11.0 AIR QUALITY

11.1 Introduction

Background

11.1.1 The only significant source of atmospheric emissions from the Sleaford REP would be the main chimney, containing a single flue. These emissions would be regulated by the Environment Agency under the terms of a PPC Permit and would comply with the requirements of the Large Combustion Plant Directive.

Methodology

11.1.2 The assessment contains the following sections:

- a statement of the current air quality standards and guidelines which apply to the pollutants which would be released from the plant;
- an assessment of the current air quality in the vicinity of the site;
- a description of the methodology used in the air dispersion modelling, including assumptions and data used;
- a description of the results of the air dispersion modelling, including dispersion diagrams;
- conclusions.

11.2 Air Quality Standards and Guidelines

11.2.1 In the UK, air quality standards for the major pollutants are described in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 (The National Air Quality Strategy, or NAQS). An Addendum to NAQS was published in 2003, leading to some tighter air quality objectives. The Government published a consultation on the NAQS in April 2006 , in which there were no recommendations for tightening air quality objectives for the protection of human health.

11.2.2 The air quality standards are implemented in a series of Statutory Instruments:

- the Air Quality (England) Regulations 2000 (SI 2000/928), as amended by The Air Quality (England) (Amendment) Regulations 2002 (SI 2002/3043);
- the Air Quality Standards Regulations 2007 (SI 2007/64).

11.2.3 For other pollutants, the Environment Agency (EA) set Environmental Assessment Levels (EALs) in Appendix D to Technical Guidance Note H1: Environmental Assessment and Appraisal of BAT ("TGN H1"). The long term and short term EALs from this document have been used when the NAQS does not contain relevant standards.

11.2.4 Both AQSs and EALs are set at levels well below those at which significant adverse health effects have been observed in the general population and in particularly sensitive groups.

11.2.5 A number of other standards and guidelines are listed for the protection of vegetation and sensitive ecosystems. Some of these are listed in TGN H1 and others are available from the APIS database from English Nature.

Nitrogen Dioxide

11.2.6 All combustion processes produce nitric oxide (NO) and nitrogen dioxide (NO_2), which are together referred to as NOx. In general, the majority of the NOx released is in the form of NO, which then reacts with ozone in the atmosphere to form NO_2. Of the two compounds, nitrogen dioxide is associated with adverse effects on human health, principally relating to respiratory illness.

11.2.7 The major sources of NOx in the UK are road transport and power stations. According to the most recent annual report from the National Atmospheric Emissions Inventory (NAEI), road transport accounted for 46% of UK emissions, with power stations accounting for a further 21%. High levels of NOx in urban areas are almost always associated with high traffic densities.

11.2.8 The NAQS includes two objectives to be achieved by 31 December 2005:

- an annual limit of 40 μg/m^3;

- a limit for the one-hour mean of 200 μg/m^3, not to be exceeded more than 18 times a year (equivalent to the 99.79th percentile).

11.2.9 The NAQS also contains an additional target for the protection of sensitive vegetation and ecosystems.

- an annual limit of 30 μg/m^3.

Sulphur Dioxide

11.2.10 Sulphur dioxide is predominantly released by the combustion of fuels containing sulphur. 66% of UK emissions are associated with power stations, with much of the remainder associated with other combustion processes. Emissions of SO_2 have reduced by 75% since 1970, due to the reduction in coal combustion and the installation of flue gas desulphurisation plants on a number of large coal-fired power stations.

11.2.11 Sulphur dioxide is an irritant when inhaled. The NAQS contains three objectives for the control of SO_2:

- a limit for the one hour mean of 350 μg/m^3, not to be exceeded more than 24 times a year (the 99.73rd percentile) to be achieved by 31 December 2004;
- a limit for the 15 minute mean of 266 μg/m^3, not to be exceeded more than 35 times a year (the 99.9th percentile), to be achieved by 31 December 2005;
- a limit for the daily mean of 125 μg/m^3, not to be exceeded more than 3 times a year (the 99.2nd percentile), to be achieved by 31 December 2004.

11.2.12 The NAQS also contains two additional targets for the protection of sensitive vegetation and ecosystems.

- an annual limit of 20 μg/m^3;
- a winter average limit of 20 μg/m^3.

