Chapter 11: Air quality and climate

Introduction

11.1 The updated EIA scoping exercise undertaken by Terence O'Rourke in March 2006 identified the potential effects of the proposed development on local air quality as being of secondary importance and focused on the following issues:

- the reduction in greenhouse gas emissions and other pollutants, that would result from the operation of this wind farm proposal
- traffic-related emissions associated with the proposed development during the construction and operational phase
- fugitive dust emissions that may result during the construction phase.

11.2 These issues suggest that the following pollutants might be of concern:

- carbon dioxide (CO_2)
- sulphur dioxide (SO_2)
- oxides of nitrogen (NO_x)
- particulate matter (PM_{10})
- dust.

11.3 This air quality assessment consists of two distinct parts. In accordance with the Updated EIA Scoping Report (March 2006), this chapter examines the influence of the proposal on the global climate and local air quality.

11.4 The local air quality element primarily examines emissions from traffic and construction activities, whilst the global climate element focuses on two key aspects of renewable energy technologies. These are:

- the level of carbon dioxide and other emission savings that are gained through displacing electricity generated from fossil fuels by conventional means
- the pay-back period, which is described as the length of time needed for the wind farm to produce the amount of energy that was originally used for its component production, transportation and construction.

11.5 There are several sources of information available regarding elements of air quality and these are included in table 11.1.

Air Quality Regulations, 2000
Air Quality (England) Amendment Regulations, 2002
Air Quality Limit Values Regulations 2003 www.hmso.gov.uk/si/si2003/20032121.htm
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DETR, 2000
Air Quality Strategy Objective Concentrations www.airquality.co.uk/archive/laqm/information.php?info=objectives
Baughan, C.J. (1980) Nuisance from road construction: a study at the A31 Poulner Lane Diversion, Ringwood: TRRL Supplementary Report 562. In: DMRB, 1994
BWEA: Calculations for wind energy. http://www.bwea.com/edu/calcs.html accessed April 2006.
Carbon trust website examples of energy efficiency and electricity generation calculations http://www.thecarbontrust.co.uk/carbontrust/low_carbon_tech/dlct2_1_6_4.html
Control of dust from construction and demolition, BRE, 2003
Controlling particles, vapour and noise pollution from construction sites Part 1: Pre-project planning and effective management, BRE 2003. Part 2: Site preparation, demolition, earthworks and landscaping, BRE 2003. Part 3: Haulage routes, vehicles and plant, BRE 2003. Part 4: Materials handling, storage, stockpiles, spillage and disposal, BRE 2003. Part 5: Fabrication processes and internal and external finishes, BRE 2003.
Danish Wind turbine manufacturers association: Wind power note: the energy balance of modern wind turbines December 1997. Available from www.windpower.dk
Department of trade and industry 1999, 2001 ETSU-R-122 New and Renewable Energy: Prospects for the 21st century: supporting analyses)
Department of trade and industry 2001: Efficiency and performance wind energy fact sheet 14
Department of Transport 2004, Transport analysis guidance – Local air quality sub-objective unit 3.3.3 www.web-tag.org.uk accessed April 2006
Design Manual for Roads and Bridges v1.02
Digest of UK energy statistics DUKES 2002 (website accessed April 2006) http://www.dti.gov.uk/administration/page13625.html
Harrop, D. Owen: Air quality assessment and management: a practical guide, SPON Press, London, 2002.
European Commission Directorate General for Energy, 1999: Wind Energy – The facts volume 4 – the environment
Local Air Quality Management, Technical Guidance, LAQM. TG(03), defra, 2003
Minerals Policy Statement 2: Controlling and mitigating the environmental effects of minerals extraction in England Annex 1: Dust. ODPM, March 2005
National Air Quality Information Archive (NAQIA) www.airquality.co.uk
Parliamentary office of Science and technology: memorandum submitted by the renewable power association (U41) and included in the minutes of evidence to the Select Committee on Environment, Food and Rural affairs. http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/130/5011212.htm#note10 accessed April 2006
Quality of Urban Air Review Group, Third report, DoE, 1996
Risk Assessment Method for Local Air Pollution Control, defra, 2004 http://www.defra.gov.uk/environment/airquality/riskam/06.htm
Scottish Natural Heritage, 2000: Technical guidance note: Windfarms and Carbon Savings
Transport Assessment conducted by Entran Ltd. April 2006
Vestas website: http://www.vestas.com/uk/sustainability/energybalance.asp
Wind power in the UK, sustainable development commission, May 2005

Table 11.1: references and data sources

The Global climate

Background

11.6 The following pollutants are the focus of emissions savings when conventional electricity generation is replaced by renewables.

Carbon dioxide (CO_2)

11.7 Carbon dioxide is a gas produced by burning carbon-based material. This includes the combustion of fossil fuels such as coal, oil and gas, which are currently the primary fuel sources for electricity production in the UK. It is CO_2's radiative capacity, or its ability to absorb energy from the sun, coupled with its ubiquitous production that makes it such an effective greenhouse gas, and one that is the focus for tackling climate change.

Sulphur dioxide (SO_2)

11.8 The generation of electricity at conventional power stations is the main source of atmospheric SO_2 (approximately 71.5%; Harrop 2002). In particular SO_2 emissions come from the combustion of sulphur-bearing fossil fuels such as coal and oil. Although diesel fuel is a contributor to ambient concentrations of SO_2, traffic is not considered to significantly affect peak levels. SO_2 can be harmful to health, causing constriction of airways by stimulating nerves in the lining of the nose, throat and airways of the lung.

Oxides of nitrogen (NO_x)

11.9 NO_x refers to oxides of nitrogen and includes NO, NO_2 and N_2O. These gases can be hazardous to human health, vegetation and they also influence the chemistry of the earth's atmosphere. The principal form of NO_x emitted to the atmosphere from industry is NO. Once released into the atmosphere, it mixes and oxidises with other gases, predominantly ozone, to produce NO_2. In the UK, power stations are the second largest producers of NO_x (27.4%) after motor vehicles (49.6%) (source: Harrop 2002).

