Guidance on consideration of air in Strategic Environmental Assessment

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Scotland's 4th National Planning Framework has recently been published. This document is therefore being reviewed and updated to reflect the new policies. You can still find useful and relevant information here but be aware that some parts may be out of date and our responses to planning applications may not match the information set out here.

1. Consideration of air in Strategic Environmental Assessment (SEA)

1.1 Good air quality is essential for a good quality of life, helping to maintain human health, the climate, habitats and ecosystems. The quality of the air is affected by pollutants released into the atmosphere through human activities including transport, energy generation, industry, waste management and agriculture, and through natural sources.

1.2 Plans, programmes, and strategies (PPS) which influence these types of human activities and / or natural processes may have the potential to significantly affect air quality and cause nuisance such as odour and dust. When released to atmosphere in sufficient quantities, pollutants can affect human health, climate change, habitats and species, soils, water and the built environment.

2. Existing environmental problems and potential significant effects

2.1 The main challenges to air quality are from three key sources of emissions: (1) transport, (2) energy production, and (3) industry (including agriculture). The main contribution to air pollution is emissions from individual sites ("point source pollution" e.g. from large-scale industrial activities) and along transport routes / nodes ("linear or nodal source pollution" e.g. road traffic, air traffic). Diffuse sources such as agriculture are also increasingly important sources as other sources decline.

2.2 These pressures result in problems such as increased levels of air pollutants including ammonia, ground-level ozone, oxides of nitrogen, particulate matter, sulphur dioxide and volatile organic compounds as well as increased levels of nuisance including dust, odour and noise. Identifying and understanding existing air pollution problems will help the Responsible Authority to assess whether a PPS is likely to have a significant effect on air quality.

2.3 At the time of publication there were 97 sites within Scotland at which automatic monitoring of atmospheric pollutant concentrations takes place (see www.scottishairquality.scot/latest/). Table 1 below sets out examples of current environmental problems in relation to air, their potential causes and the likely significant effects which a PPS could have on these existing problems.

2.4 Significance of effects is set out using a scoring system ranging from a "major positive" effect to a "major negative" effect. As an example using these significance criteria, if the magnitude of the effect is large but the receptor that experiences the effect is not particularly sensitive, then the significance of the effect is likely to be less. Responsible Authorities may wish to use these criteria as the basis of developing an assessment method that suits the PPS being assessed.

Table 1 – Existing environmental problems relating to air, their potential causes and examples of likely significant effects

Air Quality is generally good in Scotland but further improvements are needed to reduce the adverse effects caused by air pollution particularly in urban areas where 80% of the population lives. There are 'pollution hotspots' in Scotland where Air Quality Management Areas (AQMAs) have been declared. With a reduction in large-scale industry the influence of transport and other non-industrial sources continue to be significant sources of air pollution.

Existing problems relating to air quality	**Causes of existing problems**
Particulates – PM_{10} and $PM_{2.5}$ Particulate matter (PM_{10} and $PM_{2.5}$) is measured at number of locations in Scotland. Although urban background PM_{10} concentrations have been declining since the early 1990s, there is considerable yearly and daily variation. The Scottish annual mean and 24-hour air quality objectives for PM_{10} are exceeded at numerous locations across Scotland, resulting in the designation of air quality management areas. The Scottish annual mean objective is much lower than the EU limit values (and therefore UK objectives) so while AQMAs are declared for PM in Scotland they are not breaching Scotland's legal obligations. The Scottish Government introduced a new air quality objective in April 2016 for $PM_{2.5}$ to be met no later than 2020 and a $PM_{2.5}$ monitoring network has been put in place. Up-to-date information on PM monitoring and air quality objectives can be found at www.scottishairquality.co.uk	The main sources of particulate matter (PM) are: • stationary fuel combustion, especially coal, solid fuel and diesel (e.g. energy generation, manufacturing industry and domestic sources); • road transport, mainly through engine emissions and tyre and brake wear, abrasion of road surfaces and re-suspension (see below). Other sources include; mining and mineral extraction; commercial and domestic heating systems; agriculture; construction; non-road mobile sources (e.g. railways, ships and boats, aircraft, construction and industrial plant, agricultural machinery); and natural sources such as sea salt, volcanic activity and windblown soil and sand. Re-suspension of PM (either through wind whipping or vehicle movements) is also a significant issue. Secondary PM is formed from emissions of ammonia, sulphur dioxide and oxides of nitrogen as well as from emissions of organic compounds from both agricultural sources and vegetation. PM can travel significant distances and emissions from other parts of the UK and Europe can have a significant effect on air quality in Scotland. There can also be very significant spikes in recorded ultrafine particulate