Particulate Matter

11.2.13 Concerns over the health impact of solid matter suspended in the atmosphere tend to focus on particles with a diameter of less than 10 μm, known as PM10s. These particles have the ability to enter and remain in the lungs. Various epidemological studies have shown increases in mortality associated with high levels of PM10s, although the underlying mechanism for this effect is not yet understood.

11.2.14 Significant sources of PM10s are road transport (25%), quarrying (14%), power stations (14%) and other industrial combustion (10%). The NAQS includes two objectives for PM10s to be achieved by the end of 2004 and two objectives to be achieved by 2010:

- an annual limit of 40 μg/m^3, to be achieved by 1 January 2005. (Implemented in the Air Quality Standards Regulations 2007.)
- a provisional annual limit of 20 μg/m^3, to be achieved by 2010. (Not yet included in legislation.)
- a daily limit of 50 μg/m^3, not to be exceeded more than 35 times a year (the 90.4th percentile) to be achieved by 1 January 2005. (Implemented in the Air Quality Standards Regulations 2007.)
- a daily limit of 50 μg/m^3, not to be exceeded more than 7 times a year (the 98.1st percentile) to be achieved by 2010. (Not yet included in legislation.)

11.2.15 In the 2006 consultation on the air quality strategy, it was noted that the European Commission is developing a new Air Quality Directive and that the Commission has recognised that continuing to pursue the indicative 2010 limit values for particles is unlikely to generate a cost effective improvement in air quality. Therefore, it seems unlikely that the 2010 objectives will ever be included in legislation.

11.2.16 There are indications that there will be an increasing focus on PM2.5s in future European legislation, with potential emission limits included in a new draft Air Quality Directive. However, these limits are not yet finalised.

Carbon Monoxide

11.2.17 Carbon Monoxide is produced by the incomplete combustion of fuels containing carbon. By far the most significant source is road transport, which produces 73% of the UK's emissions. Carbon monoxide can interfere with the processes that transport oxygen around the body, which can prove fatal at very high levels.

11.2.18 Concentrations in the UK are well below levels at which health effects can occur. The NAQS includes the following objectives for the control of carbon monoxide:

- a limit for the 8-hour running mean of 11.6 mg/m^3, to be achieved by 31 December 2003;
- a limit for the 8-hour running mean of 10 mg/m^3, to be achieved by 1 January 2005.

Hydrogen Chloride

11.2.19 There are no standards for hydrogen chloride, but the Environment Agency regulates the emissions of HCl. Technical Guidance Note H1 defines the short-term EAL as 800 µg/m^3 and the long-term EAL as 20 µg/m^3. EPAQS have recently recommended a short term EAL of 750 µg/m^3.

Deposition

11.2.20 As stated in section 3.4 of Technical Guidance Note H1, "there are no Environmental Quality Standards in the UK for releases to land by deposition and very little information is available to date from any source on suitable benchmarks." No Maximum Deposition Rates (MDR) have been determined for any of the substances that could be released by the Sleaford REP.

11.2.21 There are no sensitive environmental habitats in the vicinity of the Sleaford REP.

Summary

11.2.22 The table below summarises the air quality standards and guidelines used in the air quality assessment. The sources for each of the values can be found in the preceding sections. Where more than one standard exists for a given averaging period for a given pollutant, the most stringent standard has been used.

Table 11.1: Air Quality Standards (AQS) and Environmental Assessment Levels (EALs)

Pollutant	Limit Value (µg/m3)	Averaging Period	Frequency of exceedence
Nitrogen Dioxide	200	1 hour	18 times per year (99.79th %ile)
	40	Annual	-
Sulphur Dioxide	266	15 minutes	35 times per year (99.9th %ile)
	350	1 hour	24 times per year (99.73rd %ile)
	125	24 hours	3 times per year (99.18th %ile)
Particulate matter (PM10)	50	24 hours	7 times per year (98.1st %ile)
	40	Annual	-
Carbon Monoxide	10,000	8 hours, running	-
Hydrogen chloride	800	1 hour	-
	20I	Annual	-

11.3 Background Air Quality

11.3.1 There is limited air quality monitoring carried out in the vicinity of the site. The available information is reviewed in this section.

Automatic Monitoring Stations

11.3.2 There are only two suitable automatic monitoring stations within 60 km of the site:

- Nottingham, an urban centre site, located 52 km west of the Sleaford plant;
- Market Harborough, a rural site, located 56 km south of the Sleaford plant.