Acid deposition

11.10 Acid deposition, also commonly known as *acid rain* is a product of NO_x or SO_2 emissions oxidising in the atmosphere. Acid deposition can have direct and indirect effects on ecosystems and the built environment, not only close to the source of the pollution but also much further afield.

Emissions saving

11.11 One of the principal drivers for the development of renewable energy sources is the reduction in volume of greenhouse gases and other pollutants that are produced from conventional, fossil fuel power plants. The main pollutants have been identified above, and are the subject of this analysis.

Electricity generation in the UK

11.12 The extent of the emission savings is dependent on the assumptions included within the calculations, such as identifying the current mix of electricity generating sources that the renewables will replace. Difficulties arise when an accurate prediction of the mix of energy sources is required; for example, the current UK electricity supply is generated from a selection of different sources, including renewables, such as tidal, wave, solar sources and wind, as well as from nuclear and conventional gas, coal and oil fuels. To determine the carbon and pollutant savings accurately, information on precisely the fuel type being replaced at any particular moment in time would need to be identified. However this is dependent on the load, or demand placed on the national grid.

11.13 The British Wind Energy Association (BWEA) states that nuclear energy would not be replaced by wind energy because it contributes to the 'base load' of the national grid and provides energy for the entire time that the plant is available. Although wind (as well as other renewable energy sources) is an intermittent source, it is considered in a similar way to base load in that the energy produced is despatched in preference to that produced by thermal plant for the entire time that the wind plant is available and producing. Electricity produced by wind will therefore displace thermal plant with the direct consequential reduction in pollutants. BWEA also indicates that the most flexible source of fuel is coal, and it mainly follows and satisfies the peaks in demand from the grid.

11.14 Information provided by the Parliamentary Office of Science and Technology confirms this, also stating that nuclear energy is considered the base-load, while coal-fired generation operates inversely to renewable sources of power such as wind; that is to say, when wind-sourced energy production rises, coal use and associated pollutants falls. Additionally, the Parliamentary Office identifies the use of gas-fired turbines of which there are of two types; combined cycle and open cycle. Combined cycle turbines (generally large capacity plant) operate continuously, assisting with the base-load, whilst the open cycle assists with following peaks in demand.

11.15 This assessment examines two scenarios in order to calculate a likely range of emission savings. The first includes the displacement of modern coal plant emissions, which is based on plants operating with modern abatement systems such as low NO_x burners and flue gas desulphurisation equipment. The second scenario assumes that the emissions avoided are not from one single fuel type. The general mix of electricity sources includes those mentioned above. Average emissions data used in the calculations are from the mix of fuels being used in 1993, as this was most frequently cited in the reference sources. As would be expected, the emissions average for the mix of fuels lie between those calculated for gas fired power stations and the modern coal-fired plant.

Life cycle emissions

11.16 Much of the research information available addresses only the operational phase of wind turbines and does not take into account the emissions of greenhouse gases (CO_2) and other pollutants during the production of the components, the construction or the decommissioning of the turbines on site. This is an important aspect of the assessment, since energy expended during construction, deployment and decommissioning is thought to be equivalent to, or even greater than, that arising from the same parts of the life cycles of conventional generating technologies (DTI, 2001). This assessment uses lifecycle figures provided by ETSU-R-122 as cited in the DTI's wind energy fact sheet 14.

11.17 Information provided in the DTI document presents emission factors for renewables as well as from life cycles of the conventional generation technologies provided by ETSU R-122, which takes into consideration mining, processing, transportation, combustion and ash disposal activities.

11.18 The methodology of the calculations for determining emissions savings from wind farms is based on that followed by Scottish Natural Heritage, the Carbon Trust and BWEA, as referenced in table 11.1.

11.19 The key information for these calculations is provided in tables 11.2 and 11.3, with the findings presented in table 11.4.

11.20 The Capacity Factor (CF), identified in table 11.2, is a measure of the actual predicted energy output of the wind farm through its lifetime as a percentage of the energy that would be produced in theory if the plant operated at the full capacity of the generator (the nameplate capacity) over the same period of time. The CF therefore takes into account factors such as the intermittency and variable speed of the wind resource. This is different from the figure highlighted in the proposals chapter for the predicted proportion of time that the turbines are expected to be turning (80%). The capacity factor is lower because the rotors will often be turning at less than full speed, thus generating at below maximum capacity.

11.21 Where there is no site specific data available the BWEA suggests that its members should use a nominal capacity factor of 0.3 (30%) in calculations. This is a conservative CF that should be achieved by a well designed windfarm. YEL has undertaken an independent evaluation of the energy production from the site using wind speed data that are specific to the proposed site and turbine layout and give a CF of 35.5%. This site specific CF has been used in the calculations rather than the generic one.

Turbine output	1.65MW
Number of turbines	6
Power output	9.9MWh
Annual power output	30,800MWh
Site specific wind turbine capacity factor*	0.355
Average UK electricity consumption per household.**	4.7MWh

Table 11.2: operational information for the West Wight wind farm
*Figure, independently verified for YEL.
**Digest of UK energy statistics 2002

11.22 The BWEA has calculated the approximate consumption of electricity per household in the UK based on statistics from the Digest of UK energy statistics, 2002, and while this is only an average it provides an indication of the number of households that will be supplied by the electricity generated by the West Wight wind farm.

11.23 Using the information provided in table 11.2, the number of houses to be supplied with electricity throughout the 25 years of the projects life-time may be calculated. Using ‘annual power output’ / ‘average electricity consumption per household’ the wind farm is expected to supply approximately 6,500 homes.

11.24 The census predicts an Isle of Wight population in 2004 of approximately 138,400. Using the average occupancy rates from the 2001 (2.25 per dwelling) census, this equates to approximately 61,500 dwellings, meaning that the West Wight wind farm will produce enough electricity for approximately 10% of the residential population.