There are a number of AQMAs across Scotland designated due to an exceedance of the Scottish annual mean objective for PM_{10}.	data during episodes of atmospheric inversions. Defra believes that between 35-50% of all measured UK PM_{10} is transboundary.
Oxides of nitrogen – NO_X Nitrogen dioxide (NO_2) is measured at number of locations in Scotland; the Scottish and UK annual mean and 1-hour air quality objectives for NO_2 are exceeded at numerous locations across Scotland, resulting in the designation of AQMAs. Whilst the concentrations of total NO_X have declined over the years, concentrations of NO_2 have increased at some roadside locations. There are a large number of AQMAs in Scotland designated due to an exceedance of the annual mean objective for NO_2. All have been caused by emissions of road traffic (and in these cases AQMAs can be declared for both NO_2 and PM_{10}). Up-to-date information can be found at www.scottishairquality.co.uk	All high temperature combustion processes in air produce oxides of nitrogen. The main source of this pollutant is emissions from transport. Other sources include; energy generation, manufacturing industry and commercial activity, domestic and commercial heating.
Ground level ozone – O_3 There has been a significant decline in the number of days when ground-level ozone concentrations are high over the last 20 years. Background levels have continued to rise across Europe and the UK due in part to the transportation of pollutants from other parts of the world. Concentrations are generally lower in areas where there is traffic because gases in the exhaust emissions destroy the ozone hence rural sites generally experience higher annual average concentrations than urban areas; this is also due to prevailing wind conditions and long range transport of primary pollutants.	Ozone is a secondary pollutant arising as a result of chemical reactions between various air pollutants, primarily oxides of nitrogen and volatile organic compounds (VOCs), initiated by strong sunlight. Formation can take place over several hours or days and background levels of ozone may have arisen from emissions many hundreds, or even thousands of kilometres away.

Ammonia – NH_3 20 sites in Scotland monitor NH_3. There has been little or no change in ammonia concentrations over the last decade and there is some evidence showing increases. Reducing ammonia is a high priority for the protection of habitats and vegetation. Across the UK, 60% of habitat areas sensitive to eutrophication exceed the critical load for nutrient nitrogen. Ammonia is also an important source of secondary particulate matter and becoming increasingly important as emissions are reduced from other sources.	The main sources of ammonia are agricultural activities such as decomposition and volatilisation of animal wastes, including livestock manure / slurry management and spreading. Other sources include; volatilisation of synthetic fertilisers (particularly nitrogen fertilisers / urea), and a wide range of non-agricultural sources such as sewage management, transport (catalytic converters and diesel emissions abatement), and industrial manufacturing.
Sulphur dioxide – SO_2 Sulphur dioxide (SO_2) is now less of a problem in Scotland therefore the number of monitoring sites has reduced considerably. A decrease in emissions from large industrial sources and a decrease in coal use both in energy generation and domestic use have led to significant reduction in emissions of SO_2 with concentrations now being consistently low. There is one AQMA declared for SO_2 – it is in the vicinity of the Grangemouth refinery. Up-to-date information can be found at www.scottishairquality.co.uk	The main source of sulphur dioxide is combustion of fuels containing sulphur, such as coal and heavy fuel oils used in energy generation. Other sources include oil and gas refining, industry, shipping and domestic fuel combustion.
Volatile organic compounds (VOCs, including benzene and 1, 3-butadiene) Benzene and 1, 3-butadiene are monitored at two sites in Scotland. Both sites continue to meet the objectives for these pollutants.	The main sources of VOC are: • Road transport (a key source of benzene);

Emissions of VOCs are showing a downward trend. UK emissions have fallen steadily since 1990, mainly due to the fitting of catalytic converters to vehicles. Emissions from the domestic and industrial sectors are also falling. There are no AQMAs declared for benzene or 1, 3-butadiene.	• Manufacturing industry and domestic combustion (a key source of benzene); • Solvent manufacturing and use; • Petrol distribution and handling (a key source of 1, 3-butadiene); • Energy generation; • Refineries; • Industry (e.g. the production of synthetic rubber for tyres, a key source of 1, 3-butadiene).