11.3.3 The nitrogen dioxide annual mean concentrations were below the air quality objectives at the Nottingham and the Market Harborough site for both years.

The 99.79%iles of hourly means at both sites were also below air quality objectives.

Table 11.2: Automatic Monitoring Results, Near Sleaford Site

Pollutant	Quantity (µg/m3)	Nottingham		Market Harborough		AQO
		2005	**2006**	**2005**	**2006**	
Nitrogen Dioxide	Annual Average	32.6	33.7	12.7	13.6	40
	99.79th %ile of hourly means	113.0	107.0	59.0	172.3	200
Particulate Matter	Annual mean	23.1	23.9	-	-	40
	98.1st %ile of daily means	44.9	51.3	-	-	50
Sulphur dioxide	Annual Average	10.5	2.5	-	-	-
	99.73rd %ile of hourly means	37.3	24.0	-	-	350

11.3.4 The particulate matter annual mean concentrations were below the air quality objectives at Nottingham, but the air quality objective for the 98.1st percentile of daily means was exceeded at Nottingham in 2006. However, the Nottingham site is an urban centre station, and so measured concentrations of pollutants are likely to be greater than in the rural area around the Sleaford REP.

National Nitrogen Dioxide Survey Results

11.3.5 There are 11 sites within about 25 km of the site that monitored nitrogen dioxide (NO_2) concentrations as part of Defra's national NO_2 diffusion tube survey between 1st January 2005 and 31st December 2006. The monitoring sites considered fall into two categories:

- •Roadside (R), 1-5 m from a busy road (5 sites);
- Urban Background (B), more than 50 metres from any road (6 sites).

11.3.6 The data from the diffusion tube sites has been analysed to give the results shown below.

Table 11.3: Diffusion Tube Survey Results, 2005-2006

Type of Site	Average Concentration of All Tubes		Highest Annual		Highest Monthly	
	2005	**2006**	**2005**	**2006**	**2005**	**2006**
Roadside	31.5	35.1	44.9	38.5	53.0	56.0
Urban Background	17.5	15.0	19.5	20.1	27.0	43.0

11.3.7 The air quality objective of 40 μg/m^3 as an annual average was exceeded at one of the roadside sites – Boston 1N. The annual average was not exceeded at any of the urban background sites.

11.3.8 The background sites are more likely to be representative of the area around the Sleaford REP. The highest annual average at a background site was 20.1 μg/m^3 at Boston 3N.

National Modelling Data

11.3.9 In order to assist councils with their responsibilities under Local Air Quality Management (LAQM), NETCEN have modelled the background concentration of pollutants throughout the UK on a 1 km by 1 km grid. This model is based on known pollution sources and background measurements. The predicted concentrations closest to the site (at 508700, 345800) were as follows:

- Nitrogen dioxide 14.7 μg/m^3 for 2005;
- Sulphur dioxide 3.39 μg/m^3 for 2001;
- PM10 20.8 μg/m^3 for 2005;
- Benzene 0.217 μg/m^3 for 2003;
- Carbon monoxide 0.244 μg/m^3 for 2001;
- 1,3-butadiene 0.089 μg/m^3 for 2003.

11.3.10 All of these predicted concentrations are below the relevant air quality objectives. Since none of the monitoring stations are close to Sleaford, the NETCEN figures have been taken as the background concentrations.

11.4 Air Quality Modelling Methodology

Stack Height Calculation

11.4.1 The first stage of the assessment of the impact on air quality is to select a suitable stack height for the plant. This was done using the method detailed in Technical Guidance Note (Dispersion) D1. The calculation is attached in Appendix 11.1, and gives a recommended stack height of 54 metres above ground level.

Model Selection

11.4.2 The detailed flue gas dispersion modelling was carried out using the computer model ADMS 3.3, developed and supplied by Cambridge Environmental Research Consultants (CERC). This is a new generation dispersion model, which characterises the atmospheric boundary layer in terms of the Monin-Obukhov length and the boundary layer depth. In addition, the model uses a skewed Gaussian distribution for dispersion under convective conditions, to take into account the skewed nature of turbulence. Modules within the model take account of the effect of complex terrain and nearby buildings.

