



Air Quality

Detailed Assessment 2004

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Abstract Summary

This is the Detailed Assessment of Air Quality in the New Forest.

This was required as the 2003 Updating and Screening Assessment of Air Quality predicted possible exceedances of the UK Standards and Objective for Benzene, Nitrogen Dioxide and Sulphur Dioxide within the New Forest.

This assessment required additional monitoring and modelling of pollution sources.

It was determined that;

Benzene

No likely exceedances of 2010 annual mean objective. Monitoring to be undertaken in Fawley village

Nitrogen Dioxide

Likely exceedances of 2005 Annual mean objective in Lyndhurst and Totton. Monitoring using real time analysers to be undertaken.

Sulphur Dioxide

No likely exceedances of 2005 15min mean objective. Monitoring will continue in Fawley and Holbury.

New Forest District Council will be declaring Air Quality Management Areas with regard to the Nitrogen Dioxide 2005 Annual Mean objective in Lyndhurst (vicinity of High Street) and Totton (vicinity of Junction Road).

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1.0 INTRODUCTION

The Updating and Screening Assessment (USA) of Air Quality in the New Forest ¹, submitted to DEFRA in 2003 was a desk top exercise designed to enable local authorities to identify, using data gathered and predictive models the likelihood of exceedances of the standards and objectives set for seven pollutants Carbon Monoxide, Benzene, 1, 3 butadiene, Lead, Nitrogen Dioxide, Sulphur Dioxide and PM10.

The second stage of the review and assessment or Detailed Assessment required that any exceedances of objectives were investigated using specified monitoring techniques and Dispersion Models.

It was necessary for New Forest District Council to proceed to the second stage with regard to the following pollutants;

Benzene	2010 annual mean objective (Hardley, Hythe)
Nitrogen Dioxide	2005 annual mean objective (Lyndhurst and Totton)
Sulphur Dioxide	2005 15 min mean objective (Fawley village, Hythe and Marchwood)

This is the detailed Assessment for New Forest District Council with regard to these pollutants

2.0 BENZENE

The Government has adopted a running annual mean concentration of $16.25 \mu\text{g}/\text{m}^3$ (5ppb) as the objective for the standard to be reached by the end of 2003.

A tighter objective for benzene has been set, this additional objective is for an annual mean of $5 \mu\text{g}/\text{m}^3$ (1.5ppb) to be achieved by the end of 2010 in England and Wales.

A detailed assessment of the Hythe petrol storage Terminal was required with regard to the 2010 annual mean objective of $5 \mu\text{g}/\text{m}^3$. (1.5 ppb)

The fuel storage depot at Hythe, although it was not likely to give rise to exceedances of the 2003 annual mean benzene objective, the USA indicated that further investigation was required as there may be a risk of the 2010 benzene objective being exceeded due to the proximity of residential properties.

Further investigation would provide New Forest DC with a guide to the real concentrations of benzene at the nearest residential properties to the terminal.

2.1 Monitoring

In accordance with LAQM.TG (03)² measured data is expected to give a more accurate indication of benzene concentrations than modeling studies, particularly when fugitive emissions e.g. from refineries or petroleum storage facilities are of the greatest significance.

2.2 Description

Monitoring was undertaken using diffusion tubes supplied and analysed by GRADKO International Ltd and exposed for periods of four weeks for a three-month period during the summer starting July 2003 and three months over the winter period starting Dec 2003

Gradko analytical technique APPENDIX A

2.3 Location

The tubes were positioned at points of relevant public exposure, in this instance the nearest residential properties to the Hardley Terminal. All were within 250m of this source.

Tubes were exposed at a height of 3m above ground level on the facades of residential properties.

