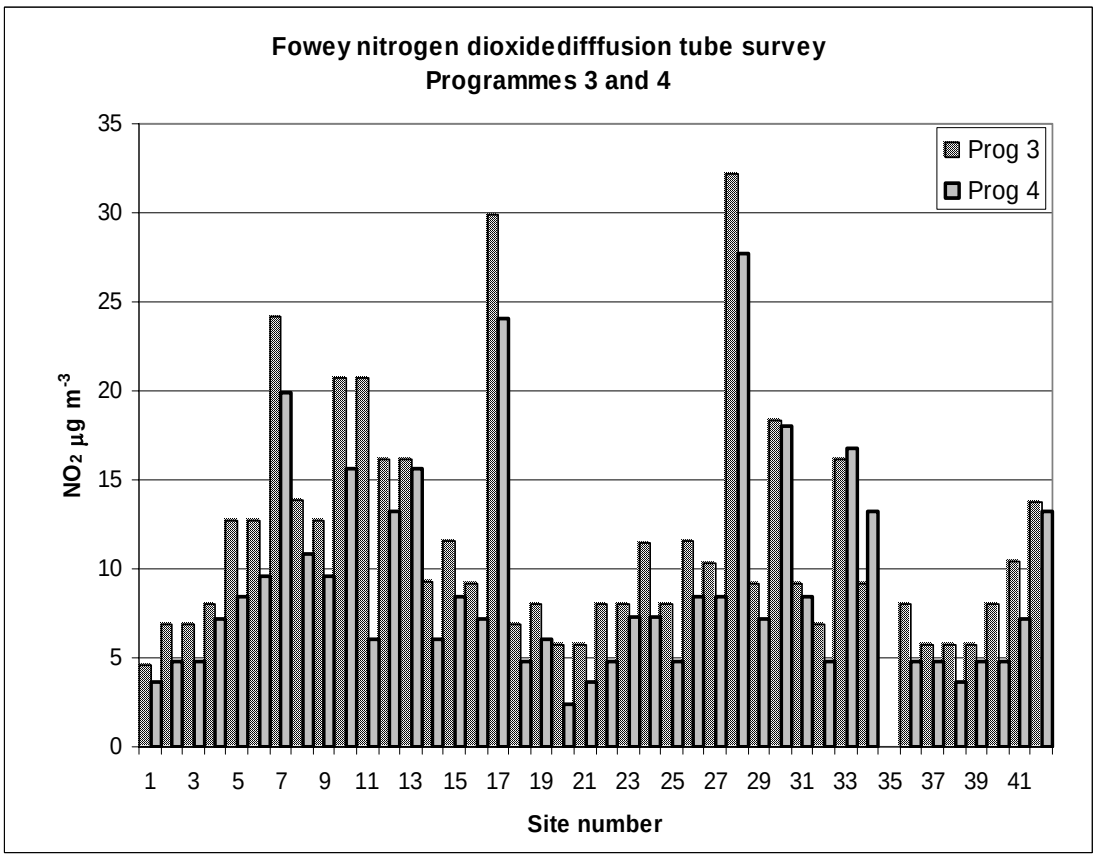


Figure 8

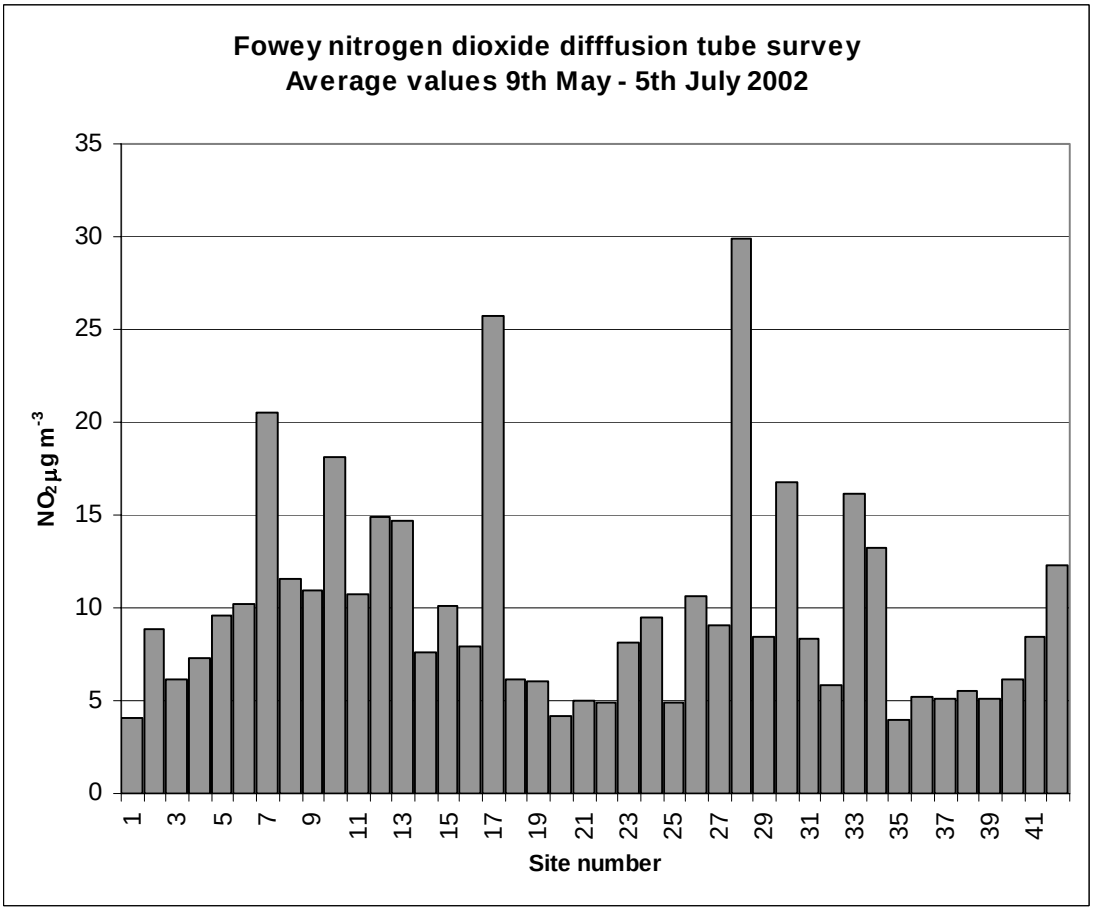

Fowey nitrogen dioxide difffusion tube survey
Average values 9th May - 5th July 2002
NO2 µg m-3
0
5
10
15
20
25
30
35
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
Site number

Figure 9

Fowey nitrogen dioxide diffusion tube survey. 2002

	NO_2 ug m^{-3}	Prog 1	Prog 2	Prog 3	Prog 4	Average
		9th May -	23rd May-	6th June -	20th June-	values
Site	Location	23rd May	6th June	20th June	27th June	
1	Tower Park			5	4	4
2	Esplanade	19	5	7	5	9
3	Esplanade	7	6	7	5	6
4	Esplanade	7	7	8	7	7
5	Esplanade 4	8	9	13	8	10
6	Slip Quay	8	10	13	10	10
7	Fore Stre	15	23	24	20	21
8	North Stre	10	12	14	11	12
9	Passage Stre	9	13	13	10	11
10	Station Roa	12	24	21	16	18
11	Fore Street	8	8	21	6	11
12	Fore Street	13	17	16	13	15