11.4.3 ADMS 3.3 is one of the few dispersion models accepted by the Environment Agency for the prediction of emissions for planning and PPC (Pollution Prevention and Control) purposes.

Atmospheric Chemistry

11.4.4 The plant will release nitric oxide (NO) and nitrogen dioxide (NO_2) which are together referred to as NOx. In the atmosphere, NO will be converted to NO_2 in a reaction with ozone which is influenced by solar radiation. Since the air quality objectives are expressed in terms of NO_2, it is important to be able to assess the conversion rate of NO to NO_2.

11.4.5 ADMS 3.3 includes a chemistry module, which models the progress of this reaction in the atmosphere. This module requires the background concentrations of NO_2, NO and ozone to provided.

11.4.6 This module requires the background concentrations of NO_2, NO and ozone to be provided. These concentrations are available from the Wicken Fen and Market Harborough monitoring sites so the chemistry module has been used in this assessment.

Source and Emissions Data

11.4.7 The principal inputs to the model with respect to the releases from the main stack are shown in Table 11.4.

Table 11.4: Source and Emissions Data

Item	**Unit**	**Value**	
Stack Height	m		60
Effective Internal Stack Diameter	m		1.64
Stack Position (Eastings, Northings)	m, m		508566, 345914
Stack Flue Gas Exit Velocity	m/s		19.97
Flue Gas Conditions			
Temperature	°C		134
Oxygen	% v/v, dry		4.92
Moisture Content	% v/v		16.38
Volume at reference conditions (dry)	Nm^3/s		37.6
	Nm^3/h		135,234
Volume at discharge conditions (wet)	Am^3/s		41.9
	Am^3/h		150,850
Emissions		**Conc. (mg/m^3)**	**Rate (g/s)**
Oxides of nitrogen (as NO2)		300	11.270
Sulphur dioxide		100	3.757
Carbon monoxide		375	14.087
Particulates (PM10)		30	1.127
Hydrogen Chloride		30	1.127
Note: Emission concentrations are for dry flue gas, 6% oxygen.			

11.4.8 The impact of weather data was taken into account by using data from the Meteorological Office for Cambridge weather station for the years 2002-2006, along with cloud cover data from the Cranwell weather station. The Met. Office consider this to be the most representative site for the Sleaford plant, since it is only around 5 miles from the plant.

11.4.9 Five years of data were used to ensure that fluctuations in weather conditions would be accounted for. The wind roses for each year are shown in Figure 11.1.

11.4.10 The presence of adjacent buildings can significantly affect the dispersion of the atmospheric emissions in various ways:

- wind blowing around a building distorts the flow and creates zones of turbulence. The increased turbulence can cause greater plume mixing;
- the rise and trajectory of the plume may be depressed slightly by the flow distortion. This downwash leads to higher ground level concentrations closer to the stack than those which would be present without the building.

11.4.11 It is generally accepted that building effects are only significant for buildings which are taller than one third of the stack height. The only buildings in the vicinity of the stack which are significant are the boiler house and the straw barn #2. The details of the buildings are shown in Table 11.5 below.

Table 11.5: Building Parameters

Item	Unit	Boiler House	Straw Barn #2
Effective Building Height	m	29.2	15.3
Building Length	m	31.2	41.6
Building Width	m	35.0	78.9
Position of building centre (Eastings, Northings)	m, m	508593,345939	508595,345867
Angle of building to north (clockwise)	°	355	355

Sensitive Receptors

11.4.12 The general approach to the assessment of the impact of air quality on human health is to evaluate the highest predicted contribution of the emissions to ground level concentrations of pollutants at any point in the vicinity, irrespective of the occupancy of the location of that highest predicted contribution. In addition, the predicted contribution at a number of sensitive receptors has also been evaluated. These sensitive receptors are shown on Figure 11.2, and listed below.

1. Kirkby La Thorpe School;
2. St Peter’s Church;
3. The Tower House;
4. House 1, The Hoplands;

5. House 2, Milton Way;
6. Bone's Farm.

11.4.13 The impact on sensitive environmental receptors is considered in section 11.4.3

11.5 Results

11.5.1 The full results of the dispersion modelling of the emissions from the plant stack can be found in the table below.