Locations detailed in APPENDIX B

2.4 Results

Benzene (parts per billion)	Brackenly (1)	Brackenly (2)	237 Long Lane (3)	Vine Cottage (4)	Rockbourne (5)
Grid reference	SU42900488	SU42900488	SU42900488	SU42900485	RURAL
Exposure periods					
1/7/03 - 28/7/03	0.97	1.04	1.53	0.95	0.76
1/8/03 - 29/8/03	0.36	0.4	0.31	0.31	0.17
2/9/03 - 29/9/03	1.3	1.35	0.4	0.37	1.07
Summer Average	0.88	0.93	0.75	0.54	0.67

2/12/2004 - 5/1/04	0.74	0.69	0.59	0.73	0.32
5/1/04 - 2/2/04	0.39	0.41	0.37	0.48	0.21
2/2/04 - 2/3/04	0.51	0.49	0.39	0.27	0.22
Winter Average	0.55	0.53	0.45	0.49	0.25

Annual Average 2003/2004 (ppb)	0.71	0.73	0.60	0.52	0.46
2010 Objective 5Ugm3 (1.5ppb)	Below	Below	Below	Below	Below

2.5 Adjustment

No collocation studies were possible, as we did not have access to a reference sampler, however the duplicate site at Brackenly showed consistent and comparable results during the monitoring period.

The diffusion tube results were used for validating the modeling exercise, refer to model validating for further information in supporting document; Air Quality Modelling Study, New Forest DC, April 2004, Faber Maunsell.

2.6 Discussion

The diffusion tube study over the monitoring period indicates that the present levels at relevant receptors were below the 2010 objective.

Bearing in mind that emissions of Benzene from vehicles and storage and distribution of petrol is likely to be further reduced through current and future EU legislation we would predict that the levels in 2010 will be below the present 2010 objective.

2.7 Modelling

Faber Maunsell was contracted by New Forest DC to undertake a modeling study with regard to benzene in the Waterside Area, taking into account all benzene emissions from Industrial sources and relevant receptors.

2.8 Description

The modeling exercise, validation methods, results and discussion are detailed fully in supporting document; Air Quality Modelling Study, New Forest DC, April 2004, Faber Maunsell.

2.9 CONCLUSION

The monitoring and modelling studies showed that the 2003 objective was not likely to be exceeded at any relevant location within the study area,

The modelling study did predict a current level of $7 \mu\text{g}/\text{m}^3$ in Fawley village, which would exceed the 2010 objective.

Bearing in mind that emissions of Benzene from vehicles and storage and distribution of petrol are likely to be further reduced through current and future EU legislation we would predict that the levels in 2010 would be below the present 2010 objective.

New Forest DC will consider further diffusion tube monitoring in this area in order to validate the modelling.

New Forest DC do not intend at the present time to declare an Air Quality Management Area (AQMA) with regard to Benzene.

3.0 NITROGEN DIOXIDE

There are two UK air quality objectives for nitrogen dioxide; an annual mean concentration of 40 $\mu\text{g}/\text{m}^3$ and a 1 hour mean concentration of 200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times per year. Both are to be achieved by the end of 2005.

Following the Authority's updating and screening assessment (April 2003), it was concluded that a detailed assessment was required for nitrogen dioxide (NO_2) in High Street, Lyndhurst and in the vicinity of the railway crossing in Junction Road, Totton.

The detailed assessment is with regard to the 2005 annual mean objective of 40 $\mu\text{g}/\text{m}^3$.

3.1 Monitoring

In accordance with LAQM.TG (03)² measured data is expected to give a more accurate indication of Nitrogen Dioxide concentrations than modeling studies

3.2 Description

The concentration of NO_2 was determined using diffusion tubes (50% TEA (triethanolamine)/Water) prepared and analysed by Gradko International Ltd. The tubes were exposed to ambient conditions for approximately 28 days, after which further diffusion tubes replace them.

Gradko Analytical Technique APPENDIX C

3.3 Location

The tubes were positioned at points of relevant public exposure, either on lampposts or building facades at a height of approximately 3m. The locations were selected in accordance with Technical Guidance LAQM. TG(03).