11.25 The expected power output from the wind farm over the 25-year period is the basis from which the displaced emissions may be calculated. Using this figure (770,000MWh) and multiplying it by the figures (kg/MWh in table 11.3) for each of the power sources, the emissions may be determined. These data should be considered with the following qualification, that the future changes in the power generation mix and fuel costs in the UK over the life of the wind farm means that this figure may change over time.

11.26 Table 11.3 includes the emission factors relating to each of the technologies’ life cycle emissions, for specific pollutants.

Lifecycle emissions (kg/MWh)				
	CO_2	SO_2	NO_x	Year of data
Onshore wind	9	0.06	0.02	1999
Coal with desulphurisation and low NO_x abatement	987	1.5	2.9	1999
Average electricity grid mix	654	7.8	2.5	1993

Table 11.3: summary of emission multipliers based on life-cycles of each electricity generating technology
Source of data: DTI 1999 (ETSU - Annex B of *New and Renewable Energy: Prospects in the UK for the 21st century: supporting analysis).*

11.27 Using the information in tables 11.2 and 11.3 onshore wind would therefore be as follows.

Total power output over 25years	x	Mass of CO_2 in kilograms per MWh	=	kg of CO_2 produced
770,000MWh	x	9kg/MWh	=	6,930,000kg (which is equal to 6930 tonnes of CO_2)

11.28 If this sequence of steps is followed for each of the pollutants of interest, this equates to the data presented in columns two, three and four of table 11.4. These quantities of pollutants represent what is produced by each source over the 25-year period, and takes into account (within the multiplication factor provided by ETSU and DTI), the emissions produced in the life-cycle of the electricity generating technology.

11.29 The results in the last two columns of table 11.4 show the difference between the emissions from the wind turbine life-cycle and those for a modern coal plant and the grid mix life-cycles respectively.

Emissions produced in 25 years of electricity generation (tonnes)				Resulting tonnage of emissions savings compared with two electricity production scenarios	
	Wind farm	Modern coal plant (low NO_x, SO_2)	Average grid mix (1993)	Modern coal plant (low NO_x,SO_2	Average grid mix (1993)
CO_2	6,930	759,990	503,580	753,060	496,650
SO_2	46	1,155	6,006	1,109	5,960
NO_x	15	2,233	1,925	2,218	1,910

Table 11.4: summary of emissions savings based on life-cycle of electricity generating technology

11.30 The lower difference in emission shown under average grid mix, is due to its inclusion of renewables in the average multiplication factor. The West Wight wind farm based on the above information are predicted to save, on average, the following annual tonnages:

- between 19,665 and 29,819tonnes of CO_2
- between 44 and 234 tonnes of SO_2
- between 75 and 88 tonnes of NO_x.

11.31 The 'spinning reserve' is a term used to describe the situation where power suppliers maintain their plant operational with no demand load applied. This situation is necessary for supplying power in the event of spikes or additional demand. During the spinning reserve scenario there is no load on the generation of electricity and therefore the emissions during this cycle are minimal. A report produced by the Commission for Sustainable Development (2005) indicates that during the spinning cycle, the emissions savings that are attributed to the renewable energy during operation should be reduced by 1%. This has been included in the annual figures stated above.

Pay-back period

11.32 The emissions calculations provided above take into account the entire life-cycle of the renewable technology, to provide a thorough assessment in determining the impact of electricity production by renewable and conventional means. The same applies to the pay-back period, or energy balance: this is an expression of the time that the turbine must operate to generate as much energy as is used in its entire life cycle, from the extraction of raw materials through manufacture to final disposal. The energy balance can be calculated on the basis of a full life cycle assessment (in accordance with the international standard ISO 14040-43).

11.33 Several studies have been undertaken by wind energy associations and turbine manufacturers. As with any life-cycle analysis calculations, the findings are dependent on the assumptions made in the calculations, though the results do provide an indication of general timescales. The studies quoted by the Sustainable Development Commission (2005) suggest 3 to 10 months as being the typical pay-back period for turbines between 600 kW and 2MW (including energy spent during manufacturing, installation, maintaining and finally decommissioning and scrapping of the components that are deemed un-recyclable).

11.34 Vestas has prepared energy balances for its V80 2MW turbines, and the details are set out on the company website. The consumption figure used for a turbine is 3,635 MWh, while it will produce 112,680 MWh over its 25 year life. The calculations therefore show that it takes 7.7 months for the turbines to generate as much energy as is used in their entire life cycles (when used onshore).

Local air quality

11.35 Local air quality management is focused on the emissions to air from local activities that are attributed to the proposal. This is typically in terms of vehicular exhaust from proposal traffic, or dust arisings from construction activities.

11.36 This element of the assessment focuses on the pollutants outlined below.

Pollutants

Nitrogen dioxide (NO_2)

11.37 During the combustion of fuel in vehicle engines, atmospheric and fuel nitrogen (N_2) is partially oxidised via a series of complex chemical reactions, to form nitric oxide (NO). When emitted into the atmosphere, NO mixes with oxygen (O_2) to form NO_2. Some NO_2 is also formed during combustion and it therefore exists as both a primary and a secondary pollutant. Exposure to elevated short-term and long-term concentrations of NO_2 can give rise to respiratory problems.

Particulate matter (PM_{10})

11.38 Fine particulate matter PM_{10} is a complex mixture of organic and inorganic substances present in the atmosphere in either solid or liquid form. It relates to particulate matter with a diameter of less than 10μm (microns). The size is important as particles of this dimension penetrate deeper into the respiratory system and as a result can potentially be the cause of serious health effects. The PM_{10} classification consists of three components:

- primary sources which result from fuel combustion, traffic and power generation
- secondary sources which result from chemical reactions in the air, mainly nitrates and sulphates
- coarse particles comprise emissions from re-suspended dusts from road traffic, construction works, demolition activities, mineral extraction processes, windblown dusts and soils, sea salt and biological particles.

11.39 In urban areas, road traffic emissions, especially from diesel exhausts, is generally the greatest local source of emissions of fine particulate matter.