11.5.2 According to the Environment Agency's Technical Guidance Note H1, the contribution to air quality is considered to be insignificant if the short-term contribution is less than 10% of the air quality objective and the long-term contribution is less than 1% of the air quality objective. Those contributions which are not considered to be insignificant are highlighted in Table 11.6 overleaf.

Table 11.6: Stack Emission Dispersion Modelling Results

Pollutant	Measure	Contribution to Ground Level Concentration at point of greatest impact (µg/m3)						Max as % of AQO/ EAL
		2002	2003	2004	2005	2006	Max	
Nitrogen dioxide	Annual Mean	1.40	1.40	0.88	0.74	0.74	1.40	3.5%
	Short term (i)	5.45	2.80	2.97	7.46	0.86	7.46	3.7%
Sulphur dioxide	Short term (ii)	34.89	30.04	34.50	30.45	28.89	34.89	13.1%
	Short term (iii)	26.55	25.29	23.49	26.50	23.24	26.55	7.6%
	Short term (iv)	12.81	10.46	10.60	11.74	12.43	12.81	10.2%
Particulate matter (PM10)	Annual mean	0.48	0.44	0.49	0.46	0.46	0.49	1.2%
	Short term (v)	2.60	2.64	2.70	3.17	3.26	3.26	6.5%
Carbon monoxide	8 hour running mean	91.6	82.5	84.0	99.5	78.0	99.5	1.0%
Hydrogen chloride	Annual mean	0.477	0.444	0.492	0.458	0.464	0.492	2.46%
	Hourly mean	10.05	10.87	9.67	11.44	10.07	11.44	1.53%

Short term measures:
(i) 99.79th %ile of hourly means
(ii) 99.9th %ile of 15 min. means
(iii) 99.73th %ile of hourly means
(iv) 99.18th %ile of daily means
(v) 98.1th %ile of daily means

11.5.3 The following discussion focuses on the contributions to ground level concentrations at the point of greatest impact. This point does not coincide with any of the sensitive receptors shown on Figure 11.2. This is illustrated in the table below, which shows the highest predicted contribution of stack emissions to ground level concentrations of nitrogen dioxide and sulphur dioxide at the sensitive receptors and compares these results with the highest predicted contribution at the point of maximum impact. (The results for other pollutants are similar, but are not shown for clarity.)

11.5.4 It can be seen that the contribution at sensitive receptors is well below the contribution at the point of maximum impact. At sensitive receptors, only the contribution to annual average concentrations of nitrogen dioxide is not considered to be insignificant.

Table 11.7: Stack Emission Dispersion Modelling Results, Sensitive Receptors

Pollutant	Quantity	Maximum Contribution to Ground Level Concentration at Specified Points (µg/m3) 2002-2006						
		School	St Peter's Church	The Tower House	House 1, The Hoplands	House 2, Milton Way	Bone's Farm	Point of Max Impact
Nitrogen dioxide	Annual Mean	0.44	0.72	0.39	0.52	0.35	0.47	1.40
	99.79th %ile of hourly means	1.04	5.31	0.60	No Increase		1.77	7.46
Sulphur dioxide	99.9th %ile of 15 min. means	5.85	8.21	5.89	16.10	11.50	6.21	34.89
	99.73rd %ile of hourly means	4.51	6.27	4.06	13.90	8.34	4.87	26.55
	99.18th %ile of daily means	1.73	3.04	1.57	5.01	4.22	1.89	12.81

Nitrogen Dioxide

11.5.5 The predicted concentrations for nitrogen dioxide are based on the assumption that 10% of the NOx is released as NO2, with the remainder being released as NO and oxidised to NO2 in the atmosphere.

11.5.6 The highest contribution of the stack emissions to the annual average ground level concentration of nitrogen dioxide is predicted to be 1.40 µg/m3, based on 2003 weather data. This peak occurs about 470 metres away from the stack in a north easterly direction and is 3.5% of the air quality objective. This distribution is shown in Figure 11.3.

11.5.7 If the highest contribution is added to the background concentration of 14.7 µg/m3, the total predicted ground level concentration is 16.1 µg/m3, which is well below the AQO of 40 µg/m3.

11.5.8 The highest 99.79th percentile hourly average ground level concentration of nitrogen dioxide from the plant is predicted to be 7.46 µg/m3, based on 2005 weather data. This peak occurs about 880 metres away from the stack in an easterly direction and is 7.46% of the air quality objective. This distribution is shown in Figure 11.4.