Locations detailed in APPENDIX D

3.4 Results

Lyndhurst

Full monthly results detailed in APPENDIX E

Grid Ref	SU298083	SU298083	SU298082	SU299082	SU300082	SU299082	SU299083	SU299083
Dates	Lyndhurst (1)	Lyndhurst Bakery (2)	Lyndhurst (Jewellery) (5)	Lyndhurst (Tea Shop) (28)	Lyndhurst (Tea Shop) (29)	Lyndhurst (Health Shop) (31)	Romsey Rd B&B (32)	Romsey Road (33)
Measured annual mean (μgm^3)	28.11	47.15	49.69	33.24	31.92	41.35	25.56	29.49
Annual Mean Using BIAS adj Factor A of 1.04 (from co location studies)	29.23	49.04	51.68	34.57	33.20	43.00	26.58	30.67
Projected Annual Mean for 2005 using correction factor 0.941 (box 6.6 technical guidance LAQM.TG(03))	27.71	46.48	48.99	32.77	31.47	40.76	25.19	29.07
2005 Annual mean objective of 40 (μgm^3).	below	above	above	below	below	above	below	below

Totton

Full monthly results detailed in APPENDIX E

Grid Ref	SU362130	SU363130	SU362131	SU362131	SU362132	SU359132	SU358133	SU361135
Dates	Rumbridge St (16)	Junction Rd 1 (17)	Junction Rd 2 (18)	Junction Rd 2 (19)	Junction Rd 3 (20)	Asda (21)	Esso (22)	Totton Library (23)
Measured annual mean (μgm^3)	33.82	44.11	49.57	45.62	39.19	37.88	39.78	28.25
Annual mean Using BIAS adj Factor A of 1.04 (from co location studies)	35.17	45.88	51.56	47.44	40.76	39.39	41.38	29.38
Projected Annual Mean for 2005 using correction factor 0.941 (box 6.6 technical guidance LAQM.TG(03))	33.34	43.49	48.87	44.97	38.64	37.34	39.22	27.85
2005 Annual mean objective of 40 (μgm^3).	below	above	above	above	below	below	below	below

3.5 Adjustment

Triplicate diffusion tubes collocated next to chemiluminescent analysers at two New Forest AQ Stations, for 12-month period.

Bias factor calculated by Air Quality Consultants on behalf of DEFRA ³. A further correction factor is then used to calculate the projected annual mean for 2005.

3.6 Discussion

Lyndhurst

The diffusion tube results showed a consistent exceedance of the 2005 Annual Mean objective at 3 relevant locations in the High Street. Following the addition of bias and correction factors, these three sites are still predicted to exceed the annual mean objective of $40 \mu\text{gm}^{-3}$. It is also worth noting that the traffic flows are unlikely to decrease significantly in this location by 2005.

New Forest DC has been unable to determine hourly means at these locations by the use of diffusion tubes. However studies⁴ have shown that the hourly objective is unlikely to be met if the annual mean exceeds $60 \mu\text{g m}^{-3}$. This is not the case from the diffusion tube data. Although further investigations into this objective will be required.

Totton

The diffusion tube results showed a consistent exceedance of the 2005 Annual Mean objective at 5 relevant locations in Junction Road where traffic is often stationary when the railway level crossing gates closed. Following the addition of bias and correction factors, three sites are still predicted to exceed the annual mean objective of $40 \mu\text{g m}^{-3}$ and the other two sites are still predicted as close to the objective. It is also worth noting that the traffic flows are unlikely to decrease significantly in this location by 2005.

New Forest DC was concerned that the situation may be exacerbated with the development of Dibden Bay Port and the increase in rail freight. However due to the recent rejection of the Dibden Bay Port will mean that the level crossing gates will continue to operate at the same frequency and will not be closing more often. (Subject of course to changes in rail timetables.)

New Forest DC has been unable to determine hourly means at these locations by the use of diffusion tubes. However studies⁴ have shown that the hourly objective is unlikely to be met if the annual mean exceeds $60 \mu\text{g m}^{-3}$. This is not the case from the diffusion tube data. Although further investigations into this objective will be required.

3.7 CONCLUSION

The 12-month monitoring studies using passive diffusion tubes at Lyndhurst and Totton have indicated likely exceedances of the annual mean objective for Nitrogen Dioxide.

Therefore, New Forest District Council will be declaring Air Quality Management Areas in both Lyndhurst and Totton with regards to the Nitrogen Dioxide 2005 Annual Mean objective.