Dust

11.40 Dust comprises particles of material of between 1 and 75µm in diameter. The heavier, larger than 30µm fraction is commonly regarded as dust and, due to its larger mass, it does not remain suspended for long periods. The distance travelled depends on factors such as meteorological conditions (especially moisture and wind speed) and soil characteristics such as friability, structure, moisture content.

Legislation and policy

The National Air Quality Strategy

11.41 The National Air Quality Strategy (NAQS) for England, Scotland, Wales and Northern Ireland (2000) sets out the latest and most relevant health-based objectives for managing local air quality. The strategy was first published in 1997 then revised in January 2000; it was designed to fulfil the requirements of the Environment Act 1995, which sets out policies for managing ambient air quality. The strategy and its February 2003 addendum have been adopted into UK policy as the Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2002 respectively. The objectives of the NAQS are based on the recommendations of the Government's Expert Panel on Air Quality Standards (EPAQS) and the European 'Daughter Directives'. The various Daughter Directives implement the Framework Directive for the Assessment and Management of Air Quality (96/62/EC).

11.42 The NAQS objectives consist of ambient air quality concentrations for eight pollutants. Seven of the pollutants have been prescribed in the Air Quality Regulations for the purpose of local air quality management (LAQM). These are carbon monoxide (CO), nitrogen dioxide (NO_2), benzene, 1,3-butadiene, particulate matter (PM_{10}), sulphur dioxide (SO_2) and lead (Pb). LAQM does not include objectives for ozone (O_3) due to its trans-boundary nature.

11.43 Table 11.5 indicates the NAQS objectives for NO_2 and PM_{10}, the two pollutants most closely related to road traffic emissions, which have been identified as being the principal source of any effects on air quality arising from the proposed development.

Air quality objective		Date to be achieved by
Concentration	Measured as	
Nitrogen dioxide (NO_2)		
200µg/m^3 Not to be exceeded more than 18 times per year	1 hour mean	31 Dec 2005
40µg/m^3	Annual mean	31 Dec 2005
Particulate matter (PM_{10}) (Gravimetric European method)		
50µg/m^3 Not to be exceeded more than 35 times per year	24 hour mean	31 Dec 2004
40µg/m^3	Annual mean	31 Dec 2004
50µg/m^3 Not to be exceeded more than 7 times per year***	24 hour mean	31 Dec 2010
20µg/m^3 ***	Annual mean	31 Dec 2010
*** These are provisional figures, not yet included in the regulations. While this means that an AQMA cannot be declared if these figures are likely to be reached, they are nevertheless an important consideration for local authorities.		

Table 11.5: summary of the objectives of the UK Air Quality Strategy

NO_2 and PM_{10}

11.44 The LAQM guidance which controls pollutants such as NO_2 and PM_{10} emissions (amongst others) was published in March 2000 to help local authorities review and assess the current and likely future air quality, as required by Part IV of the Environment Act 1995.

11.45 Where a local authority considers that one or more of the air quality objectives prescribed in the Regulations is unlikely to be met by the due dates, it must declare an Air Quality Management Area (AQMA), covering the area where the problem is expected. AQMAs allow the local authority to develop an Air Quality Action Plan (AQAP) to deliver improved air quality in the relevant area. Local air quality management in this assessment refers to the pollutants of NO_2 and PM_{10} as shown in table 11.5.

Dust

11.46 Currently the only statutory limits for dust are in relation to exposure in work place atmospheres, for example, the Health and Safety Executive publication EH40/01. Dust can be controlled as a statutory nuisance under Part III of the Environmental Protection Act 1990, for which the Environmental Health Department of the local authority is responsible. Under Part IV of the Environmental Act 1995, local authorities have to ensure that dust emissions from construction sites within their areas are adequately controlled.

Methodology

11.47 Local air quality has been addressed by examining the key elements and likely pollutants from the construction and operational phases of the proposal. This section describes the methodologies employed for purposes of assessing the effects on air quality from the construction and operational phase of the proposals.

11.48 The assessment has identified the different key operations and related pollutants that have the potential to affect the local air quality. These include possible dust implications from site clearance, plus traffic emissions from delivery of materials and construction vehicle movements. Once operational, any emissions would primarily be from traffic sources.

11.49 Air quality assessments are designed to determine the incremental increases in pollution concentrations at surrounding sensitive receptors that may arise from a proposal. Once calculated, the resulting concentrations are compared with air quality criteria where applicable, such as the NAQS objectives.

11.50 Three pollutants are examined in this section - NO_2, PM_{10} and dust arisings. NO_2 and PM_{10} are assessed together using the *Design Manual for Roads and Bridges* (DMRB) methodology, whilst the methodology for dust arisings follows a more qualitative assessment, based on deposition zones around likely dust-producing activities. The assessment is therefore split between these two methodologies.

NO_2 and PM_{10}

Desktop baseline

11.51 In order for predictions to be made later in the assessment, it is first essential to understand the current air quality conditions in the vicinity of the proposed site. This is established through a number of keys steps, which are:

- retrieving air quality data from local monitoring programmes such as those run by the local authority
- determining background concentrations from the National Air Quality Information Archive (NAQIA) for 1km x 1km grid squares provided by Netcen
- comparing results with other sources of pollutant monitoring data for verification, such as diffusion tube and automated analyser results.

Local authority review and assessment process

11.52 The IoWC produced its second annual progress report in 2005, which updates air quality monitoring data, and assesses any changes that have occurred since the first progress report dated May 2004. The report concludes that all NAQS objective concentrations will be met by the relevant timescales and therefore is not considering any designation of AQMAs.

11.53 The IoWC completed its second stage review and assessment of air quality and did not declare any AQMAs based on its findings. The subsequent Updating and Screening Assessment (USA) report (February 2004) recommended further detailed studies of benzene and SO_2 concentrations at specified locations. Further benzene monitoring and analysis was required at

East Cowes, while SO_2 monitoring was required at the ports of Fishbourne, Cowes and Ryde. Each of these locations is considerable distance from the proposed site and will not be addressed in this assessment. No other pollutants were predicted to exceed the NAQS objective concentrations for 2005. No AQMA currently exists on the Isle of Wight.