11.5.9 It would not be correct to add the peak short-term contribution from the plant to the highest recorded short-term background concentration, since the two peaks would not be coincident in time or space. Instead, Technical Guidance Note H1 recommends that the short-term process contribution should be added to twice the long-term ambient concentration. If the short-term peak is added to two times the background concentration, the total predicted ground level concentration is 36.86 µg/m3, which is less than a fifth of the AQO of 200 µg/m3.

Sulphur Dioxide

11.5.10 The highest contribution to the 99.9th percentile of 15-minute means of ground level concentration of sulphur dioxide is predicted to be 34.89 µg/m3 based on 2002 weather data. This peak occurs about 300 metres away from the stack in a north easterly direction and is 13.1% of the air quality objective. If this short-term peak is added to twice the annual average background concentration of 3.39 µg/m3, the total predicted peak is 41.69 µg/m3, which is around 16% of the air quality objective of 266 µg/m3. This distribution is illustrated in Figure 11.5.

11.5.11 The highest contribution to the 99.73rd percentile hourly average ground level concentration of sulphur dioxide from the plant is predicted to be 26.55 µg/m3, based on 2002 weather data. This peak occurs about 325 metres away from the stack in a north westerly direction and is 7.6% of the air quality objective. If this short-term peak is added to twice the annual average background concentration, the total predicted peak is 33.33 µg/m3, which is less than a tenth of the air quality objective of 350 µg/m3.

11.5.12 The highest contribution to the 99.18th percentile daily average ground level concentration of sulphur dioxide is predicted to be 12.8 µg/m3, based on 2002 weather data. This peak occurs about 330 metres away from the stack in a north westerly direction and is 10.2% of the air quality objective. (Using weather data for the other four years considered, the contribution is predicted to be less than 10% of the air quality objective.) If this short-term peak is added to twice the annual average background concentration, the total predicted peak is 19.59 µg/m3, which is less than 16% of the air quality objective of 125 µg/m3.

Particulate Matter

11.5.13 The highest contribution of the stack emissions to the annual average ground level concentration of particulate matter is predicted to be 0.49 µg/m3, which is 1.2% of the AQO. If the highest contribution is added to the background concentration of 20.8 µg/m3, the total predicted ground level concentration is 21.3 µg/m3, which is well below the AQO of 40 µg/m3.

11.5.14 The highest contribution to the 98.1st percentile of the daily average ground level concentration is predicted to be 3.26 µg/m3, which is 6.5% of the EAL. This distribution is illustrated in Figure 11.6.

11.5.15 If this short-term peak is added to twice the annual average background concentration, the total predicted peak is 44.86 µg/m3, which is less than the air quality objective of 125 µg/m3.

Carbon Monoxide

11.5.16 The highest contribution of stack emissions to the eight-hourly running mean ground level concentration is predicted to be 99.47 µg/m3, which is around 1.0% of the EAL. Therefore, the plant will not make a significant contribution to carbon monoxide levels in the atmosphere. Since the contribution is so low, no diagram for the dispersion is included.

Hydrogen Chloride

11.5.17 The highest contribution to the annual average ground level concentration of hydrogen chloride is predicted to be 0.492 µg/m3, which is 2.5% of the AQO. The highest contribution to the hourly average ground level concentration is predicted to be 11.44 µg/m3, which is 1.53% of the EAL. The distribution of the annual average concentration using 2004 weather data is illustrated in Figure 11.7.

Roughness Sensitivity

11.5.18 The sensitivity of the results to the surface roughness length has been assessed by running the model using 2006 weather data and a roughness length of 0.1, 0.2 and 0.3 metres, representative of root crops and agricultural areas (min and max) respectively. The results for nitrogen dioxide were as follows:

- the contribution to the annual average ground level concentration increased with increasing roughness length. The results were 0.61, 0.74 and 0.83 µg/m3 respectively for the three roughness lengths in 2006;
- the contribution to the 99.79th percentile of the hourly ground level concentration barely changed, being 0.87, 0.87 and 0.89 µg/m3 respectively for the three roughness lengths in 2006.

11.5.19 The selected roughness length of 0.2 metres is considered to be the most suitable roughness length to take account of the combination of flat land and light building density.