13	Lostwithial	12	15	16	16	15
14	Daglands Roa	7	8	9	6	8
15	Lostwithial	9	12	12	8	10
16	Cobbs Well	7	8	9	7	8
17	Rawlings Lan	26	23	30	24	26
18	Green Lane	6	7	7	5	6
19	Browns Hill	3	7	8	6	6
20	Tower Park C	4	5	6	2	4
21	Hanson Drive	6	5	6	4	5
22	Hanson Driv	1	6	8	5	5
23	Hanson Drive	8	9	8	7	8
24	Hanson Drive	9	10	11	7	10
25	Saffron Cl Ca	0	7	8	5	5
26	Place Road	11	12	12	8	11
27	Polvillion R	7	10	10	8	9
28	New Road Hill	25	35	32	28	30
29	New Road Hil	8	9	9	7	8
30	Fore Street	9	22	18	18	17
31	Park Road 2	9	7	9	8	8
32	Tavern Barn	6	6	7	5	6
33	Station Road	12	20	16	17	16
34	Polvillion	13	17	9	13	13
35	Langurtho Ro	4				4
36	Langurtho R	1	7	8	5	5
37	Readymoney	4	6	6	5	5
38	Windmill Roa	7	6	6	4	6
39	Off Rawling	4	6	6	5	5
40	Vicarage Mea	6	6	8	5	6
41	Daglands Ro	8	8	10	7	8
42	Polvillion	7	15	14	13	12