Example of typical effects of a PPS on existing air quality problems

Major positive ++ Action very likely to lead to a significant decrease, or a series of long-term decreases, leading to large-scale and permanent reductions in particulate matter / ozone / ammonia / oxides of nitrogen / sulphur dioxide / volatile organic compounds in the air. *E.g. air quality, especially in the AQMAs, should improve. The action will have a positive impact on vulnerable groups (e.g. asthmatics, people with respiratory diseases). The number of days where air quality at monitoring stations is considered as moderate or low will decrease significantly – especially in relation to one or more of these key pollutants.*

Minor positive + Action likely to lead to moderate decrease in both short and long-term, leading to large-scale temporary, or medium-scale permanent reductions in particulate matter / ozone / ammonia / oxides of nitrogen / sulphur dioxide / volatile organic compounds in the air. *E.g. air quality, especially in the AQMAs, might improve. The action might have a positive impact on vulnerable groups (e.g. asthmatics, people with respiratory diseases). It is highly likely that the number of days where air quality at monitoring stations is considered as moderate or low may decrease – especially in relation to one or more of these key pollutants.*

Minor negative – Action likely to lead to moderate increase in both short and long-term, leading to large-scale temporary, or medium-scale permanent increase in particulate matter / ozone / ammonia / oxides of nitrogen / sulphur dioxide / volatile organic compounds in the air. *E.g. air quality, especially in the AQMAs, is unlikely to improve and may in fact decline, meaning that air quality objectives are unlikely to be met. The action may have an impact on vulnerable groups (e.g. asthmatics, people with respiratory diseases). The number of days where air quality at monitoring stations is considered as moderate or low may increase in relation to one or more of these key pollutants over and above existing trends.*

Major negative - - Action likely to lead to a significant increase, or series of long-term increases, leading to large-scale and permanent increase in particulate matter / ozone / ammonia / oxides of nitrogen / sulphur dioxide / volatile organic compounds in the air. These negative effects could require a new AQMA to be declared (or an existing AQMA to be increased in size). *E.g. air quality, especially in AQMAs will decline; it is likely that the air quality objectives will not be met; it is highly likely that number of days where air quality at monitoring stations is considered as moderate or low may increase significantly – especially in relation to these key pollutants; it is likely that the action will have a significant impact on vulnerable groups (e.g. asthmatics, people with respiratory diseases); it is likely the action exposes new people to harm (e.g. new developments can introduce receptors where there were none previously - such as a new block of flats on an arterial route or adjacent to a roundabout).*

Nuisance – includes odour, noise, dust and fine particulates (including haze and smoke). It can result from poor decisions in siting development e.g. it can occur as a result of locating new sensitive receptors (housing) near existing sources of emissions or sources of emissions into areas where sensitive receptors already exist. It can also result from introducing additional / new sensitive receptors (people) into AQMAs.

Existing problems relating to nuisance	**Causes of existing problems**
Emissions of odour, noise, dust and fine particulates (including haze and smoke) can have a negative effect on health and quality of life for humans and other species / habitats. Nuisance can also act in combination to cause negative effects (e.g. noise and dust, noise and odour).	Main sources of dust include; mining and mineral extraction and use; road transport; construction / demolition activities. Main sources of fine particulates include; combustion of fuels (e.g. road transport, energy generation), biomass (e.g. agriculture, energy generation, domestic heating), and other combustion sources (e.g. waste disposal); emissions of ammonia, SO_2, oxides of nitrogen. Domestic stoves are also now becoming a major issue for some local authorities. Main sources of odour include; waste transport, storage, handling and disposal (e.g. landfilling, composting); the waste water network and treatment (e.g. sewage works); agriculture (e.g. use of manure fertilisers and slurries); manufacturing industry.