In order to establish more accurate NO₂ levels New Forest DC have undertaken to monitor NO₂ concentrations at both areas at relevant locations using chemiluminescent analysers.

Totton site is now operational subject to commissioning and hourly mean data will now be available.

Lyndhurst High Street is very narrow and unsuitable for roadside cabinets, New Forest DC are currently in negotiation with local businesses to provide a secure and relevant site for an analyser.

4.0 SULPHUR DIOXIDE

The UK has adopted three objectives with regard to sulphur dioxide;

15 -minute mean objective of $266 \mu\text{g}/\text{m}^3$ as an air quality standard for sulphur dioxide with an objective for the standard not to be exceeded more than 35 times in a year by the end of 2005.

1-hour mean objective of $350 \mu\text{g}/\text{m}^3$ not to be exceeded more than 24 times a year, to be achieved by 2004.

24 –hour objective of $125 \mu\text{g}/\text{m}^3$ not to be exceeded more than 3 times a year to be achieved by the end of 2004.

Following the Authority's updating and screening assessment (April 2003), it was concluded that a detailed assessment was required for sulphur dioxide (SO_2) in Fawley, Hythe and Marchwood villages. The detailed assessment is with regard to the 15 min mean not to be exceeded more than 35 times a year, to be achieved by Dec 2005 and was undertaken by monitoring and modeling.

The sources of SO_2 in Fawley are from industry and shipping, In Hythe and Marchwood the potential source of SO_2 is from shipping.

4.1 Monitoring

In accordance with LAQM. TG(03)² measured data is expected to give a more accurate indication of Sulphur dioxide concentrations than modeling studies.

Continuous Monitoring of sulphur dioxide has been undertaken in Fawley since 2002 and Holbury since 2001.

Sulphur Dioxide from shipping with regard to the 15 min mean objective has not been monitored in Hythe or Marchwood.

4.2 Description

Monitoring of sulphur dioxide in Fawley and Holbury has been undertaken using a UV fluorescent analysers located in residential locations namely the village hall and the grounds of a local school. APPENDIX F

The data capture for the sites has been above 90% for all years in operation.

4.3 Results

Fawley

(Fawley, 1/1/2002 - 31/12/2002)

	SO ₂	SO ₂	SO ₂
	µg/m ³	µg/m ³	µg/m ³
Period	1 hour	15 minute	24 hours
Mean	7.0	7.1	7.1
Minimum	0.0	0.0	0.5
Maximum	370.2	533.6	72.0
Exceedences			
15 minutes		37	
1 Hour	1		
24 Hour			0
Capture	92.1%	90.1%	94.4%

(Fawley, 1/1/2003 - 31/12/2003)

	SO ₂	SO ₂	SO ₂
	µg/m ³	µg/m ³	µg/m ³
Period	1 hour	15 minute	24 hours
Mean	10.2	7.4	10.4
Minimum	0.0	0.0	0.6
Maximum	675.2	1392.6	178.9
Exceedences			
15 minutes		19	
1 Hour	7		
24 Hour			1
Capture	94.0%	95.9%	97.5%

Holbury*(Holbury, 1/1/2001 - 31/12/2001)*

		SO ₂	SO ₂	SO ₂
		µg/m ³	µg/m ³	µg/m ³
Period		1 hour	15 minute	24 hours
Mean		6.5	6.5	6.6
Minimum		0.2	0.0	0.0
Maximum		216.2	502.7	67.0
Exceedences				
15 Minute			5	
1 Hour		0		
24 Hour				0
Capture		93.5%	95.5%	97.5%

(Holbury, 1/1/2002 - 31/12/2002)

		SO ₂	SO ₂	SO ₂
		µg/m ³	µg/m ³	µg/m ³
Period		1 hour	15 minute	24 hours
Mean		5.8	5.8	5.8
Minimum		0.1	0.0	0.5
Maximum		299.5	549.2	63.5
Exceedences				
15 Minute			15	
1 Hour		0		
24 Hour				0
Capture		95.4%	97.5%	99.5%

(Holbury, 1/1/2003 - 31/12/2003)

		SO ₂	SO ₂	SO ₂
		µg/m ³	µg/m ³	µg/m ³
Period		1 hour	15 minute	24 hours
Mean		5.7	5.7	5.7
Minimum		0.1	0.0	0.6
Maximum		316.7	537.8	67.4
Exceedences				
15 Minute			15	
1 Hour		0		
24 Hour				0
Capture		95.4%	97.5%	99.5%

4.4 Adjustment

The results obtained from the analysers have been fully ratified and validated in accordance with LAQM. TG(03)² by Faber Maunsell.

It should be noted that Faber Maunsell, who undertook the data ratification, included two 15 min mean exceedances on 27/10/03 at the Fawley analyser that appear extremely high (over 1000 µg/m³). During this episode the analyser fails to record further concentrations for over an hour, after which time the analyser records low concentrations of SO₂.

To the best of our knowledge there was no manual calibration or maintenance of the analyser. However, it is our opinion that these two exceedances should be disregarded as extremely unusual episodes in view of the periodic shut down of the analyser during the episode.

4.5 Discussion

There were in 2003, 19 (ratified) exceedances of the 15 minute objective for SO₂ at Fawley, in 2002 there were 37 (ratified) exceedances.

The permitted number of exceedances over a year is 35. It was also noted, however, that the 37 exceedances in 2002 occurred over 10 days, compared to the 2003 results of 19 exceedances over 11 days.

Therefore the number of exceedances has decreased over the two years of monitoring, however the number of days recording exceedances has remained consistent. This may be attributed to the weather conditions and wind direction of the area.

The Holbury analyser showed no exceedances of the 2005 Sulphur Dioxide 15 min mean objective of over 35 exceedances in a year.

Holbury site recorded 5 exceedances in 2001, and 15 exceedances in both 2002 and 2003.

The main source of SO₂ in the localized area of the Fawley and Holbury analysers is the Esso refinery site. New Forest DC has been working with the refinery with regards to monitoring sulphur dioxide concentrations.

The number of exceedances at Fawley may be a combination of infrequent wind directions and speed, which aligns a number of stacks on the refinery site which emit SO₂ and / or the quality of the crude slate being refined.

This may result in short term, but significant increases in the SO₂ concentrations in a localized area of Fawley.

Holbury and the analyser are very close to the refinery boundary; fortunately the predominant wind direction blows emissions from the refinery away from the residential areas.

Although the number of exceedances has decreased over the last monitoring year, further monitoring at both of the established sites will continue.

4.6 Modelling

Faber Maunsell were contracted by New Forest DC to undertake a modeling study with regard to sulphur dioxide in the Waterside Area, taking into account sulphur dioxide emissions from shipping and industrial sources (combined and individually) and relevant receptors.

4.7 Description

The modeling exercise, validation methods, results and discussion are detailed fully in; Air Quality Modelling Study, New Forest DC, April 2004, Faber Maunsell.

4.8 Comments

The model only predicted exceedances within the refinery site boundary, however high concentrations of Sulphur dioxide were predicted within the residential area of the village.

The model also shows that shipping is the main source of SO₂ in the Marchwood area (greater than 50%), but only a minor contributor to Sulphur dioxide concentrations in Fawley (10%).

4.9 CONCLUSION

Clearly the 15min SO₂ levels in Fawley village are of concern, the number of exceedances over the past two years has been relatively high, recent monitoring and modeling have both shown that the 2005 objective will not be exceeded in Fawley.

Based on this evidence New Forest DC will not be declaring an AQMA with regard to the 15min SO₂ objective in Fawley.

New Forest DC will continue to work closely with both Esso and the Environment Agency to ensure that this objective is achieved.

REFERENCES

1. New Forest District Council (2003) Updating and Screening Assessment.
2. DEFRA (2003) Local Air Quality Management. Technical Guidance. LAQM.TG(03)
3. Air Quality - NO₂ diffusion tube collocation
Review and Assessment Website (<http://www.uwe.ac.uk/agm/review/index.html>)
4. Analysis of the relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. **Prof D. Laxen and Dr B. Marner** July 2003