Table 2					
A3082 Fowey					
Date		**To Fowey**	**To Newtown**	**2 Way**	**Difference**
09/05/2002	Thursday	2849	2239	5088	610
10/05/2002	Friday	3275	2554	5829	721
11/05/2002	Saturday	2934	2348	5282	586
12/05/2002	Sunday	2472	2015	4487	457
13/05/2002	Monday	2869	2262	5131	607
14/05/2002	Tuesday	3240	2584	5824	656
15/05/2002	Wednesday	3347	2651	5998	696
16/05/2002	Thursday	3189	2580	5769	609
17/05/2002	Friday	3588	2982	6570	606
18/05/2002	Saturday	2799	2244	5043	555
19/05/2002	Sunday	2399	1932	4331	467
20/05/2002	Monday	2762	2130	4892	632
21/05/2002	Tuesday	2521	1931	4452	590
22/05/2002	Wednesday	2803	2183	4986	620
23/05/2002	Thursday	2786	2214	5000	572
24/05/2002	Friday	2797	2150	4947	647
25/05/2002	Saturday	2236	1583	3819	653
26/05/2002	Sunday	2040	1489	3529	551
27/05/2002	Monday	2870	2210	5080	660
Total		53776	42281	96057	
Average		2830	2225	5056	
Table 3					
B3269 Fowey					
Date		**To Fowey**	**To Newtown**	**2 Way**	**Difference**
09/05/2002	Thursday	641	1248	1889	607
10/05/2002	Friday	718	1343	2061	625
11/05/2002	Saturday	692	1242	1934	550
12/05/2002	Sunday	581	1104	1685	523
13/05/2002	Monday	528	1170	1698	642
14/05/2002	Tuesday	750	1450	2200	700
15/05/2002	Wednesday	798	1471	2269	673
16/05/2002	Thursday	686	1333	2019	647
17/05/2002	Friday	667	1237	1904	570
18/05/2002	Saturday	650	1285	1935	635
19/05/2002	Sunday	540	1068	1608	528
20/05/2002	Monday	554	1249	1803	695
21/05/2002	Tuesday	501	1195	1696	694
22/05/2002	Wednesday	602	1274	1876	672
23/05/2002	Thursday	586	1209	1795	623
24/05/2002	Friday	498	1190	1688	692
25/05/2002	Saturday	462	1128	1590	666
26/05/2002	Sunday	433	1067	1500	634
27/05/2002	Monday	553	1210	1763	657
Total		11440	23473	34913	
Average		602	1235	1838	

GRADKO INTERNATIONAL LTD
ST.MARTINS HOUSE , WALES STREET
WINCHESTER, HAMPSHIRE SO23 0RH
TEL : 01962 860331 FAX : 01962 841339
E-MAIL : gradkoint@aol.com

UKAS TESTING
2187

LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER 4370 a

CUSTOMER CORNWALL COLLEGE
Research Dept. Cornwall College, Pool, Redruth, Cornwall.