Example of typical effects of a PPS on existing nuisance problems

Major positive ++ Action very likely to lead to a significant decrease, or a series of long-term decreases in sources of nuisance, leading to large-scale and permanent reduction. *E.g. odour / dust sources are very likely to be reduced significantly, in particular in urban areas (i.e. more densely*

populated areas). Haze and / or smoke causing nuisance are very likely to be significantly reduced due to the action, having a positive impact on sensitive groups (e.g. urban areas, arterial routes / motorways, designated landscapes).

Minor positive + Action likely to lead to moderate decrease in sources of nuisance in both short and long-term, leading to large-scale temporary, or medium scale permanent reduction. *E.g. odour / dust / haze / smoke sources might be reduced permanently or temporarily due to the action.*

Minor negative – Action likely to lead to moderate increase in nuisance sources in short and long-term, leading to large-scale temporary or medium scale permanent negative effect. *E.g. odour / dust / haze / smoke sources might increase permanently or temporarily due to the action*

Major negative - - Action likely to lead to a significant increase, or series of long-term increases, leading to large-scale and permanent increase in nuisance sources. *E.g. odour / dust / haze / smoke sources are very likely to be increased significantly, in particular in more densely populated areas) due to the action, having a negative impact on sensitive groups (e.g. urban areas, arterial routes / motorways, designated landscapes).*

2.5 Neutral, mixed and uncertain effects of a PPS on air quality

- Neutral effects - an action which is unlikely to have any beneficial or negative effects on any existing air quality problem. Neutral scoring should only be used where it is very likely that the effect on the current environmental baseline or trends will be neither positive nor negative. It is possible that a neutral effect may be enhanced through mitigation measures such as policy or project intervention.

- Mixed effects – an action which is likely to result in a combination of positive and negative effects, particularly where effects are considered on sub-issues, areas or criterion. Such mixed effects will be hard to predict, but could be significant in the long-term, or when taken with other effects e.g. cumulative or synergistic.

- Uncertain effects - the effect of an action on air quality is not known, or is too unpredictable to assign a conclusive score. Uncertainty may arise where an action covers a range of issues, or where the manner in which the action is implemented is a material factor in the nature of the effects it may have.

2.6 Where a PPS has the potential to have significant environmental effects on another EU Member State these effects are known as Transboundary effects. In relation to air transboundary effects are generally characterised as being a particular problem for pollutants that are not easily destroyed or those which react in the atmosphere to form secondary pollutants. These pollutants can survive for periods of

days or years and can be transported incredibly long distances. Typical transboundary pollutants include particulate matter, sulphur dioxide, oxides of nitrogen, volatile organic compounds (VOCs), ground-level ozone, ammonia and heavy metals. Transboundary effects typically include acidification, eutrophication and formation of ground-level ozone. Transient primary and secondary particulate matter can be carried over long distances - sources include volcanic eruptions, desert sand, industrial / agricultural activities (such as fertiliser application) and forest fires.

3. SEA objectives

3.1 SEA objectives can be used to develop a systematic, rigorous and consistent framework with which to assess environmental impacts. The level of detail appropriate for the SEA objectives will depend on the characteristics of the PPS being assessed and the potential significance of its environmental effects. Where appropriate, "headline" SEA objectives can be broken down into sub-objectives or assessment criteria – examples of SEA air objectives are set out in Table 2 below.

Table 2 - Examples of SEA air objectives and assessment questions

Headline objective	Sub-objectives	Example assessment questions
To maintain or improve air quality and reduce emissions of key pollutants.	• To protect and improve air quality. • To reduce levels of air pollution. • To reduce levels of nuisance.	• Will the PPS contribute to reducing emissions of key pollutants to air? • Will the PPS contribute to reducing levels of nuisance?

3.2 Additional details of this approach and how it can be combined with site assessments for local development planning can be found in the Local Development Plan Site Assessment and SEA checklist which has been produced by the Consultation Authorities.

4. Baseline information

4.1 Sufficient data about the current and likely future state of the environment should be collected to allow the Responsible Authority to predict and evaluate the potential effects of the PPS. However, where such information is not available, any data gaps and difficulties should be listed in the Environmental Report. The gathering of new data may be appropriate to include as recommendations in the Environmental Report, Post Adoption Statement or Monitoring proposals.

4.2 The sources of baseline information and trends set out in Table 3 below cover the air issues which we would typically expect to see presented (depending on the scope and purpose of the PPS) at the Scoping or Environmental Report stage. These include:

- information on existing Air Quality Management Areas (including details of the air quality action plan);
- information on locations that are close to exceeding air quality objectives or where an area is at risk of becoming an AQMA;
- information on SEPA-regulated sites including (i) new developments which will be regulated by SEPA, (ii) location and concentration of activities which impact on air quality (iii) location and concentration of activities within existing AQMAs (iv) effects on air quality management thresholds, (v) number of people exposed to poor air quality;
- information on nuisance (odour, dust and noise) – for example created by proposed co-location of new development adjacent to existing SEPA regulated sites

Table 3 – Sources of baseline information and trends	
Key facts regarding **air quality** together with datasets and interactive maps.	www.scottishairquality.co.uk/
State and trend information and key messages.	www.environment.gov.scot/our-environment/air/
The **Scottish Pollutant Release Inventory** (SPRI) – The database and map of annual mass releases of specified pollutants to air, water and land from certain SEPA-regulated industrial sites.	www.sepa.org.uk/environment/environmental-data/spri/
The Air Quality in Scotland website provides access to technical reports, including the **Scottish Air Quality Database Annual Report** which provides a summary of air	http://www.scottishairquality.scot/news/

quality monitoring carried out on behalf of Government and local authorities and summarises trends in air quality monitoring for certain pollutants.	
Maps and datasets for **Air Quality Management Areas** and LAQM tools and guidance.	www.scottishairquality.co.uk/laqm/
Air quality data from the present day back to 1986 from sites monitoring at hourly and less frequent intervals.	www.scottishairquality.co.uk/data/
Air quality information produced by **individual local authorities** – each local authority is required to review and assess air quality in their area annually (this process identifies where an AQMA may be required).	www.scottishairquality.co.uk/news/reports?view=laqm

5. Other plans, programmes and strategies

5.1 Comprehensive links to other plans, programmes and strategies relevant to the topic of air can be found at:

- www.scottishairquality.co.uk/
- www.environment.gov.scot/our-environment/air/
- www.sepa.org.uk/environment/air/
- www.sepa.org.uk/regulations/air/
- Cleaner Air for Scotland - The Road to a Healthier Future

Table 4 – Key PPS and their associated provisions relevant to air

PPS title	Key provisions	Relevant SEA air objectives
Directive 2008/50/EC relating to ambient air quality and cleaner air for Europe	Sets EU air quality standards for ground-level ozone, particulate matter, nitrogen oxides, heavy metals and a number of other pollutants.	All
Directive 2016/2284/EU on the reduction of national emissions of certain atmospheric pollutants	Sets National Emission Ceilings (NEC) for the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution (i.e. sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds and ammonia) and fine particulate matter ($PM_{2.5}$).	All
Clean Air Programme for Europe (2013)	Includes measures to ensure that existing ambient air quality targets are met by 2020 and new air quality objectives set to reduce emissions by 2030.	Air quality
Cleaner Air for Scotland – The Road to a Healthier Future (2015)	The national cross-government strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution further to protect human health and fulfil Scotland's legal responsibilities.	All
Air Quality Plan for nitrogen dioxide in the UK (2017)	Sets out the UK's plan for reducing roadside nitrogen dioxide concentrations.	All

Environment Act 1995	Provides the legal basis for the local air quality management (LAQM) regime, secondary legislation and the UK Air Quality Strategy.	Air quality
Clean Air Act 1993	Provides the legal basis for controlling emissions of smoke, dust, grit from commercial, industrial and domestic premises (these are not regulated under Pollution Prevent and Control).	All
Environmental Protection Act 1990 and Public Health etc. (Scotland) Act 2008	Provides the legal basis for controlling emissions of smoke, fumes, gases, dust, steam, smell or other effluvia which are prejudicial to health or a nuisance.	All
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1) (2007)	Sets policy objectives and measures to tackle air quality issues from a variety of sources, including transport (not aviation), industry and domestic. UK health and habitat based standards and objectives are set under the strategy for the main air pollutants.	All
Pollution Prevention and Control Regulations	The Pollution Prevention and Control (Scotland) Regulations 2012 (as amended) , and Part II of the Environmental Protection Act 1990 (in relation to the waste management licensing regime) contain provisions in relation to regulation of emissions to air and offensive odours from industrial activities.	Nuisance
Climate Change (Scotland) Act 2009	Required Scottish Government to set a target for 2050, an interim target for 2020, and to provide for annual targets, for the reduction of greenhouse gas emissions; gave power to Ministers to: impose climate change	All

	duties on public bodies; make further provision about mitigation of and adaptation; make provision about energy efficiency, reduction and recycling of waste; and for connected purposes.	
Scottish Climate Change Adaptation Programme (SCCAP) Progress Report 2018	Aims to increase the resilience of Scotland's people, environment and economy to the impacts of a changing climate. Annual progress reports are published.	All
Scottish Planning Policy (2014)	Includes a presumption in favour of development that contributes to sustainable development.	All
National Planning Framework 3 (2014)	Takes forward the spatial aspects of the Scottish Government's Economic Strategy with a focus on supporting sustainable economic growth and the transition to a low carbon economy.	All
Air Quality Action Plans	AQMA Action Plans are prepared to provide a strategic policy framework for local authorities to address the air quality issues causing the designation.	All

6. Mitigation and enhancement

6.1 Mitigation involves the identification of measures which are envisaged to prevent, reduce and as far as possible offset any adverse environmental effects identified by the assessment. The best form of mitigation is avoidance; mitigation should therefore start with the avoidance of degradation of air quality or increase in nuisance as a first choice in the decision-making process. For example in relation to nuisance this would include avoiding the introduction of new sensitive receptors adjacent to a potential source of nuisance (e.g. not locating new housing adjacent to a landfill). In relation to air quality this would include avoiding the introduction of new sources of pollution into

existing AQMAs or where AQMA objectives would likely be exceeded.

6.2 Other examples of mitigation include setting a requirement for additional surveys and assessments at the next level of planning or project management e.g.

- setting a requirement for an air quality survey or air quality impact assessment (e.g. where a development is within or adjacent to an AQMA);
- requiring that processes to ensure that suitable mitigation measures to abate air quality degradation are identified and implemented.

6.3 Opportunities for enhancement should be explored for any neutral, uncertain and minimal effects identified. Such measures should aim to result in improvement of air quality or a decrease in levels of nuisance. PPS which include areas of existing poor air quality or an AQMA will also provide opportunities for enhancement.

7. Monitoring

7.1 The information gathered as a result of monitoring the environmental effects of the PPS enables the Responsible Authority to track the environmental effects of the PPS, gauge the effectiveness of any mitigation measures employed, identify unforeseen effects and manage any uncertainty encountered in the assessment process.

7.2 Table 5 below provides some examples of indicators relevant to monitoring significant effects of a PPS on air. Other more contextual indicators should be identified by the Responsible Authority to monitor for unexpected effects and consider the effectiveness of mitigation and enhancement measures.

Table 5 – Examples of SEA indicators

SEA air objective	Example of monitoring indicators
To improve air quality.	• Concentration of all Air Quality Strategy (AQS) pollutants within urban areas (µg.m^{-3}). • Number of exceedances of Air Quality Objectives (per month/year). • Number of AQMAs (per year). • Percentage of ecosystem areas that exceed acidification limits (per year).
To reduce levels of pollution.	• Volume of all AQS pollutants emitted from all regulated sources and linear / nodal sources (per month/year). • Number of breaches of regulations for industrial emissions of Air Quality Strategy pollutants. • Concentration of oxides of nitrogen / SO_2 / PM_{10} and $PM_{2.5}$ in air (µg.m^{-3}). • Number of exceedances of (a) oxides of nitrogen concentrations above 200µg.m^{-3} (1hr mean) or 40µg.m^{-3} (annual mean); (b) PM_{10} concentrations above 50µg.m^{-3} (24hr mean), 40µg.m^{-3} (annual mean – current UK objective) and 18µg.m^{-3} (annual mean – Scottish objective), (c) SO_2 concentrations above 350µg.m^{-3} (1-hr mean), 125 µg.m^{-3} (24hr mean) or 266 µg.m-3 (15-minute mean). • Trunk road length and capacity within Plan area (per year) / traffic flow on key routes within Plan area (vehicles per month).
To reduce the levels of nuisance (e.g. odour, dust).	• Number of complaints made regarding nuisance (by type per week/month/year). • Number of recorded breaches of regulations (associated with statutory nuisance) on construction / demolition sites (per week/month/year).

8. Interaction with other topics / cumulative effects

Table 6 – Cumulative effects	
Cumulative effect	**Examples**
Time crowding - frequent and repetitive effects	Incremental nuisance from a number of separate developments.
Time lag - long delays between cause and effect	Time delay for oxides of nitrogen and VOCs in the presence of ultra-violet (UV) light to produce ground-level ozone.
Space crowding - high spatial density of effects	Dust nuisance generated by several development / demolition projects occurring simultaneously in the same area / elevated particulate matter levels caused by numerous biomass micro-generation installations in an urban area.
Cross-boundary - effects occur some distance away from the source	Long-range transport of air pollution. Production of ground-level ozone at a point far removed from the source of oxides of nitrogen and VOCs.
Synergistic - effects resulting from multiple sources or combined effects different in nature from the individual effects	Combination of oxides of nitrogen, particulate matter and sulphur dioxide to produce smog. Combination of oxides of nitrogen and VOCs to produce ground-level ozone. Combination of oxides of nitrogen and sulphur dioxide with water in the atmosphere to produce acid rain.
Indirect - secondary effects resulting from a primary activity	Air pollutants deposited in soils becoming established in the food chain and negatively affecting human health and biodiversity (bioaccumulation).
Nibbling - incremental effects	Small additional traffic pressures acting cumulatively on traffic loadings - overall increase in emissions.

Table 7 - Interaction of air with other SEA topics

SEA topic	**Existing air problems and interactions with other SEA topics**						
	Ammonia (NH_3)	Ozone (O_3)	Oxides of nitrogen (NO_X)	Particulate matter (PM_{10} and $PM_{2.5}$)	Sulphur dioxide (SO_2)	Volatile organic compounds (VOCs)	Nuisance - dust, fine particles (e.g. haze and smoke), odour, noise
Biodiversity, fauna and flora Interactions with air include biodiversity affected by air quality / nuisance and the impacts of biodiversity / habitats on air quality / nuisance	Can have direct health effects on ecosystems and can lead to damage of sensitive terrestrial and aquatic ecosystems (e.g. heathland, woodland) through deposition of eutrophying	Includes physical damage to many plant species including loss of yield and quality of crops, damage to forests and negative impacts on biodiversity.	Includes leaf or needle damage and reduced growth. Acidification and / or eutrophication caused by NO_X can lead to loss of biodiversity, often at locations far removed from the original emissions.	Deposition of PM contributes to acidification of water and soils and / or eutrophication of water bodies, which can lead to detrimental effects on ecosystems.	Includes degradation of chlorophyll, reduced photosynthesis, changes respiration rates and protein metabolism. Acidification of waters and soils associated with SO_2 emissions can lead to loss of biodiversity,		Dust covering leaf surfaces may reduce photosynthesis capacity. Dust can affect pH of soils / water with knock-on effects on ecosystem function and health.

	and acidifying pollutants. Can also cause direct damage to vegetation.				often at locations far removed from the original sources of emissions.		
Climatic factors Interactions with air include air pollution as a contributor to climate change / climate change exacerbating air pollution and / or nuisance		Climate change increases the production of photochemical air pollutants such as smog and ground level ozone.	Emissions of greenhouse gases such as carbon dioxide, methane and nitrous oxide alter climate.	PM can have cooling or warming climate effects both locally and globally. Soot can be deposited on ice surfaces changing their reflective properties			Climate change increases the production of photochemical air pollutants such as haze and smog. Soot can be deposited on ice surfaces changing their reflective properties
Soil Interactions with air include air acting to transport and deposit pollutants to soil and the exchange of gases between	Can have direct health effects on ecosystems and can lead to damage of sensitive terrestrial and		Deposition of pollutants derived from NO_X emissions contribute to acidification of soils.	Deposition of PM contributes to acidification of water and soils and / or eutrophication of water bodies, which	Deposition of pollution derived from SO_2 emissions contributes to acidification of soils.		Dust covering leaf surfaces may reduce photosynthesis capacity. Dust can affect pH of soils with knock-on

soil and the atmosphere .	aquatic ecosystems (e.g. heathland, woodland) through deposition of eutrophying and acidifying pollutants. Can also cause direct damage to vegetation.			can lead to detrimental effects on ecosystems.			effects on ecosystem function and health.
Water Interactions include water as a receptor for some air pollutants / nuisance	Can have direct health effects on ecosystems and can lead to damage of sensitive terrestrial and aquatic ecosystems (e.g. heathland, woodland) through deposition of		Deposition of pollutants derived from NO_X emissions contributes to acidification of water and / or eutrophication of water bodies.	Deposition of PM contributes to acidification of water and / or eutrophication of water bodies, which can lead to detrimental effects on ecosystems.	Deposition of pollution derived from SO_2 emissions contributes to acidification of waters.		Dust covering leaf surfaces may reduce photosynthesis capacity. Dust can affect pH of water with knock-on effects on ecosystem function and health.

	eutrophying and acidifying pollutants. Can also cause direct damage to vegetation.						
Population and human health Interactions include effects on health of air pollution / nuisance	Ammonia is a toxic pollutant with acute direct effects depending on concentration (e.g. atmospheric concentrations will not produce such effects whereas large-scale chemical leaks may). It is also an important precursor to the formation of secondary PM and	Includes irritation to eyes and nose; very high levels can damage airways leading to inflammatory reactions. May also increase susceptibility to infection. Reduces lung function and increases incidence of respiratory symptoms, respiratory hospital	Includes inflammation of the airways due to short-term exposure; long-term exposure may affect lung function and respiratory symptoms. NO_2 enhances the response to allergens in sensitive individuals. NO_X contributes to the formation of secondary PM and	Includes respiratory and cardio-vascular illness and mortality as well as other ill-health effects. PM may carry surface-absorbed carcinogenic compounds into the lungs. Exposure to fine $PM_{2.5}$ can trigger heart attack or stroke.	Includes constriction of the airways of the lung (particularly in people suffering from asthma and chronic lung disease), and acute effects of irritation to eyes and throat. Precursor to the formation of secondary PM and therefore contributes to ill-health effects caused by	Contributes to the formation of ground-level ozone and associated health effects. Benzene and 1, 3-butadiene may increase human susceptibility to cancer.	Odour, light, vibration, noise, electromagnetic radiation, radioactive pollution and PM can affect the overall amenity value of the environment which can negatively affect physical and mental health.

	therefore contributes to ill-health effects caused by PM_{10} and $PM_{2.5}$.	admissions and mortality.	ground-level ozone.		PM_{10} and $PM_{2.5}$.		
Material assets Interactions include air pollution as a source of damage		Damages building materials which impacts on their integrity. Can reduce the productivity and yield of crops.	One of the causes of acid rain – damages buildings.	Soot deposited on buildings and infrastructure.	One of the causes of acid rain – damages buildings.	Damages crops. Damages metals and paints.	Soot deposited on buildings and infrastructure.
Landscape Interactions include effects of air pollution / nuisance on amenity value		Includes physical damage to many plant species including damage to forests ad negative impacts on biodiversity.	One of the causes of acid rain – damages landscape features.		One of the causes of acid rain – damages landscape features.	Damages crops.	Loss of amenity due to haze / smoke.

Cultural heritage Interactions include effects of pollution / nuisance on amenity value		Damages building materials and impacts on integrity of buildings.	One of the causes of acid rain – damages buildings.	Soot deposited on buildings and infrastructure.	One of the causes of acid rain – damages buildings.	Damages metals and paints.	Loss of amenity due to haze / smoke. Soot deposited on buildings and infrastructure.