Summary

11.5.20 According to Technical Guidance Note H1, emissions are unlikely to lead to significant environmental impacts where:

- the contribution to long term ground level concentrations is less than 1% of the air quality standard; and
- the contribution to short term ground level concentrations is less than 20% of the air quality standard.

11.5.21 It can be seen that the emissions from the plant are unlikely to lead to significant environmental impacts on a short term basis for any of the pollutants except for sulphur dioxide and, marginally, hydrogen chloride. On a long term basis, concentrations of nitrogen dioxide, particulate matter and hydrogen chloride exceed the 1% criterion.

11.5.22 Where environmental impacts cannot be screened out as insignificant, it is necessary to consider the combination of the emissions from the Sleaford REP with background concentrations. In all cases, the air quality objective is not exceeded when background concentrations are considered.

Health Impact Assessment

11.5.23 For all substances released from the Sleaford REP, the most significant effects on human health will arise by inhalation. The air quality standards discussed above have been set by the various authorities at a level which is considered to present minimum or zero risk to human health. It is widely accepted that, if the concentrations in the atmosphere are less than the air quality standards, then the pollutant is unlikely to have an adverse effect on human health.

11.5.24 Rather than attempting to identify the location of the most sensitive groups of people, the approach has been to predict the highest contribution of the plant at any point. The contribution of the plant to the most sensitive people is likely to be significantly lower than the highest contribution.

11.5.25 Therefore, since the highest contribution of the plant to ground level concentrations of any substance is less than 30% of the air quality objective, even under the most adverse conditions, it can be seen that the plant is highly unlikely to have an adverse effect on human health.

Sensitive Environmental Receptors

11.5.26 The Natural England website was used to identify all sensitive environmental areas within 10 km of the plant. The impact of air emissions on more distant sites is generally considered to be negligible.

11.5.27 The most significant areas are Ramsar sites, Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI). There are no significant areas within 10 km of the stack location.

Deposition Assessment

11.5.28 ADMS 3.3 includes two deposition modules.

- dry deposition occurs when material is lost from the plume at the surface of the ground. This is the primary method of deposition for particulate matter. All particulate matter, including metals, was assumed to have a diameter of 10 microns;
- wet deposition occurs when pollutants are washed out of the plume by rain. For most pollutants, this is assumed to depend on the precipitation rate, using the assumptions and equations contained in the ADMS User Guide, section 5.3.4.

11.5.29 Since deposition depends on atmospheric concentrations at ground level and is a long term phenomenon, the weather data used was for 2002 and 2006, which were the years which resulted in the highest annual average ground level concentrations. It was assumed that the plant would operate at the emission limits for the whole year.

11.5.30 The highest deposition rates for each substance are shown in the table below.

Table 11.8: Maximum Deposition Results, [2002-2006]

Substance	Deposition Rate	
	µg/m2/s	mg/m2/day
Nitrogen dioxide	0.031	2.658
Sulphur dioxide	0.036	3.097
Hydrogen chloride	0.011	0.950

11.5.31 For nitrogen, the maximum deposition rate is 2.6598 mg/m2/day, which is equivalent to 9.70 kg NO2/hectare/year, or 2.95 kg N/hectare/year. This occurs around 70 metres from the stack in a westerly direction. In addition, it should be noted that at least 90% of the NOx released by the plant is in the form of NO, which has a much lower deposition velocity than NO2 and is very insoluble so has negligible wet deposition. Therefore, the contribution of the plant to the nitrogen load will be much lower than 2.95 kg N/hectare / year.

11.5.32 The local area is insensitive to nitrogen deposition. There are no sensitive environmental receptors in the vicinity and much of the adjacent agricultural land is treated with fertiliser in order to increase nitrogen levels in the soil.

11.5.33 There are three potential sources of acid deposition from the biomass plant:

- Nitrogen oxides, through dry deposition of nitrogen and wet deposition of NO_3^-;
- Sulphur dioxide, through dry deposition of sulphur and wet deposition of SO_4^{2-};
- Hydrogen chloride, through wet deposition and dry deposition.

11.5.34 These were all combined to give a total acid deposition figure in equivalent H+ ions, keq/hectare/year. The highest predicted acid deposition rate is 0.535keq/ha/yr. This occurs around 300 metres from the stack in a north easterly direction, and is dominated by sulphur dioxide which accounts for 66% of the maximum acid deposition.

11.5.35 The local area is insensitive to acid deposition. There are no sensitive environmental receptors in the vicinity.

Plume Visibility

11.5.36 A plume visibility assessment was carried out, with a water content in the flue gases of 16.4% by volume, or 0.115 kg water per kg dry gas. The results are shown in Table 11.9 below:

Table 11.9: Plume Visibility Results

Weather Data	Percentage of time plume is visible	Longest Visible PlumeLength (m)	Average Visible Plume Length (m)	Percentage of time there is a visible plume greater than stack height	Percentage of time there is a visible plume outside site boundary
2002	47.3%	219.1	49.6	30.3%	2.1%
2003	46.9%	241.7	48.7	29.2%	2.8%
2004	48.0%	246.5	48.9	29.4%	2.8%
2005	48.2%	247.8	53.3	32.3%	5.2%
2006	47.4%	212.3	50.8	30.3%	3.2%
All Data	47.6%	233.5	50.3	30.3%	3.2%

11.5.37 It can be seen that the plume is visible for around 50% of the time, but the visible length is only more than 60 metres (stack height) for around 30% of the time. Most importantly, the visible length is more than 125 metres (the shortest distance from the stack to the north and east perimeters of the site, i.e. in the direction of the prevailing wind) for only around 3.2% of the time, so the visible plume will rarely pass outside the site boundary.

11.5.38 It is worth noting that the plume never reaches the ground while visible. Therefore, the impact can be assessed as "Low" to "Insignificant" when applying the guidance in section 3.8.2 of Technical Guidance Note H1.

11.6 Other Air Quality Impacts

11.6.1 During construction of the proposed facilities, there is the potential for short-term effects to occur, mainly in the form of dust emissions generated by earthmoving activities associated with the following construction operations:

- movement of vehicles and plant on exposed surfaces; and
- regrading and landscaping activity.

11.6.2 It is generally the case that potential nuisance from dust generated during construction activity does not arise until deposited dust levels at residential properties exceed a level of between 130 and 350 mg m-2 d-1. For the majority of small to medium-sized construction projects, it is very unlikely that these levels would be reached, even at properties close to the construction activity (within 100 metres). Even for large construction projects, it is extremely unusual for properties beyond 250 metres to experience elevated dust deposition levels. In addition, fine particulate matter (PM10) is not normally a problem from construction activity, as the particle sizes released are normally coarse. Given that the proposed site is located approximately 550 metres from the nearest residential property, and it is considered to be a small to medium-sized construction project, no material impacts associated with dust would occur.

11.6.3 Notwithstanding the above, measures that could be implemented to prevent the occurrence of dust problems are relatively straightforward and practical. As a consequence, the following would be incorporated into clauses of the construction contract:

- design of working methods to minimise dust generation;
- identification of all potentially dusty activities prior to starting work and incorporation of mitigation;
- misting/watering of all dusty areas on a regular basis during dry periods to reduce dust suspension;

- deployment of street washing /sweeping units to clean deposits from the highway;
- sheeting/covering of all lorry loads of exported/imported/transferred material;
- location of temporary stockpiles of material away from properties and designed to minimise wind blown dust emissions;
- limitations of vehicle speeds on unmade haul roads to <20 km h-1; and
- maintenance of engines on all plant and equipment to minimise exhaust emissions.

11.7 Conclusions

11.7.1 The methodology used in this assessment of the impact on air quality of the Sleaford REP uses a number of conservative assumptions. These include the following:

- it is assumed that the plant will continually operate at its maximum emission limits. In practice, this will not be the case and actual emissions will be less than the limits;
- the maximum ground level concentrations are considered in each case. These concentrations occur in small areas; in general, the concentration will be much lower.

11.7.2 Even with these conservative assumptions, the concentration of all pollutants is less than 10% of the short term air quality standard or guideline, with the exception of sulphur dioxide for which the concentration is up to 13% of the air quality standard.

11.7.3 The concentration of most pollutants is less than 4% of the long term air quality standard or guideline.

11.7.4 The peak long and short term concentrations are combined with pessimistic background concentrations for comparison with air quality standards and guidelines. No breaches of any of the standards or guidelines are predicted.

11.7.5 It can be concluded that the impact on both the local community and the general population from the atmospheric emissions from the Sleaford REP is small.