Netcen data for site background

11.54 The NAQIA is a national database that identifies and predicts air quality concentrations for 1km x 1km grid squares across the UK. These are based on 2004 measured values and they provide values for an array of pollutants and future years. Twenty grid squares were chosen that are representative of the proposed development site's area and the location of identified sensitive receptors. Following the guidance provided in the updated LAQM.TG(03) (2006), mapped data were used to calculate NO_2, PM_{10} concentrations for the current year 2006, and the opening year 2008.

IoWC's air quality monitoring programme

11.55 The second phase of the data gathering process is obtaining sampled air quality data. This assessment uses ambient air quality monitoring data from IoWC, which currently undertakes regular NO_2 diffusion tube monitoring at nine locations across the Island.

11.56 The sites are listed in table 11.6.

1. Carisbrooke Castle
2. Cowes High School
3. Medina High School
4. Sandown High School
5. Ryde High School
6. Newport Road, Cowes
7. Fairlee Road Newport
8. Blackwater Service Station
9. Lake Hill Sandown

Table 11.6: IoWC air quality monitoring locations

NO_2 and PM_{10} predictive modelling

11.57 Once the monitoring data and background pollutant concentrations have been reviewed, the *Design Manual for Roads and Bridges* (DMRB 1.02) model is used as an air quality screening tool. The model is used to highlight if air quality is likely to be significantly affected and hence determine if any further detailed assessment is required with more sophisticated predictive tools.

11.58 The DMRB is used for predicting air quality concentrations that result from changes in traffic flow and composition. Its calculations are derived from input data such as sensitive receptor location, distance from busy roads or junctions and composition of traffic, such as percentage of HGV vehicles. The air quality input data comprise background concentrations from the year of interest, such as those determined by NAQIA in the desk-top assessment.

11.59 By its nature the DMRB screening model tends to overestimate its predictions, therefore, in order to obtain predictions that are more representative with sampled data, a model validation process is usually undertaken.

11.60 The validation of the DMRB predictions is carried out by comparing the findings with ratified monitoring data such as that from diffusion tube monitoring data supplied by the local authority. If the model uses the 1km x 1km background Netcen data (NAQIA data) from 2006 and includes current traffic data from the 2006 traffic assessment, the 'predicted values' as provided by the DMRB in this case should correspond with the ratified 2006 diffusion tube sampled data and therefore represents the 'current baseline' scenario. The difference between the diffusion tube data and the DMRB prediction is then calculated and represents a factor by which further findings of the DMRB should be multiplied.

11.61 No additional diffusion tube monitoring was considered necessary for this assessment because:

- no AQMA has been declared or likely to be declared by IoWC
- background data from Netcen was very low.

11.62 Table 11.7 shows the sources of input data utilised in this DMRB screening assessment.

Data and source of guidance	Air quality field concentrations	Traffic	Receptor information and identification
Diffusion tubes monitoring carried out by IoWC	√	-	-
Site and desktop surveys	-	-	√
LAQM Technical Guidance	-	-	√
1km x 1km grid background mapped netcen data (Air Quality Information Archive)	√	-	-
Transport Assessment for West Wight, conducted by Entran Ltd.	-	√	-

Table 11.7: sources of DMRB v1.02 data inputs

11.63 Whilst no thresholds of traffic flow or traffic flow change exist in the DMRB, Web-tag guidance 2004, which supersedes the Guidance on Methodology for Multi Modal Studies (GOMMMS) 2001, states in unit 1.3.2 that:

"Due to the uncertainty of traffic forecasting and the size of traffic flow change needed to affect air quality, options which change traffic flows by less than 10% can usually be scoped out, unless the road is a motorway (due to high traffic flows) or there are particular sensitivities (eg traffic congestion, changes in speed limits or the presence of an AQMA."

Construction dust

11.64 Where there is predicted to be prolonged construction activity involving substantial earth moving, excavation, transport of soil, the extent of dust arisings may be predicted by using dispersion modelling and detailed site meteorological information to predict the effect of any likely impact. However, prior to undertaking such a detailed assessment it is common practice to provide a qualitative assessment based on experience elsewhere, using the relative distance between receptors and the sources of dust, and to focus on mitigation measures to minimise suspension of dust.

Baseline

11.65 The qualitative assessment of the impacts associated with dust releases during the construction phase has been undertaken using guidance published by the Building Research Establishment (BRE) in 2003. A range of absolute values and incremental values over existing dust deposition rates are described in this guidance; values of between two and three times the baseline deposition rate are recommended as being the trigger for a nuisance complaint. There are three bands described:

- Open country 39mg/m^2/day
- Outskirts of towns 59mg/m^2/day
- Industrial areas 127mg/m^2/day

11.66 The proposed site is considered to be best described by the ‘open country’ classification.

Prediction of effects

11.67 The majority of dust (greater than 30µm diameter), and that which has most potential to result in soiling of nearby surfaces, will be deposited in the area immediately surrounding the source (within 100 metres). The slightly smaller fraction (10µm to 30µm) may travel up to 500 metres and the smallest fraction (and smallest percentage of the total dust) at less than 10µm can travel up to a kilometre (ODPM 2005). Due to the wide range of conditions in which construction activities may occur, the use of an absolute value limit is considered inappropriate. Therefore an increase over the baseline deposition rate in the area under consideration has been adopted as the most appropriate criterion for the purposes of this assessment.

11.68 In the absence of any monitoring on-site, the assessment of effects from dust deposition is based on the distance from potential source to the nearest receptor. Those outside the 100 metre zone are expected to receive negligible changes in dust deposition, with any dust arising from the proposals being indistinguishable from background levels. Receptors within 50 to 100 metres are predicted to experience a low to medium change and those within 50 metres of the source of dust are predicted to have a large change in magnitude of dust deposition rates where the nuisance threshold is likely to be triggered and a nuisance caused. These are in accordance with figure 11.2, air quality magnitude of change.

Sensitivity of receptor

11.69 Technical guidance document (LAQM.TG(03)) describes in detail typical locations where consideration should be given to pollutants defined in the NAQS. Generally, the guidance suggests that all locations 'where members of the public are regularly present' should be considered. At such locations, members of the public will be exposed to air pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for the assessment.

11.70 For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standard (i.e. 15-minute mean or 1-hour mean) may be relevant. In a school, or adjacent to a private dwelling, however, where exposure may be for longer periods, comparison with a long-term standard (such as a 24-hour or annual mean) may be more appropriate. In general, long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods.

Assessment of significance

11.71 The significance of potential air quality effects has been determined from a two-stage process developed by Terence O'Rourke, which incorporates criteria from best practice techniques and expert knowledge. Effect significance is derived from measures of the sensitivity (or importance) of the receptors potentially affected and the magnitude (or scale) of effect.

11.72 The first stage requires the sensitivity of the potentially affected receptors and the magnitude of change to be determined. The categories for the sensitivity of receptors and the magnitude of change are defined in figure 11.1 and figure 11.2 respectively. There are no known published standard criteria for determining the significance of air quality effects. There are however, NAQS objectives for NO_2, PM_{10} and the BRE recommended threshold for changes in dust deposition rates, these are used as a guide in this assessment.

11.73 Figure 11.1 categorises the sensitivity of the different air quality and dust receptors between high, medium, low and negligible, depending on their characteristics. Figure 11.2 represents both the changes to the NO_2, PM_{10} and dust emissions. The first two rows in figure 11.2 represent changes in air pollutants, taking into account the changes in both the baseline and the remaining air quality capacity. The air quality capacity represents the proximity of the baseline levels to the NAQS objectives. The third row reflects the magnitude of change in dust that could constitute a nuisance.

11.74 The second stage involves comparing the measures of magnitude and sensitivity to determine the potential significance. In determining whether an effect on a receptor is significant, reference has been made to a range of criteria relating to the nature of the receptors and the predicted magnitude of change. The significance of an effect is determined by comparing the two measures with the determination of significance matrix figure 11.3.

Baseline

11.75 The scope of this local air quality assessment addresses the following scenarios:

- current baseline 2006
- future baseline 2008 (without development)
- 2008 scenario (with development).

Background

Sources of air pollution

11.76 This assessment focuses on the effect of the proposal on the existing baseline local air quality. In order to determine current and future baseline concentrations, it is important to identify the contribution of different sources of air pollution within the area, which are likely to affect the site and surrounding sensitive receptors, and thus will be examined when determining the baseline scenario. Existing sources are separated into two types: industrial and non-industrial activities.

Industrial source

11.77 There are no industrial sources of air pollution within the site or the vicinity of the application boundary. Prospect Quarry to the south of the application boundary, located adjacent to Broad Lane is no longer in use.

Non-industrial sources

11.78 The main non-industrial source of air pollution around the site consists of traffic and transport related emissions. There are no trunk roads on the Isle of Wight. The site and surrounding areas are rural in nature and comprise farm cottages / buildings accessed from narrow country lanes. The two busiest roads near the site are the A3054, which links Newport to Yarmouth, and the B3401, which, whilst smaller, also links Newport and the west of the Island.

Proposal related sources

11.79 The traffic assessment chapter should be consulted for specific details regarding expected traffic throughout the lifetime of the proposal. The construction phase will include conventional traffic for on-site construction workers, vehicles delivering construction materials and abnormal-sized loads transporting turbine components. In addition, there will be excavation plant operating on site for a large percentage of the construction phase.

11.80 These vehicles will give rise to NO_2, PM_{10} and fugitive dust emissions. The last mentioned is likely to constitute the largest contribution during this phase in the absence of suitable mitigation and adequate dust suppression measures.

11.81 The operational phase of the wind farm will predominantly consist of periodic maintenance visits by limited numbers of personnel, depending on what type of maintenance is required. The pollutants released during the operational phase are likely to comprise NO_2, PM_{10} and some fugitive dust.

Sensitivity of receptors

11.82 The potential air quality effects expected to arise from the proposals were examined separately for the construction and operational phases. Sensitive receptors were identified within the vicinity of the proposed site. Their selection follows Defra and LAQM guidance. The receptors are presented in table 11.8, and their location is shown in context with the site in figure 11.4.

Sensitive receptors to dust deposition

11.83 To assist with the qualitative assessment, it has been assumed that the zone of potential effects generated by un-mitigated dust emissions during construction is limited to within 100m of the proposed development site. For this reason, the assessment has focussed on receptors within 100m of the following construction activities:

- soil excavation and earth removal for turbine foundations and crane pads, road construction and installing the underground cabling which links to the local electricity network
- preparation of the building foundations
- movement of HGVs over exposed soil.

Receptor description	Type of air pollutant			Sensitivity
	Dust	PM_{10}	NO_2	
R1: Dog Kennel Cottage (Broad Lane)	✓ C	✓ C/PC	✓ C/PC	High
R2: Tapnell cottage on B3399	-	✓ C/PC	✓ C/PC	High
R3: Shalcombe Cottage (B3401)	-	✓ C/PC	✓ C/PC	High
R4: Chessell Pottery Residential property	-	✓ C/PC	✓ C/PC	High
R5: Residential properties on junction with Thorley Street and Broad Lane	✓ C	✓ C/PC	✓ C/PC	High
R6: Residents on junction of Thorley Road and Tennyson Road	-	✓ C/PC	✓ C/PC	High
R7: Residential properties on Ningwood Hill west of Shalfleet	-	✓ C/PC	✓ C/PC	High
R8: Hummet Copse	✓ C	-	-	Low
R9: On site water courses	✓ C	-	-	Negligible - Low
R10: Residential properties in Thorley east of Thorley Parish Church including residents in North View	✓ C	-	-	High
R11: Thorley Parish Church – St Swithen's Church	✓ C	-	-	High
R12: Residents to the south of Holmfield Avenue, Thorley	✓ C	-	-	High

Table 11.8: importance / sensitivity of receptors

C = construction phase PC = operational phase

11.84 Figure 11.6 shows a 100 metre buffer zone around each of the areas where earthworks are likely. The figure shows that the residential properties to the east of St Swithen's Church, Thorley and the church itself are close receptors to any of the proposed construction activities specifically the temporary access created at the north west of the site. The residential properties and the church are attributed a high sensitivity to dust.

Vegetation communities

11.85 Particulate matter in rural settings, both from vehicle exhausts and suspended construction dust, can also have differing ecological effects depending upon its composition. Dust can alter effective photosynthesis by light interception, interfere with stomata responses and water relations, and lead to increased leaf temperature (Ashmore 2002).

11.86 Within the 100 metre buffer zone shown in figure 11.6 there are two copses. One of them, Hummet Copse, is listed as a SINC for its ancient woodland interest. In accordance with figure 11.2, the sensitivity to dust deposition for this local designation is low.

11.87 Four surface water courses fall within the 100 metre dust deposition buffer zone. Three of these arise within the site boundary and one traverses the site in a northerly direction.

11.88 Many potential secondary effects are attributable to dust deposition in small surface water bodies. The severity of the effects depends largely on the amount of dust suspended and the dimensions and flow rates of the water body. Dust deposition can cause turbidity, which in turn reduces light penetration and can have a detrimental effect on riparian and aquatic fauna and flora, and ultimately water quality. According to figure 11.1, receptor sensitivity is dependent upon the type of habitats and the degree of geographic importance of the species within them. The four small watercourses that are within the dust deposition buffer zone are of only local importance and are considered to have a negligible to low sensitivity.

Receptors sensitive to construction and operational traffic

11.89 The majority of traffic during the construction phase of the development will be HGVs. This will be in the form of:

- oversized loads, such as those delivering the turbine blades and other components
- construction worker transport vehicles
- the delivery and on-site movement of earth moving excavation plant and construction cranes.

11.90 The operational phase of the proposals involves far fewer traffic movements by comparison, and has not been analysed further in this assessment. The specific transport routes for both phases have been planned in order to minimise any potential disruption to new and existing communities. They are presented in the traffic and transport chapter of this environmental statement and the sensitive receptors were chosen in accordance with these routes. All receptors related to traffic emissions are those that are in close proximity to the designated construction and operational traffic routes. Residential receptors are afforded a high sensitivity in accordance with figure (11.1).

Construction dust baseline

11.91 In the absence any ambient dust monitoring, only broad estimates can be made on baseline dust depositions. The site is considered to qualify as open country when referencing the BRE guidance. A background deposition prediction of $39mg/m^2/day$ has therefore been used.

Air quality baseline data - NO_2 and PM_{10}

11.92 The baseline information for this assessment has been derived from two different sources. These sources are:

- Netcen background air quality concentration data obtained from the NAQIA which provides the basis of any predictive assessment
- IoWC field data from diffusion tube monitoring programme supplied for comparative purposes.

Netcen data

11.93 The data provided by Netcen for the NAQIA form the starting point for this assessment. They comprise predicted background levels of various pollutants at 1km x 1km grid squares across the UK. 'Background' is defined as ambient pollutant concentrations that do not include the influence of specific traffic related emissions.

11.94 Figure 11.6 shows the twenty, 1km x 1km grid squares that are considered representative of the proposed development's location. Alongside these grid squares are concentrations for each of the pollutants examined in this assessment. 2006 represents the current year and 2007/2008 the opening year of the proposal.

11.95 The progressive decrease in background concentration with time is attributed to predicted improvements in fuel and fuel-efficiency technology for the automobile industry.

Diffusion tube monitoring programme

11.96 A summary of the IoWC NO_2 diffusion tube monitoring results is shown in table 11.9.

11.97 The results show decreasing concentrations of NO_2 across the three year period, with those predicted for 2005 staying below the NAQS objective limit of $40\mu g/m^3$.

Location	2002	2005*
1. Carisbrooke Castle (B)	**11**	**11**
2. Cowes High School (B)	13	12
3. Medina High School (K)	24	22
4. Sandown High School (B)	36	34
5. Ryde High School (B)	17	16
6. Newport Road, Cowes (K)	15	14
7. Fairlee Road Newport (K)	10	9
8. Blackwater Service Station (K)	37	34
9. Lake Hill Sandown ((K)	16	15

Table 11.9: IoWC NO_2 monitoring results

K = kerbside site (within 5m of road centre)
B = Background monitoring site (>5m of nearest road centre)
NAQS objective 40µg/m^3 (31/12/05)
* the 2005 data are predicted results by IoWC.

11.98 These results show that none of the monitored / predicted data was in breach of the NAQS objective concentrations for 2005 at any of the sampling locations. The closest monitoring locations to the sensitive receptors identified are at Carisbrooke Castle. However, between these sites there is a range of distances from the road-side and differences in characteristics. The monitored data should therefore be used as an indicative guide when considered in relation to the modelled data.

11.99 No PM_{10} monitoring is currently undertaken by the IoWC.

Potential effects

Dust arisings

11.100 Dust deposition from construction works is dependent on many local variables, such as wind direction, moisture content of the soil, temperature and the type of activity occurring on the site.

11.101 Figure 11.6 identified five sets of receptors, which are on, or within the 100 metre threshold. These are:

- Hummet Copse SINC
- each of the on site water courses
- Dog Kennel Cottage and the residences to the south and east of Holmfield Avenue
- St Swithen's Church in Thorley
- The residences to the east of the church and those in North View.

11.102 The residential receptors are identified for the cable trench excavations works and the provision of the switching station, which are expected to have a maximum construction duration of four months. The residential dwellings that are identified as the sensitive receptors fall within the 100 metre limit of the ODPM dust deposition zone and are within 50m of the source. In accordance with the magnitude of change methodology outlined earlier this constitutes high potential change in dust deposition. Given the high sensitivity of the receptor coupled with the high change in magnitude, a very substantial significance of effect from construction dust arisings may occur if the activities are left un-mitigated.

11.103 Hummet Copse is a small woodland which is a locally listed SINC. Its sensitivity is assessed to be low. Due to its location within 50 metres of the source it is likely to have a large magnitude of change for un-mitigated earthworks. When the magnitude and sensitivity is coupled, this predicts a moderate significance of effects in accordance with figure 5.1.

11.104 The on-site watercourses have been applied a negligible to low sensitivity to dust loading. These streams are also within 50 metres of the source excavation for the turbine and crane foundations, and access tracks. With un-mitigated construction works the magnitude of change could be anticipated to be large. This coupled with the negligible to low sensitivity of the water courses, gives a moderate significance of effect.

11.105 Based on the generic estimates of baseline deposition rates presented in the BRE guidance, the significance criterion adopted for deposition rates that might lead to complaints of annoyance is in the order of twice the baseline deposition rate. A trigger rate of 78 $mg/m^2/day$ is therefore proposed as the limit over which significant adverse effects might occur.

11.106 Given the assessment outlined above, the trigger rate may be exceeded within the 100 metre dust deposition zone. However, this is considered unlikely once dust suppression measures / mitigation measures have been employed. Dust suppression techniques commonly used in construction practice are outlined in table 11.10. These originate from the BRE guidance documents noted in table 11.1.

11.107 These guidance documents prepared as a research project supported by Department of Trade and Industry (DTI) includes measures for suppressing dust throughout five phases of typical construction practices:

- pre-project planning
- site preparation, demolition, earthworks and landscaping
- haulage routes, vehicles and plant
- materials handling storage, stockpiles, spillage and disposal
- fabrication processes and internal / external finishes.

11.108 The documents draw their recommendations from cases where the techniques have been found to be effective, however it is acknowledged that they have not been validated under controlled conditions.

Traffic (NO_2, PM_{10})

NO_2

11.109 The background data provided by Netcen is the basis of the predicted methodology, coupled with the baseline traffic flows. The background concentrations provided in figure 11.5 shows these as being very low, and expected, given the open rural landscape in this region of the Island.

11.110 The baseline data gathered for NO_2 concentrations show that no NAQS objective concentrations have been breached by modelled data. The monitoring data available from the site are, in the most part, distant from the proposals site, and they do represent more urban environments, such as Cowes and Newport. Emissions from vehicles are likely to be higher in these locations than at the proposals site.

11.111 The very low background concentrations provided by Netcen demonstrates the rural nature of the proposals site where NO_2 concentrations do not exceed 7ug/m^3 for any of the 20 grid squares used in this assessment.

11.112 For this background concentration to exceed the NAQS objective concentrations a very substantial increase in traffic would be required. According to findings of the traffic and transport assessment, less than a 10% increase in traffic is predicted (less than 4% in all cases assessed). Therefore in accordance with the Web-tag guidance 2004 (formerly GOMMMS), any DMRB assessment is unnecessary as any exceedence of the NAQS objective limits is very unlikely.

PM_{10}

11.113 The IoWC does not undertake any PM_{10} monitoring on the Island. The baseline information has been retrieved from the latest Updating and Screening Assessment work. The work identifies concentrations of PM_{10} for kerbside receptors (within 5 metres of the road centre). The highest concentration identified was 22.4ug/m^3 for central Newport.

11.114 As highlighted in the NO_2 section above, the site is rural in nature, as this is reflected by the background concentrations and the lack of main roads passing the identified receptors. Substantial changes in traffic volumes would therefore be required to increase the ambient concentrations for each of the receptors identified. No discernible change in air quality is likely for these receptors as the increase in predicted traffic flow is less than 10% (less than 4% in all cases assessed). This is the threshold provided by the web-tag guidance. No further assessment is therefore considered necessary for PM_{10} concentrations.

Mitigation

Construction

Dust

11.115 In order to mitigate the release of dust, a number of mitigation methods will be implemented as appropriate, such as those outlined in table 11.10.

Completed earthworks shall be covered or vegetated as soon as is practicable
Vehicles carrying loose aggregate and workings shall be sheeted at all times
Slopes of stockpiles and mounds are at an angle not greater than the natural angle of repose of the material, the stockpiles / mounds must not have sharp changes in shape.
Short-term storage mounds and stockpiles may be enclosed or kept under sheeting. Prevention of wind borne dust from these mounds may also be achieved through suitable and sufficient water sprays, wind barriers, protective fences of similar size and height to the mound.
Design controls for construction equipment and appropriately designed vehicles for materials handling shall be used.
Suitable wetting of soil surfaces shall be carried out during the earth moving activities on the proposed development site to minimise soil loss through airborne dust, this may be done through the use of a water bowser, or static sprinklers. Early hard surfacing of internal roads will also aid in minimising dust re-suspension on site.
Regular inspection and, if necessary, cleaning of local highways and site boundaries, to check for dust deposits shall be carried out (and dust removed if necessary).
Wheel-washing devices shall be used at the proposed development site exits to minimise transfer of dust and particulate material onto surrounding highways.
All construction plant and equipment shall be maintained in good working order and not left running when not in use.
No unauthorised burning of any material shall be carried out anywhere on the proposed development site
Construction vehicle access arrangements shall be designed to avoid sensitive streets or narrow, congested roads.
Material deliveries and vehicle access to the proposed development sites shall be timed to avoid the need to queue outside the site prior to opening or whilst other deliveries are completed.
Timing and phasing of construction activities plus contact details of relevant offices shall be published, to facilitate the raising of concerns should they arise.

Table 11.10: proposed construction dust mitigation measures

11.116 Close liaison will be maintained with IoWC throughout the construction phase, in order to facilitate awareness and to deal with complaints should they arise.

Residual effects

11.117 No residual effects on air quality receptors are expected as a result of this development.