DATE SAMPLES RECEIVED 27/05/02

Tube Number	Exposure Data Date On	Date Off	Time (hr.)	ug/m3 *	ppb *	TOTAL uG NO2
2 Esplanade 1			335.50	19.08	9.94	0.48
3 Esplanade 2			335.50	6.74	3.51	0.17
4 Esplanade 3			335.50	6.74	3.51	0.17
5 Esplanade 4			336.00	7.85	4.09	0.20
6 Slip Quay			336.00	7.85	4.09	0.20
7 Fore Street			336.00	14.57	7.59	0.36
8 North Street			336.00	10.09	5.25	0.25
9 Passage Street			336.00	8.97	4.67	0.22
10 Station Road			336.50	12.31	6.41	0.31
11 Fore Street Alley			336.00	7.85	4.09	0.20
12 Fore Street/Quay			337.00	13.41	6.99	0.34
13 Lostwithial Street/Ally			336.00	12.33	6.42	0.31
14 Daglands Road 1			336.00	6.73	3.50	0.17
15 Lostwithial Street			336.00	8.97	4.67	0.22
16 Cobbs Well			336.00	6.73	3.50	0.17
17 Rawlings Lane			336.00	25.78	13.43	0.64
18 Green Lane			336.00	5.60	2.92	0.14
19 Browns Hill			336.50	3.36	1.75	0.08
20 Tower Park Car Park			341.00	4.42	2.30	0.11
21 Hanson Drive 1			341.00	5.52	2.88	0.14
22 Hanson Drive 2			341.00	1.10	0.58	0.03

NB : Results are blank subtracted

Uncertainty of Measurement 2.06%+/-
Run on UVS 01

Limit of Detection 0.00ug
(To 2 decimal places)

Analyst Signature

Analyst Name E Campbell

Date of Analysis 27/05/02

Date of Report 27/05/02

Analysis carried out in accordance with documented in-house Laboratory Method GLM6

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures
Calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS Accreditation . Those results obtained using exposure data shall be indicated by an asterisk.
Expressions of Opinions and Interpretations are not included in Gradko International Ltd U.K.A.S accreditation schedule
Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd.

GRADKO INTERNATIONAL LTD
ST.MARTINS HOUSE , WALES STREET
WINCHESTER, HAMPSHIRE SO23 0RH
TEL : 01962 860331 FAX : 01962 841339
E-MAIL : gradkoint@aol.com

UKAS TESTING
2187

LABORATORY ANALYSIS REPORT

NITROGEN DIOXIDE IN DIFFUSION TUBES BY U.V.SPECTROPHOTOMETRY

REPORT NUMBER 4370 b

CUSTOMER CORNWALL COLLEGE
Research Dept. Cornwall College, Pool, Redruth, Cornwall.

DATE SAMPLES RECEIVED 27/05/02

Tube Number	Exposure Data Date On	Date Off	Time (hr.)	ug/m3 *	ppb *	TOTAL uG NO2
23 Hanson Drive 3			340.50	7.74	4.03	0.20
24 Hanson Drive 4			341.50	8.82	4.60	0.22
26 Place Road			337.50	11.16	5.81	0.28
27 Polvillion Road 3			335.50	6.74	3.51	0.17
28 New Road Hill 1			337.50	24.55	12.79	0.61
29 New Road Hill 2			336.00	7.85	4.09	0.20
30 Fore Street 2			336.00	8.97	4.67	0.22
31 Park Road 2			336.00	8.97	4.67	0.22
32 Tavern Barn			336.00	5.60	2.92	0.14
33 Station Road 2			336.00	12.33	6.42	0.31
34 Polvillion Road 2			336.50	13.43	7.00	0.34
35 Langurtho Road 1			335.50	4.49	2.34	0.11
36 Langurtho Road 2			336.00	1.12	0.58	0.03
37 Readymoney Road			340.50	4.42	2.30	0.11
38 Windmill Road			336.00	6.73	3.50	0.17
39 Off Rawlings Lane			336.00	4.48	2.34	0.11
40 Vicarage Meadow			336.00	5.60	2.92	0.14
41 Daglands Road 2			336.00	7.85	4.09	0.20
42 Polvillion Road 1			337.00	6.71	3.49	0.17
Customer Blank			341.50	0.00	0.00	0.00
Customer BLK			341.50	0.00	0.00	0.00

NB : Results are blank subtracted

Uncertainty of Measurement 2.06%+/-
Run on UVS 01

Limit of Detection 0.00ug
(To 2 decimal places)

Analyst Signature

Analyst Name E Campbell

Date of Analysis 27/05/02

Date of Report 27/05/02

Analysis carried out in accordance with documented in-house Laboratory Method GLM6

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures
Calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS Accreditation . Those results obtained using exposure data shall be indicated by an asterisk.
Expressions of Opinions and Interpretations are not included in Gradko International Ltd U.K.A.S accreditation schedule
Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd.