Doncaster Health Authority

and

DONCASTER
Doncaster Metropolitan Borough Council

with technical support from

Institute for Environment and Health

and

THE UNIVERSITY OF SHEFFIELD
PUBLIC HEALTH GIS UNIT
GIS Expertise & High Quality Research for Public Health

HEALTH IMPACT ASSESSMENT, FINNINGLEY AIRPORT

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2. SUMMARY & RECOMMENDATIONS

Health impact assessment (HIA) allows those responsible for planning decisions to make informed choices to maximise the health benefits of any proposed development and to minimise any negative impacts on health. The HIA for the proposed Finningley airport was initiated in May 2000 by Doncaster Health Authority, in partnership with the Directorate of Environment, Health and Housing of Doncaster Metropolitan Borough Council, and supported by the MRC Institute for Environment and Health, University of Leicester and the Public Health Geographical Information Systems Unit, University Of Sheffield. This report describes the methods and findings of the HIA.

2.1 Objectives

To provide those responsible for planning decisions with information on positive and negative impacts of the proposed Finningley airport development on the health of local populations.

2.2 HIA Methodology

The HIA included the following activities:

1. Policy appraisal (review of the planning application documents).
2. Profiling of the local communities affected by the airport.
3. Interviewing stakeholders and key informants.
4. Searching the literature for evidence of the likelihood of health impacts.
5. Ranking and prioritising health impacts for recommendations.

Activity	**Agency**
Policy appraisal	MRC Institute for Environment and Health (IEH), Leicester
Profiling communities	Doncaster Health Authority / GIS Unit, Sheffield
Stakeholders/key person interviews	Doncaster Health Authority / Health and Public Protection, DMBC
Evidence-base	IEH, Leicester / Doncaster Health Authority
Making recommendations	HIA Steering Group
HIA Report	Doncaster Health Authority / DMBC

2.3 Recommendations of the HIA Steering Group:

Employment and regeneration opportunities are the main positive impacts that could lead to improvements in the health of the Doncaster population. The main negative impacts are from noise and pollution affecting local residents. The balance of effects will be a positive benefit to the health of Doncaster through the creation of jobs and regeneration of the area, provided effective amelioration measures are implemented to minimise negative impacts. The following recommendations were identified by the HIA Steering Group to maximise the health benefits and reduce the negative impacts.

2.3.1 Ongoing HIA activities

This is the first time that a HIA has been carried out at the initial stage of a planning application for an airport, even before the application is considered. The current report was based on the information presented in the planning application documents which were lodged with Doncaster Metropolitan Borough Council in November 1999. It is recognised that any amendments or details relating to the plans could have significant impacts on health that differ from those predicted within this HIA.

1. The HIA should therefore be a continuous process, with ongoing review of predicted health impacts if the application is approved.
2. Section 106 agreements will be made with reference to this HIA report and due consideration of the health impacts of the proposals; (Planning Act) Section 106 agreements between DMBC and the airport applicants set out details and criteria of proposed mitigation measures.
3. The HIA Steering Group will be consulted during the process of preparing the Section 106 agreements before decisions are finalised. The input of the HIA Steering Group into these agreements is particularly important because some of the mitigation measures stated in the application documents are not sufficiently detailed for the HIA Steering Group to make specific recommendations at this stage.

2.3.2 Airport Health Impact Group

An independent Airport Health Impact Group should be established if the airport development goes through. The Group should include representatives from the health authority, the local authority and local communities. The aims of this group should be:

1. To assess environmental impacts and mitigation measures (outlined in the Environmental Statement)
2. To check the validity of the assumptions of the Environmental Statement e.g.:

- Road traffic flow and predictions for air pollution and noise.
- Rail traffic from Lincoln to the airport.
- Aircraft types including training aircraft.

3. To monitor the health impacts and enhancement/amelioration measures (listed in Tables 6.1 to 6.4 of this Health Impact Assessment).
4. In addition to statutory monitoring of air quality, a watching brief should be maintained for the potential effects of ozone and aircraft de-iceants on health.

The Terms of Reference for the Airport Health Impact Group should be agreed by Doncaster Health Authority and Doncaster Metropolitan Borough Council. Meetings should be open to the public. The Group should be supported and led by the Health Authority, in conjunction with the Local Authority, reporting annually to Doncaster Health Authority and Doncaster Metropolitan Borough Council. Consideration should be given to how this group relates to the proposed Airport Consultative Committee, Air Transport Forum and Noise Monitoring Sub-Committee.

2.3.3 Employment

Positive health impacts of the proposed development relate to the creation of large numbers of permanent on-site jobs.

1. There should be an ongoing review of the number of direct on-site jobs created by the airport development (reviewed by the Airport Health Impact Group).
2. There should be a clear policy of employment opportunity for local people, wherever possible.
3. There should be a clear policy of training for local people in relation to airport employment opportunities. The policy should be developed in consultation with interested bodies.

2.3.4 Noise

All necessary measures should be taken by the applicant to ensure residents of Doncaster do not suffer sleep disturbance from aircraft noise. Consideration should be given where possible to World Health Organisation guideline levels for noise. The following measures stated in the Environmental Statement should be implemented:

1. Quiet Operations Policy
    - Runway optimisation that encourages use of a preferred runway.
    - Time restrictions on training flights.
    - Ensure landscape bunding is maintained.
    - Noise Manager to monitor the measures, community response and complaints.
2. Noise monitoring.
3. Sound Proofing Scheme to eligibility criteria agreed by the Airport Health Impact Group.
4. Night Flying Regulation
    - Noise restrictions and bans on the noisiest aircraft.
    - Restricted non commercial general aviation movements at night.
5. Restrict high power maintenance runs to the designated facility.
6. Restrict ground running of engines.
7. Restriction on construction activities to reduce noise annoyance.
8. Airport Environmental Management Scheme: monitor railway and traffic noise.

2.3.5 Green Transport Plan

A comprehensive Green Transport plan is essential. The plan as outlined in the Transport Impact Assessment document should be implemented. Key policy components that should be addressed are:

1. Address reductions in air pollution. Consideration should be given to World Health Organisation guideline levels where possible.
2. Address reductions in noise.
3. Address reductions in road traffic.
4. Minimise congestion.
5. Maximise local worker access.
6. Maximise pedestrian/cyclist access for local communities.

7. Maximise public transport access with
    - Detailed information of both coach and train services to be provided,
    - Detailed subsidy guarantees for provision of these services,
    - Agreed time period for the subsidy guarantees.

2.3.6 Motorway link road

Due consideration should be given to building a new motorway link road to the airport which will:

- reduce local traffic congestion
- improve local road safety
- improve social integration
- reduce community severance
- and which should be designed to minimise air pollution and noise.

However, because the health impacts of a link road have not been formally appraised in this report, proposals regarding a link road should be assessed as part of the on-going HIA review.

2.3.7 Review of public services infrastructure (including emergency planning and preparedness)

All public service bodies e.g. Police, Fire & Rescue, Social Services, schools and health services (GP practices, Trusts and Primary Care Groups) should review the potential impact of the airport development on their service delivery. This review should include procedures and facilities for providing routine everyday services, as well as emergency response plans in case of an emergency arising at or near the airport.

3. INTRODUCTION

3.1 Description of the proposed development

The planning application was submitted to Doncaster Metropolitan Borough Council in November 1999 by Peel Holdings to develop the former RAF airbase at Finningley into a commercial airport. The application proposes to cater for the movement of over 2 million passengers a year by 2014 and 62,000 tonnes of freight. Environmental, economic and transport impact assessments have already been conducted as part of the application. However, before the application is considered, it has been stipulated that a health impact assessment be conducted and submitted (although this was not a statutory requirement). This is the first time that an HIA has been carried out at the initial stage of a planning application for an airport in the UK.

3.2 What is health impact assessment

The World Health Organisation has defined health in its wider sense as “complete social, physical and mental well-being, not merely the absence of disease”. The health of a community is therefore determined by a wide range of economic, social, psychological and environmental influences (called health determinants).

Health impact assessment (HIA) is the process of estimating the effects of a given action on the health of a specified population. The actions concerned may range from projects to programmes or policies. By definition, any change in the determinants of health status of an individual or group is a health impact. HIA is a relatively new methodology, but builds on accepted scientific methods of qualitative and quantitative evidence-based research. An HIA is strengthened considerably by involving the local communities and other stakeholders, as well as experts, in identifying the health impacts.

There is a statutory requirement for major new developments to include environmental impact assessments, but not health impact assessments. Health impact assessment extends the environmental impact assessment further to identify how environmental changes would impact on human health. Other non-environmental determinants of health (e.g. social, economic) are also considered.

3.3 Health impact assessment, Finningley airport

The HIA for Finningley Airport is a prospective HIA, and is particularly timely because it will inform the planning decisions. During the statutory public consultation process, Doncaster Health Authority pointed out the need for a health impact assessment before the application is considered.

HIA activities were initiated in May 2000 by Doncaster Health Authority, in partnership with the Directorate of Environment, Health and Housing of Doncaster Metropolitan Borough Council (jointly funded). Technical support was provided by the MRC Institute for Environment and Health, University of Leicester (IEH), and the Public Health GIS Unit, University of Sheffield School Of Health And Related Research (ScHARR). This document is the final report which describes the key potential health impacts of the airport development.

4. OBJECTIVES OF FINNINGLEY HEALTH IMPACT ASSESSMENT

4.1 Aim of HIA

To provide planners with information on the potential health impacts of the proposed Finningley commercial airport on local residents, and on Doncaster as a whole.

4.2 Scope of HIA

This HIA report will inform the planning decision by DMBC in October 2000. HIA activities will, however, continue beyond that time to monitor and document health impacts if the airport development goes through. The scope of the assessment has been limited to Doncaster. It is, however, recognised that many of the direct impacts will extend beyond Doncaster to neighbouring districts, given the location of the airport, and that some of the indirect impacts could extend to the whole of S.Yorkshire and beyond.

4.3 Objectives:

1. To identify the potential impacts of the proposed Finningley airport on health.
2. To assess the likelihood and scope of those impacts.
3. To review the scientific evidence relating to those impacts.
4. To highlight the key health impacts that should be addressed in the airport planning stage.

4.4 Main outcomes:

1. The HIA has identified positive as well as negative health impacts.
2. The HIA does not provide a ready yes or no answer to the airport development. It informs planners of the health effects that could be expected if the airport development (as stated in the planning application) were to go through.
3. The HIA findings are particularly useful in negotiating for measures to maximise the positive impacts and minimise negative impacts on health.
4. The HIA has also identified areas where monitoring of health impacts is necessary, and where health impact assessment activities need to continue in parallel with the airport development.
5. The HIA should guide future developments directly or indirectly related to the airport.

5. HIA METHODOLOGY

5.1 Agencies involved

The HIA was conducted by Doncaster Health Authority in partnership with Directorate of Environment, Health and Housing, DMBC.

The MRC Institute for Environment and Health, University of Leicester conducted the policy and literature appraisal activities.

The Public Health GIS Unit, Sheffield School of Health and Related Research have supported Doncaster Health Authority in the geographical information system techniques used to profile the local communities.

The HIA Working Group have conducted the HIA activities. It is a multidisciplinary group including members from Doncaster Health Authority, DMBC and IEH.

The Finningley HIA Steering Group have been overseeing the conduct of HIA. Members represent Doncaster Health Authority, East Primary Care Group, DMBC, and local councils.

5.2 HIA activities:

This HIA report was limited in scope to the population of Doncaster, and limited in time to the end of September 2000. Potential health impacts were identified using a modified version of the model for HIA presented in the Merseyside Guidelines for HIA by the Merseyside Health Impact Assessment Steering Group (Scott-Samuel 1998). The methodology involved the following activities:

1) Policy appraisal (review of the planning application documents, and the environmental, transport and economic impact documents included with the application) to identify potential health impacts.
2) Profiling of the local communities affected by the airport development to identify vulnerable communities, groups or individuals.
3) Involving stakeholder and key informants to identify perceptions of how the airport will impact on health.
4) Searching the literature for evidence of the likelihood of health impacts.
5) Ranking and prioritising health impacts for recommendations.

These activities have been guided by the experiences of other HIAs documented in the literature, and in particular those involving airport developments. The activities have been conducted in parallel, so that findings complement each other. The results triangulate to ensure that all potential impacts are identified by including the views of all agencies, stakeholders and the local communities.

5.3 Policy appraisal (See Annex 1)

A policy analysis of the following documents was conducted:

1. The planning application.
2. A planning policy and position statement by Airport Planning and Development Limited.
3. An economic impact assessment by DTZ Pieda Consulting.
4. A transport impact assessment by the Tucker Parry Knowles Partnership.
5. An environmental statement (ES) and non-technical summary prepared by Scott Wilson Resource Consultants.

The HIA has therefore built on the information stated in the application documents including the technical impact assessments as conducted for the planning application. Those environmental, transport and economic impact assessments were conducted by independent consultants on behalf of Peel Holdings and have been reviewed by independent reviewers on behalf of DMBC (Institute of Environmental Management & Assessment, Transport Research Laboratories reports). On the whole, the independent reviews have upheld the findings of those assessments. The minor differences in some predicted outcomes (e.g. passenger forecasts, numbers of jobs created) are not expected to affect the findings of the HIA substantially.

The policy analysis involved extracting information relating to potential health impacts and any planned mitigation from the documents listed and presenting them in a data extraction table agreed by the HIA Working and Steering Groups (Appendix 1). In addition to those impacts explicitly addressed in the documentation, IEH investigators have recorded other potential impacts identified through expert judgement.

5.4 Profiling of local communities (See Annex 2)

Routinely collected data, held at the health authority, were used to profile the local communities potentially affected by the airport. Data for the wards adjacent to the airport were used to profile the age, sex, deprivation and health status of those communities. Geographical information system (GIS) mapping techniques were used specifically for the Finningley Airport HIA. Maps were produced for the whole of Doncaster district to inform wider impacts on health. The data used were collated from the 1991 Census and the Family Health Service Register (persons registered with GPs). Data were also extracted from details presented in the planning application documents e.g. flight paths, households potentially affected by noise.

5.5 Stakeholders and key person interviews (See Annex 3)

Public participation throughout the HIA is essential, both to ensure that local concerns are addressed and for ethical reasons of social justice. In the first step, the responses to public consultation from town and parish councils in Doncaster have been reviewed to provide the wider scope of impacts on the whole of Doncaster. The formal responses of lobby groups were also requested.

In addition to the public consultation, semi-structured interviews and focus group discussions were conducted specifically for the HIA to identify perceptions of how the airport will impact on health. The activity aimed to elicit views from the local population (local residents, professionals working in the vicinity of the airport) on the positive and negative potential health impacts of the development. The local communities targeted for this activity comprised four communities directly adjacent to the flight path: Blaxton, Auckley, Finningley and Bawtry, and two others potentially affected by ground-traffic: Rossington and Bessacarr. The selected areas differ in socio-economic composition and therefore provided a range of perspectives. These communities were selected purposively because of their location in relation to the airport, but it is expected that the responses will be relevant to other communities within and outside Doncaster.

5.6 Evidence-based literature reviews (See Annex 4)

The current literature was appraised by IEH to identify potential health impacts from the airport and to validate the perceptions on the likelihood and scope of those impacts. The stages of collecting the evidence were:

1. Identifying similar HIA studies
2. Collecting information from official sources (DoH, DETR, DSS, DfEE)
3. Searching bibliographic databases for evidence of links between the airport development and health
4. Appraising the literature (selecting important studies)
5. Assessing the likelihood of health impacts (based on evidence)

5.7 Ranking and prioritising health impacts

The HIA Working Group convened a workshop to review the potential health impacts identified from each of the preceding activities. The Group referred to the Trent HIA scoring system (Appendix 2), to prioritise the key health impacts from the airport development. However, the scoring system could not be applied due to the difficulty of scoring impacts where the proposed mitigation was not detailed or agreed. Findings on key health impacts were collated and presented to the Steering Group. The Steering Group agreed not to score health impacts in view of the fact that noise and other potential impacts might vary in relation to the amelioration measures put in place. So, the health impacts could not be ranked in order of importance.

6. DISCUSSION OF KEY HEALTH IMPACTS

The different activities have been conducted in parallel. The main results of each activity are presented in Annexes 1-4. In this section the key health impacts are presented and discussed, linking public perception with the evidence for the likelihood and scope of the health impact.

During the policy analysis and evidence-base exercises a large number of potential health impacts were explored. Full details of all these impacts are given in the data extraction forms in Annexes 1 and 4. The main positive impact arises from the employment and regeneration opportunities that the airport development will bring. The main negative impacts are from noise and pollution affecting local residents. However, it must be emphasised that the majority of health effects compiled in the data forms are theoretical and are extremely unlikely to manifest themselves at the environmental exposure levels predicted for the airport development and related activities.

6.1 Socio-economic considerations

There is a reasonable body of evidence to support the finding that employment is associated with better health (Table 6.1). Much of the research and information available discusses the negative health impacts resulting from unemployment rather than looking at the positive impacts that employment can bring. However, it is reasonable to assume that if unemployment is bad for a community then employment should be good for it. People in work enjoy better physical and mental health than those without work. Unemployment increases the risk of illness and premature death. For example, a middle-aged man who loses his job is twice as likely to die in the next five years as a man who remains employed (DH, 1999). Theoretically, greater income equality is associated with better health because it tends to improve social cohesion and reduce social divisions. Other psychosocial issues, such as feelings of low control, insecurity and low self esteem may also be important (Wilkinson, 1997). Access to employment is crucial to people's ability to participate in many of the economic and social opportunities of society. Inequality in access to jobs contributes substantially to poverty and social exclusion, with

debilitating effects on the morale, health, family status and even social networks of individuals and communities (Pantazis & Gordon, 2000).

Previous health impact assessments (HIAs) have considered the positive health impacts resulting from transport policies e.g. various policies for improving the Merseyside transport system have been prospectively assessed. The positive health impacts identified would result from employment opportunities, improved access and greater physical activity. However, counter to this were concerns that, by improving links with national networks, economic benefits could actually be taken away not brought into the area (Fleeman, 1999). Infrastructure developments have economic impacts, both on the regions in which they are located and on more distant areas. For instance, the Channel Tunnel had notable short-term economic impacts (through construction activities) but also the existence of the new piece of infrastructure may have significant long-term implications for the UK. However forecasts showed more job losses (in ports and on ferries) than would be created by the tunnel (Button 1994). The HIA of Manchester Airport's second runway considered the potential (positive) impacts from airport-related employment. It highlighted that for the greatest potential health impact, recruitment packages should specifically target disadvantaged populations (such as residents in deprived areas, single parents, or disabled people) and by offering some part-time posts for single parents (including a crèche facility).

The proposed development is situated within an area which used to be dominated by coal mining, and, since the immense reduction in coal production, has suffered from rates of unemployment consistently higher than the national average. General levels of deprivation are high and health indicators such as mortality rates show that people experience less good health than is expected nationally. While the area immediately surrounding the airfield is not as deprived as other parts of South Yorkshire, a large part of the South Yorkshire Coalfields area is within 30 minutes drive of the airfield and hence could benefit directly from employment so long as suitable training and transport infrastructure are put in place. The more deprived parts of Doncaster town centre and Rossington are particularly well placed to benefit. There are estimated to

be 4.2 million people living within one hour's drive of the airfield; this is the area which is likely to benefit from an airport's role as a facilitator of economic growth.

The results from the stakeholder and key person interviews indicated unanimous recognition that the airport development opened up job opportunities, economic benefits and regeneration potential. The effects of employment on quality of life and social benefits were perceived by most respondents, although the medical benefits were quoted by the GPs interviewed (e.g. reduced coronary heart disease and improved mental health). The regeneration effect was felt to be more important for young people increasing aspiration and expectation, and making Doncaster more attractive to young graduates. The socio-economic benefits were thought to be more relevant to particular areas of Doncaster, not necessarily closest to the airport. In particular, Rossington residents were keen on the employment opportunities the airport would bring. It was pointed out however that the skill base was not adequate in the area and that the beneficial effect of job creation on the area would be undermined by work displacement and by lack of training opportunities. There was also mixed feeling about the impact of regeneration on social cohesiveness; that prosperity would strengthen community spirit or that inevitably urbanisation would overtake the peaceful quality of village life.

We may conclude therefore that although the Finningley airport re-development does open up employment opportunities, the economic benefits could largely be taken away by recruitment policies that are not specifically focused on local populations. There is a need therefore to develop policies that will maximise the positive effects on regenerating Doncaster and South Yorkshire by focusing training and recruitment towards local populations. The planning application states that there will be a net 6217 full time equivalent jobs created by 2014, but the Transport Research Laboratory review of the planning application using different assumptions gave somewhat lower estimates.

Table 6.1 Summary of socio-economic impacts and planned mitigation/enhancement measures identified from the policy analysis and evidence base

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
POSITIVE IMPACTS						
Employment	Quality of life	Trained persons or those who can be trained.	AIRPORT-RELATED: Direct estimated at 4782 net jobs; Indirect estimated at 1435 net. CONSTRUCTION: 117 full-time equivalent jobs.	N/A	- Work closely with local training, employment and recruitment agencies to develop training and recruitment support. - Work to ensure transport links to airport are developed, particularly to priority regeneration areas.	P27-29, E37
NEGATIVE IMPACTS						
Employment	Quality of life		DISPLACED JOBS: 114 full-time jobs.		- Work closely with local training, employment and recruitment agencies to develop training and recruitment support. - Work to ensure transport links to airport are developed, particularly to priority regeneration areas.	P27-29, E37

6.2 Noise

The policy appraisal identifies noise, from aircraft (air and ground operations), construction, road traffic and railways, as a source of a number of potential health effects on the local population around the proposed airport. The ES predicts noise levels for the period before the construction of the airport is started, during construction and when the airport is fully operational in 2014. It has been assumed that the predicted noise levels are a reasonable representation of noise from the development. Table 6.2 summarises these data. This Health Impact Assessment has focused on comparing the predicted noise levels, for construction and the fully operational airport, with guideline values in the Planning Policy Guidance, namely PPG24 from the evidence-base (DoE, 1994), in order to assess the likelihood of an increase in health effects occurring in the Doncaster region.

Potentially, the main public health impacts of exposure to noise are community annoyance, anxiety, sleep disturbance and effects on child health. There is some evidence to suggest that these may in turn lead to secondary health impacts such as cardiovascular disease (CVD), immune system effects, cognitive dysfunction (reduced memory, performance and social behaviour) and respiratory illness. However, there are very limited data to suggest that these 'secondary' effects may, in certain circumstances, also be directly related to noise exposure, and which are not considered to be of sufficient quality/quantity. Overall, the risk of these health effects, whether 'secondary' or primary, occurring as a result of noise from the airport is not considered to be significant for the majority of the local population, as will be outlined in the subsequent sections.

Noise induced annoyance and anxiety

There are only a few isolated locations around the proposed airport that will exceed the World Health Organisation's (WHO) guidance value for noise ($55L_{Aeq}$,16h dB; general environmental goal for outdoor noise in residential areas to prevent community annoyance) (See Table 6.2 for areas). At only one location (Bawtry High Street) are there expected to be noise levels (from road traffic) that may cause severe annoyance. However, from the ES it is expected that these dwellings will fall within the remit of the Sound Proofing scheme, and the majority may have already

been sound insulated by the RAF. Consideration should be given to susceptible groups, such as the elderly and noise-sensitive individuals, who may suffer these health effects at noise exposures below the guidance levels. If the development proceeds, new residential dwellings will be assessed for noise exposures as part of the planning application, and therefore no further residents near the airport should suffer from noise-induced annoyance or anxiety. Low levels of noise annoyance and anxiety are expected, although it is not expected to be a significant public health impact if sufficient mitigation is undertaken to reduce noise to as low as practicable.

Child Health and noise

Children comprise a noise-susceptible group, particularly in relation to the potential effects on cognitive function. There is evidence to suggest that children attending schools in noisy areas are susceptible to reduced memory and a reduced capacity to perform tasks. However, the schools in this area do not fall into the footprint of noise at which these effects are likely to occur. Therefore, disturbance of the cognitive function of children from noise exposure is not believed to be a significant risk for this development.

Noise induced sleep disturbance

Sleep disturbance to individuals may occur if noise levels are above $48L_{Aeq}$,8h dB. The ES estimates that some individuals in dwellings in specific locations around the airport (see Table 6.2) would be exposed to noise levels that could cause some risk of sleep disturbance. With the implementation of basic mitigation the risk of sleep disturbance should be minimal. In addition, if the development proceeds, new residential dwellings will be assessed for noise exposures as part of the planning application, and therefore no further residents near the airport should suffer from noise-induced sleep disturbance.

Noise induced aural pain and hearing loss

There is a slight risk that extremely sensitive individuals, such as those taking ototoxic drugs and those exposed to high levels of certain industrial chemicals, high levels of vibration and shift workers, may suffer some hearing loss when exposed to the highest of noise levels that the airport could produce. Individuals with inflammatory conditions of the ear and hearing-aid users may suffer from aural pain at very high noise levels, but the risk of these aural effects is believed to be minimal.

In considering the potential health impact of noise levels it is important to look at indicators of the current levels of stress experienced by the local residents. This is very difficult to do with any precision using routinely available data. The amounts of stress-related medicines (anti-depressant, anxiolytic and sleep-inducing drugs) currently prescribed by GPs in the area around Finningley vary from practice to practice, but are not consistently higher than the rest of Doncaster (although rates in Doncaster tend to be higher than the national average). Stress can cause heart disease, rates of which are higher than the national average in Hatfield, Rossington and Armthorpe wards (but not particularly high in Bessacarr and South East wards, the wards most directly affected by traffic and aircraft noise).

The number of persons in these wards affected by significant aircraft noise (i.e. levels that will lead to community annoyance or sleep disturbance) are few (See Annex 2) due to the relatively isolated situation of the airfield. However there are some people whose sleep could be affected if appropriate mitigation measures are not taken. Finningley Church of England and Hayfield schools are also close to (but outside) the area subject to low community annoyance. The number of persons affected by increased road traffic noise on the busiest roads will be very small (only 11 people living within 20m of roads with 30% increase in traffic in 2001, and 137 people by 2014), but the two schools are located on the roads with the largest increase in traffic. Only four people live within 20m of the railway line anticipated to give access to the airport from Doncaster. However, access from Lincoln has not been assessed.

Concerns were voiced by the local communities regarding the effects of noise on their health. The noise from aircraft appeared to be of more concern than that from traffic, mostly regarding night flying. Traffic noise was perceived as a compounding factor. The health effects recognised by residents to result from noise were sleep disturbance, stress, and concern about educational attainment of children in local schools, including the Social Education Centre close to the airfield. On the other hand, some respondents felt that traffic noise was already part of their life, and that one would soon become accustomed to aircraft noise.

Table 6.2 Summary of Noise health impacts and planned mitigation/enhancement measures identified from the policy analysis and evidence base

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
NEGATIVE HEALTH IMPACTS							
NOISE	Annoyance	Noise sensitive individuals, those who fear the source of the noise, children. Residents who live within 20m of main access roads are most at risk.	AIR: 57-63L_{Aeq}, 16h dB from Long Plantation to North edge of Bawtry (include parts of Blaxton, Finningley). 63-69L_{Aeq}, 16h from Blaxton to Partridge Hill Farm. AIRCRAFT GROUND OPS: 55L_{Aeq}, 16h exceeded at western perimeter of Finningley Village and in Church Lane. Typical levels around 50L_{Aeq}, 16h. CONSTRUCTION: Short periods above 65L_{Aeq}, 16h. RAILWAY: Around 57L_{Aeq}, 18h ROAD TRAFFIC: Significant increases in noise expected along main routes to the airport. Bawtry High Street expected to reach levels of 70L_{Aeq}, 18h by 2014.	**WHO** **Noise & Number Index (NNI)** **Replaced by:** **PPG24 (Planning permission categories for new houses - aircraft noise only)**	55L_{Aeq}, 16h general environmental goal for outdoor noise in residential areas to prevent community annoyance. High annoyance: >69L_{Aeq}, 16h Moderate annoyance: 63-69L_{Aeq}, 16h Low annoyance: 57-63L_{Aeq}, 16h DAYTIME: >72L_{Aeq}.16h dB Planning permission (PP) for housing normally refused 66-72L_{Aeq}.16h dB PP normally refused but permitted with sound proofing in certain circumstances. 57-66L_{Aeq}.16h dB PP given with approp conditions <57L_{Aeq}.16h dB PP given with no need to consider noise.	- Quiet Operation Policy – Runway optimisation that encourages use of a preferred runway. – Restricted non commercial general aviation movements at night. – Time restrictions on training flights. – Noise monitoring. – Sound Proofing Scheme (note: 125 of 150 houses within the 70L_{Aeq},16h dB contour were sound insulated by the RAF when Finningley was operating as a military base). – Night Flying Regulation – noise restrictions and bans on the noisiest aircraft. – Noise Manager will be appointed to monitor the measures, community response and complaints. – Ensure landscape bunding is maintained. – Restrict high power maintenance runs to the designated facility. – Restrict ground running of engines. – BS 5228: restriction on construction activities to reduce noise annoyance.	P1 P2 P3 P5 P6 See also: E4

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
NOISE	Annoyance (cont.)			NIGHT-TIME: >66L_{Aeq}.8h dB Planning permission (PP) for housing normally refused 57-66L_{Aeq}.8h dB PP normally refused but permitted with sound proofing in certain circumstances. 48-57L_{Aeq}.8h dB PP given with approp conditions <48L_{Aeq}.8h dB PP given with no need to consider noise. Noise events regularly exceeding 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of $L_{Aeq, 8hr}$	– Airport Environmental Management Scheme: monitor railway and traffic noise. - Green Transport Plan.	
NOISE	Anxiety	Noise sensitive individuals, those afraid of the source of the noise. Individuals susceptible to anxiety/stress	See annoyance entry above		.	P8. E42, 43
NOISE	Aural pain	Inflammation of the ear, sensorineural hearing disorders and hearing-aid users.	See annoyance entry above	Pain threshold in normal hearing persons – 110-130 dB Physical discomfort threshold – 80-100 dB. In cases of inflammation the pain threshold may be reduced to 80-90 dB. Discomfort associated with exposure to sudden loud noises (even raised voices) is a common complaint of hearing-aid users.		E8

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
NOISE	Aural pain (cont.)			Road vehicles, trains and aircraft emit low frequency noise. Intense low frequency noise may produce aural pain.		
NOISE	Hearing loss	Elderly individuals, those taking ototoxic drugs, individuals occupationally exposed to certain industrial chemicals, vibration and shift work.	See annoyance entry above	None		P47, E9
NOISE	CVD	Suffers of COPD and other cardiopulmonary conditions.	See annoyance entry above			P23, E21
NOISE	Immune system effects	Compromised immune systems.	See annoyance entry above			E39
NOISE	Child health – cognition	Children	See annoyance entry above	None		P46, E24
NOISE	Child health – birthweight	Foetus	See annoyance entry above	noise >85L_{Aeq}, 8h dB may contribute to decreased utero-placental blood flow resulting in foetal hypoxia and increased secretion of maternal catecholamines.		P48, E22
NOISE	Child health – CVD	Children	See annoyance entry above			P23, E21, 23
NOISE	Child health – endocrine system	Children	See annoyance entry above			E25
NOISE	Cognitive dysfunction – memory	Children and noise sensitive individuals.	See annoyance entry above	Long-term memory and mental arithmetic impaired in noise sensitive individuals at 55-57 dB(A).		P46, E29

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
NOISE	Cognitive dysfunction – performance	Children and noise sensitive individuals.	See annoyance entry above			E30
NOISE	Cognitive dysfunction – social behaviour	Predisposition to aggressive behaviour.	See annoyance entry above			E31
NOISE	Respiratory illness	Asthmatics and suffers of COPD.	See annoyance entry above			E53
NOISE	Sleep disturbance	There is evidence that older people (55 years and older) are affected more than younger people by noise during sleep. Children appear less susceptible to sleep disturbance caused by noise. Some studies suggest that women are more vulnerable than men to sleep disturbance by noise, but the results are inconsistent. It has been reported that babies who have gastric difficulties or have suffered brain injury, may be particularly sensitive to noise. In addition, a slightly higher sensitivity to noise during sleep has been observed for persons with neurotic tendencies.	The footprint expands with development of the airport. By 2014 it is anticipated that some 981 dwellings will fall within the $48L_{Aeq}$,8h dB (onset of any risk of sleep disturbance) contour, and 148 within the $55L_{Aeq}$,8h dB (at risk of sleep disturbance) contour. None are in the $65L_{Aeq}$,8h dB (discernible increased disturbance) contour. Numbers of dwellings affected using the '90dB Footprint Method' depends on the aircraft in question	Sleep disturbance is likely to occur if more than 50 noise events per night. The maximum indoor noise level for no disturbance of sleep is 50 dB (A).		P44, 45, E54

6.3 Environmental pollution

The interpretation of results and conclusions drawn from the policy analysis and evidence base activities have relied heavily on the information and predictions given in the Environmental Statement (ES), particularly in relation to noise and air pollution. On the basis of available scientific and medical knowledge, and on the basis of the environmental changes predicted as a result of the airport development, the overall impacts on public health in the Doncaster region in 2014 are likely to be negligible for the vast majority of hazards associated with the airport development and related activities.

6.3.1 Air quality

The negative effect of pollution from aircraft, and traffic exhaust emissions on health was regarded as a concern by many local respondents. Air pollution generated from the airport and related activities may have a potential impact on public health at a local and regional level. Pollutant sources stem primarily from the combustion of fossil fuels and a number of air pollutants of potential importance have been identified either in the ES or from the evidence-based literature review. The sources of these pollutants include aircraft movements (approach, climb-out, taxi, take-off, landing, holding), road traffic (construction traffic, airport access traffic, car parks and airside vehicles), airport combustion plant, fuel handling and railway operations. The pollutants that are considered to be of most potential importance are listed below (full details about the health effects of these pollutants are provided in the evidence base and policy analysis data extraction forms in Annexes 1 and 4 of this report) :

Carbon monoxide (CO) — Carbon monoxide reduces the oxygen carrying capacity of blood and can affect people with pre-existing cardiovascular diseases. Exposure to CO has also been linked with cognitive dysfunction and may affect other susceptible groups such as the pregnant mother and foetus and individuals suffering from haematological diseases that affect oxygen uptake and transport.

Benzene — Almost all of the benzene found in the environment is likely to have occurred from human activities, in particular the combustion of motor vehicle fuels. Cigarette smoking is also a major source of exposure to benzene. Studies on people occupationally exposed to benzene have identified a small but significant risk of developing certain types of leukaemia. However, the risk to the general population from environmental exposures is believed to be negligible.

Lead (Pb) — Lead is no longer widely used as a petrol additive, but has been linked with a number of adverse health effects, the most notable being the impairment of cognitive function. Children may be particularly susceptible to such effects.

Nitrogen oxides, in particular nitrogen dioxide (NO_2) — Nitrogen dioxide is an irritant gas that can affect the airways and lungs. Asthmatics are considered to be susceptible to the effects of NO_2 and children may be at an increased risk of respiratory infection. On a regional scale, nitrogen oxides contribute to the formation of ozone.

Ozone (O_3) — Ozone arises from chemical reactions in the atmosphere between nitrogen oxides and hydrocarbons, derived mainly from vehicle exhausts. It can cause irritant effects in the airways and lungs and asthmatics may be more sensitive to its effects.

Particulates — Very fine airborne particulate matter can aggravate existing heart and lung conditions and may have a role in exacerbating asthma. It is believed that individuals who suffer from chronic obstructive pulmonary disease (COPD) and other cardiopulmonary conditions may be susceptible to the effects of particles.

Polycyclic aromatic hydrocarbons (PAHs) — PAHs are emitted in engine exhausts. They comprise a large group of chemical compounds that may be absorbed and some of which may be altered in the body into substances that can cause damage to the genetic material in cells. PAHs are always encountered as a chemical mixture in human exposures. Some occupational and animal studies have found an association between PAHs and cancer.

Sulphur dioxide (SO_2) — Sulphur dioxide can act as a respiratory irritant and individuals suffering from asthma and chronic lung diseases are believed to be susceptible to these health effects.

In addition to the pollutants and health impacts listed above, a number of others were examined, details of which can be found in Table 6.3. It is important to note that many of these theoretical health effects listed in the Table are exceedingly unlikely to be experienced at the environmental exposure levels predicted for the airport development and related activities

The wards potentially likely to be most affected by air pollution (South East, Bessacarr and Hatfield) do not have particularly high rates of lung cancer and other respiratory disease, although Doncaster residents do suffer more from these conditions than the country as a whole. Lung cancer is primarily caused by tobacco smoking, but air pollution is likely to be an important factor in chronic obstructive pulmonary disease such as asthma. The only area of Doncaster with the exceptionally high rates of asthma is Rossington and this should be remembered when future infrastructure developments are considered. However Rossington is unlikely to suffer increased pollution as a result of the current developments.

On analysis of the evidence base and the information provided in the ES, the likely impact on public health of the air pollution generated by the Finningley airport and its related activities is considered to be very small. However, of potential concern are the possibility for the potentiation of allergic sensitisation and the exacerbation of asthma, respiratory illness and cardiovascular effects resulting from exposure to NO_2 and particulate matter.

The predictions given in the ES indicate that by 2014 air pollution levels in general are likely to fall well within currently accepted limits. These predictions have been compared with the UK air quality standards recommended by the Expert Panel on Air Quality Standards (EPAQS); the recently published Air Quality Objectives for England, Scotland, Wales and Northern Ireland (NAQS objectives); and with the World Health Organisation (WHO) Air Quality Guidelines. All of these standards and guidelines are health-based and are designed to take account of the effect of human exposure to each pollutant and in particular to account for various sensitivities within the population including children and the elderly. The Air Quality Objectives, published in the National Air Quality Strategy earlier this year, will be included in regulations for the purposes of Local Air Quality Management, while the WHO guidelines are not regulatory standards in themselves but are intended to provide recommendations to help individual countries to develop their own nationally-based standards in the European Region.

For CO and SO_2, predicted levels by 2014 (total annual average including airport and road traffic emissions together with background levels and maximum rolling 8-hour mean) indicate that no detectable adverse effects on the health of the Doncaster-region population will be experienced as a result of exposure to these pollutants. For PAHs a similar conclusion is drawn although predicted levels given in the ES are for hydrocarbons (which include compounds other than PAHs) based on aircraft fuel emissions only and do not account for other sources of hydrocarbon emissions such as road traffic.

For NO_2, predicted levels by 2014 (total annual average including airport and road traffic emissions together with background levels and maximum 1-hour mean) suggest that adverse effects on public health are unlikely to be experienced. However, the highest predicted annual mean concentration (recorded at a roadside location in Blaxton) indicates that NO_2 levels may begin to approach the WHO guidelines and NAQS objectives; this may have limited implications for the health of individuals who are particularly susceptible to the adverse effects of NO_2, namely asthmatics.

Predictions for airborne particulates (PM_{10}) indicate that annual mean concentrations are unlikely to exceed air quality guidelines and standards. The contribution to these levels from the airport and local roads is small (predicted annual mean concentrations from these sources range from 0.07µg/m^3 – 0.68 µg/m^3). Predictions for 24-hour running-averages suggest that particulate levels may exceed both the EPAQS and NAQS standards on occasions. Short-term elevations in ambient particle levels have been associated with increases in morbidity, mortality and hospital admissions with acute cardiopulmonary impairment being the predominant effect. The elderly and individuals suffering from existing chronic obstructive pulmonary disease and other cardiopulmonary conditions are considered to be most at risk, and there is evidence to suggest that environmental exposure to particles may exacerbate asthma. However, the overall effects on public health as a result of particulate air pollution in the Doncaster region are not likely to be significant,

particularly as the contribution to total particulate levels from the airport and related activities is small.

The risk to public health from exposure to lead in air is considered to be negligible, particularly with the phasing out of leaded petrol as a road transport fuel. Because no emission predictions are provided in the ES, no firm conclusions can be drawn with regard to the impact of ozone or benzene exposure on public health as a consequence of the proposed airport development. It should be noted, however, that the risk to health from environmental exposures to benzene are considered to be negligible.

These conclusions have been drawn on the basis of a careful analysis of the information provided in the ES and on a review of published scientific and medical literature on the health effects of air pollution. It should be noted that a number of attempts have been made to quantify the impact of air pollution on public health (DH, 1998; Küzli et al., 2000; Seethaler, 1999) but this literature has not been used in our analysis for a number of reasons:

- It is almost always impossible to directly identify individual responses to exposure to complex chemical mixtures such as air pollution. Neither is it possible to define the specific characteristics of an exposure or identify a direct causal link between a particular pollutant and an adverse effect at a public health level. There is, therefore, inherent uncertainty in any attempt to derive attributable cases.
- Co-variation of air pollutants means that in many instances there is uncertainty about which pollutants or mixture of pollutants have resulted in a recorded health outcome. In addition it is often not possible to determine whether any additive or synergistic effects have taken place. Thus, although some authors have used particulates (PM_{10} and $PM_{2.5}$) levels in air pollution as a quantifiable measure to account for morbidity and mortality, this may not be the actual causative agent *per se* but a surrogate for a range of complex biologically active ingredients.
- Some studies quantify their findings in terms of extra morbidity or mortality events occurring in a given year. This may be misleading as there is no way of knowing

with any certainty whether such events would have occurred without the added effects of air pollution. In these types of studies, a significant proportion of the estimated morbidity and mortality events are likely to occur among individuals already suffering from existing diseases.

- Because of differences between geographical location, population demographics, lifestyle factors etc., the extrapolation of quantified estimates (that are already inherently uncertain) from one situation to another is subject to a great deal of uncertainty and can lead to misleading conclusions.

6.3.2 Water and land quality

Participants in the focus group discussions were concerned that water from bore holes/artesian wells could be polluted by airport activities. The policy analysis identified a number of potential health hazards associated with pollutants in land and water. The main hazardous materials identified in the ES are arsenic, asbestos and hydrocarbons (such as diesel, kerosene and mineral oils). These materials have been found as contaminants in some areas of the proposed airport development. Although the literature evidence reveals a wide range of potential health impacts associated with these pollutants, there are various factors to suggest that such health impacts will be unlikely — in most instances environmental exposure levels and scenarios mean that these health effects are extremely unlikely to manifest themselves. Potential health impacts associated with water and land quality are presented in Table 6.3.

The levels of contamination reported in the ES are generally low. On the whole, areas where elevated levels of contamination have been found do not correspond with proposed areas of construction, reducing the likelihood of exposure. Furthermore, it is stated in the ES that specific measures will be taken to segregate, classify, handle and dispose of contaminated material. This will form part of an overall strategy for dealing with contaminated soils and groundwater. According to the ES, the airport development will operate a Construction Management Plan to test for and manage previously undetected contamination and ensure compliance with relevant Health and Safety legislation, thereby helping to minimise the opportunity for

exposure to the contaminants. Once construction work is complete, there will be minimal opportunity for exposure to contaminants because any residual contamination will be covered by car parks or buildings and the opportunity for mobilisation or exposure will be negligible. Monitoring will also be undertaken to observe the groundwater quality beneath the site before, during and after construction. Previous monitoring exercises have not shown any detrimental impacts on the groundwater beneath the site.

There is the potential for asbestos to be encountered during demolition and deconstruction phases of the development. However, by complying with relevant legislation for the safe handling and disposal of asbestos materials, as is stated in the ES, the opportunity for exposure to asbestos will be minimised. Therefore, potential health impacts are unlikely.

Fuels and de-iceants will also be stored and used at the airport during its operation. All on-site storm water and foul drainage will be handled by a secure, positive drainage system to protect local surface watercourses and groundwater from contaminated run-off. The main concern relates to operational use of de-iceants. Exposures to these chemicals may be an issue of occupational concern but any health impacts should be adequately managed through relevant health and safety legislation and procedures. The drainage systems (diversion chambers, storage lagoons, controlled discharge to the sewage treatment works) should avoid the risk of these materials reaching surface or ground waters. The potential adverse impacts of accidental spillages of materials such as fuels and de-iceants will be minimised by appropriate bunding of storage facilities, oil interceptors in drainage systems and suitable operating and emergency procedures, as set out in the ES. The application of these measures will ensure that occupational and public health impacts are unlikely.

Table 6.3 Summary of Air, Water and Land Pollution health impacts and planned mitigation/enhancement measures identified from the policy analysis and evidence base

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
NEGATIVE HEALTH IMPACTS							
Nitrogen dioxide	Potentiation of allergic sensitisation, Cancer (via the formation of nitroarenes) Respiratory illness	Asthmatics Particularly individuals suffering from asthma and chronic obstructive pulmonary disease (COPD). Children are also susceptible because repeated lung infections can cause lung damage in later life.	Total annual mean (2014) range from 9.16ppb (Hatfield Moors) to 18.0ppb (Blaxton) Maximum 1-hour concentrations (2014) range between 39.3ppb (Hatfield Moors) and 96.1ppb (Blaxton)	**EPAQS** **WHO** **NAQS (provisional achieved by 2005)**	150ppb (1-hr average) 110ppb (1-hr average) 20-30ppb (annual av) 105ppb (1-hour average) 21ppb (annual average)	- Green Transport Plan - Air quality monitoring programme	E1 E11 P34-36, E45
Sulphur dioxide	Potentiation of allergic sensitisation Respiratory illness	Asthmatics COPD sufferers	Total annual mean (2014) range from 1.66 ppb (Hatfield Moors) to 1.77 ppb (Finningley). 99.9th percentile of 15-minute mean concentrations for 2014 are around 23 ppb at all sites.	**EPAQS** **WHO** **NAQS (achieved by 2004/5)**	100ppb (15-min av) 175ppb (10 min av) 44ppb (24-hr average) 17ppb (annual average) 32ppb (1-hour average) 47ppb (24-hour average) 100ppb (15-minute average)	- Green Transport Plan - Air quality monitoring programme	E3 P41-43. E48
Ozone	Potentiation of allergic sensitisation Respiratory illness	Asthmatics	Not identified	**EPAQS** **WHO**	50ppb (8-hr running average) 60ppb (8-hr running average)	None specifically identified in ES for ozone but should include - Air Quality Monitoring programme. - Green Transport Plan	E2 E46

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
Odours	Annoyance Anxiety	Sensitive sense of smell, low annoyance threshold. Individuals susceptible to anxiety/stress	None reported		None identified	- Air Quality Monitoring Programme. - Use of biological filters at the sewage treatment works together with careful positioning of new houses to minimise odour nuisance from this source.	E5, P9
Benzene	Cancer		No predictions made	**EPAQS** **NAQS (achieved by 2003)**	5ppb (annual running average) 5ppb (annual running average)	None specifically identified in ES for ozone but should include - Air Quality Monitoring programme. - Green Transport Plan	E10
Hydro-carbons	Cancer		Annual mean HC concentration (2014) due to aircraft fuel emissions ranged from 0.16 (Hatfield Moors) to 3.43 µg/m^3(Hayfield). Hydrocarbon fuel loss emissions from the airport development are estimated to be 0.2 tonnes/yr in 2014.		No standards available for hydrocarbons as a group.	- Air Quality Monitoring programme. - Green Transport Plan. - Paint fuel tanks white. - Site walkover/monitoring to identify contaminated land and removal of contaminated soils to disposal site. - Drainage system incorporating diversion chambers, lagoons and oil interceptors - On-going monitoring of groundwater wells at the site at 6 monthly intervals before, during and after construction of major developments. - Bunding at all areas where fuel/oil could be spilled. - Positive and secure drainage system and operation according to Environment Agency discharge consents. - Drainage system incorporating diversion chambers, lagoons and oil interceptors.	P15-20, E12

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
Hydro-carbons	Cancer (cont.)					- Monitoring of water and biological quality of watercourse draining the site; water quality in monitoring/abstraction bore holes. - Emergency response plan in event of major accident.	
Carbon monoxide	Cardiovascular disease	Suffers of coronary, pulmonary and vascular diseases. Elderly, pregnant mother and foetus and suffers of haematological or other disease that affect either oxygen uptake or transport in the body.	Total annual mean (2014) range from 0.052 ppm (Hatfield Moors) to 0.88 ppm (Blaxton, proposed pre-school nursery site). Maximum rolling 8-hour mean concentrations ranged from 0.54 (Hatfield Moors) to 0.9 ppm (Blaxton, proposed pre-school nursery site)	**EPAQS** **WHO** **NAQS (achieved by 2003)**	10ppm (8-hr running average) 90ppm (15-minute) 50ppm (30 minute) 25ppm (1-hr) 10ppm (8-hr) 10ppm (running 8-hour average)	- Air quality monitoring programme. - Green Transport Plan.	P21, 22, E18
	Cognitive dysfunction	Children and those with reduced oxygen carrying capacity, foetus.					E27
Particulates	Cardiovascular disease Respiratory illness	Suffers of COPD and other cardiopulmonary conditions.	Total annual mean (2014) is approximately 18 µg/m^3 at all sites. Estimated 99-percentile of the highest daily 24-hour running mean concentration ranges from 55.5 (Hatfield Moors) to 57.4 µg/m^3(Blaxton).	**EPAQS** **NAQS (achieved by 2004)**	50µg/m^3 (24-hr running average for PM10) 200µg/m^3 (1-hour average) 40µg/m^3 (annual average)	- Green Transport Plan - Air quality monitoring programme	P37-40, E47
Lead	Cognitive dysfunction - IQ	Foetus and children	No predictions made	**EPAQS** **WHO** **NAQS**	0.25µg/m^3 (annual av) 0.5µg/m^3 (maximum) 0.25µg/m^3(annual		E26, 28

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
				(achieved by 2008)	average)		
Arsenic	Cancer		No predictions made.	**COSHH**	0.1mg/m^3 Maximum 8-hour exposure limit (MEL)	- Construction Management Plan - Removal of contaminated soils to disposal site	P12, E13
				WHO	No guideline value suggested as it is a carcinogen		
	Cardiovascular disease	Suffers of COPD and other cardiopulmonary conditions.					E20
	Respiratory illness	Very high doses required.					E49
	Dermal effects	Individuals with eczema.					E33
Asbestos	Cancer		No predictions made	**COSHH**	Exposure should be reduced to the lowest achievable level. Chrysotile 0.3 fibres/.ml of air (4-hr average) and 0.9 fibres/ ml of air (10 minute av)	- On-site monitoring during construction. - Comply with regulations for conducting work with asbestos materials.	P13, 14, E14
Diesel, Kerosene, Mineral oils	Cancer		No predictions made.		None	See cancer caused by hydrocarbons.	P17-20, E15 P17-20, E16 P17-20, E17
Diesel, Kerosene	Dermal effects	Individuals with eczema	No predictions made.		No standards available for environmental exposures		E35, E36
	Respiratory effects	Asthmatics and suffers of COPD.					E51, 52

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
Diesel	Kidney disease	Individuals with pre-existing kidney disease				E41
De-iceants	Dermal effects	Individuals who use these chemicals regularly (e.g. cosmetics and automotive servicing businesses) may be more susceptible to cumulative dermal irritation and sensitisation. Individuals with eczema.	No predictions made.	De-iceants not regulated for environmental exposure purposes. Ethylene glycol (ethane-1,2-diol OES) 10mg/m^3 (particulate) or 60mg/m^3 (vapour)	- New technology that uses less ethylene and propylene glycol to spray aircraft and runways. - Recapture/treatment of run-off. - Regulations on use of de-icers/anti-icers.	E34
	Kidney disease			Propylene glycol (propane-1,2-diol OES) 474mg/m^3 (total)		E40
De-iceants	Respiratory illness	Asthmatics and sufferers of COPD.				E50

6.4 Other health impacts

In addition to the possible health impacts associated with noise, air, water and land pollution and socio-economic considerations, a number of other factors have been examined, these are presented in Table 6.4.

The health impacts of the physical injury resulting from fire and explosion hazards, vortex damage and aircraft crashes are likely to be exceedingly small. Although an aircraft crash in the vicinity would undoubtedly have a major health consequence, the risk of such an event is negligible. Analysis of the available literature suggests that anxiety provoked by heightened risk perceptions about the potential for aircraft crashes and the potential for chronic ill-health associated with the airport and related activities may be an issue of concern. The public perception of risk was such that respondents under the flight path were specifically concerned about accidents and near-misses, referring to recent accidents reported in the media and to a light-aircraft crash in the preceding year.

Increased traffic congestion in the area may also contribute to an increase in anxiety, particularly among drivers and residents. There is an increased risk of physical injury from road traffic accidents at certain locations owing to the predicted increases in road traffic in the area. These increased risks should be addressed through the Green Transport Plan and provisions for pedestrian and cyclist safety should be made where a clear need for doing so is indicated. The increased volume of traffic on the roads was felt by most local respondents to impact negatively on safety particularly of children, elderly and the disabled. As well, the heavy traffic would contribute to less opportunity for recreation and sport like cycling, horse-riding, jogging and walking. It was also felt that heavy traffic could put off carers and domiciliary helpers from visiting those in need living near the airport.

A link road between the motorway and the airport that bypasses the main villages was generally viewed as a way around the problem that could alleviate traffic congestion. Developing the rail link was also considered important by a number of respondents. However, the potential for a motorway link road was not considered in the policy appraisal activity of the HIA because it is not stated in the planning

application. At the time of writing of the HIA report, a scoping report for a motorway link was under preparation. So the health impacts of a link road proposal have not been formally assessed.

Risk perceptions tend to be heightened for hazards that individuals have no personal control over, that are considered to be man-made, that are surrounded by uncertainty, that may have significant consequences and that may affect vulnerable groups such as children or whose outcomes are delayed in their onset. Evidence suggests that heightened risk perceptions can manifest themselves as a range of non-specific physical symptoms. However, it is difficult to draw any firm conclusions about the likely public health impacts of heightened risk perceptions and consequent anxiety about the proposed airport development owing to the qualitative and contextual nature of the issue. Nonetheless, much can be done to address such concerns by ensuring that stakeholders are adequately involved in any decisions that may affect them, their family or community health and well-being. In addition, two-way risk communication strategies that are well targeted and give full consideration to cultural and social factors can also provide a valuable tool for addressing risk perceptions and local community concerns.

There is also the potential for anxiety and annoyance caused by visual intrusion. All-night lights were a concern of some respondents, as was damage to homes from vibration. Also expressed by local respondents was anxiety regarding the ability of existing public services (like schools) and health services to cope with greater numbers of residents attracted by the airport. For example, the ability of local GPs to cope with imported diseases was considered. However, a positive view was that revenue generated through regeneration of the area would be put into schools and nursing homes.

Table 6.4 Summary of other health impacts and planned mitigation/enhancement measures identified from the policy analysis and evidence base

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
POSITIVE HEALTH IMPACT						
Increased Exercise	Improved physical fitness	Those who are able to cycle to work, users of improved sports and recreational facilities.	No predictions made	N/A	Green Transport Plan.	P49
NEGATIVE HEALTH IMPACTS						
Fuel dumping	Annoyance	Individual affected by a fuel dumping episode.	None reported; although only occurs in cases of urgency and is usually over sea or at high altitude.	None	Dump fuel at sea whenever possible; if this is impossible and aircraft is airworthy, dump fuel away from built-up areas; dump fuel above 5000ft	P4
Vibration	Annoyance	Low annoyance threshold.	Isolated properties less than 20m from highway such as in Hatfield Woodhouse	BSi Standards (1990) for measuring vibration and its effect on buildings and evaluating human exposure	- Airport Transport Forum - Green Transport Plan - Environmental Management Strategy	P7
Visual intrusion	Anxiety	Individuals susceptible to anxiety/stress	Caused by communication masts and lighting.	None	- Careful planning to avoid or minimise any visual impacts in the surrounding area - Extensive landscaping (mounding, fencing and planting) - Routine maintenance of landscape.	P11
Anxiety	Traffic congestion	Individuals susceptible to anxiety/stress. Drivers and those having to cross busy roads (elderly, disabled in particular).	Assuming no Green Transport plan: No. trips in 2014: 24 hour 2-way trips - 19700	None identified.	- Green Transport Plan - Monitor queue lengths at junctions - Monitor levels of adherence to signed access routes	P10

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)		Mitigation or enhancement measure	Form ID No.
Anxiety	Traffic congestion (cont.)		Night-time 2-way trips - 2676 Peak hours (07.00 - 09.00) 2-way trips - 1915			- Monitor schemes to minimise car use. - Signalisation to j4, 6, 7 and 15 plus an increase in capacity of j5 will accommodate anticipated flows (see ES for locations). - Rail spur will minimise need for level crossing at Gatehouse Lane.	
Anxiety	Risk perception (crashes and chronic ill-health		None reported		None	Risk communication and participatory decision-making	E6, E7
Infected travellers and imported vectors	Communicable diseases	Those not immune.	No predictions made		None.	- International Health Regulations, 1969 co-ordinated by WHO (ensure the maximum security against the international spread of disease with a minimum interference with world traffic) (Moreland, 1991) - Spraying of aircraft with insecticides - Immunisation of passengers and crew members - Traveller education	E32
Aircraft crashes	Physical injury	Significant risks not expected more than 12Km from the runway ends.	10^{-4} to 10^{-5} individual annual risk contour contains 12-18 people. 10^{-5} to 10^{-6} individual annual risks contour contains 1125 people.	HSE	10^{-5} individual annual risk is considered tolerable providing it is ALARP.	- Public safety zones (>10^{-4} per year: houses and any other development occupied for a high proportion of the day to be removed; airport operators to purchase them; and >10^{-5} per year: new housing developments and most types of new non-housing development	P30, E44

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
Aircraft crashes	Physical injury (cont.)				should not be approved. Non-housing with a low density of human occupation can be approved. Extensions to these restriction may be warranted in cases of sensitive developments (such as schools and hospitals). - Route flight paths away from residential areas and hazardous installations where practicable. - Restriction of development of land within the 1 x 10^{-5} per year contour.	
Fire and explosion	Physical injury	Fuel farm: max effect distance to 4 kW/m^2 estimated to be 80m for a catastrophic rupture of one Avtur fuel tank in a bund area of 2360m^2. This radiation would cause pain after 20 seconds. The max effect distance to 14 kW/m^2 estimated to be 37m for a catastrophic rupture of one Avtur fuel tank in a bund area of 2360m^2. This radiation level is equivalent to HSE's dangerous dose during 30 seconds. Buildings will withstand this radiation level.	No predictions made	None	Pre-construction safety report to HSE and EA Minimisation of stored inventory Bunding to minimise the size of major pool fires and reduce the chance of escalation to the neighbouring tank Fire protection design measures (fire detection systems, fire-safe shutdown valves, emergency shutdown push buttons, provision of firewater and foam, drainage for hydrocarbon/firewater release) Hazard and operability study Hazard identification study Off-site emergency plan	P31

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
Road accidents	Physical injury	Children, elderly, cyclists, disabled.	Blaxton - increase in vehicle flows and reduction in amenity value for non-vehicle road users. Effects are likely to be minor as little pedestrian or cycling activity has been recorded. Hayfield Green and Hayfield village - significant pedestrian activity, child movements and equestrian activity. Possibility for a perception of increased risk to safety. Hatfield Woodhouse - some reduction of amenity value for pedestrians and cyclists. Predicted to suffer from minor to moderate effects due to increased vehicle numbers and HGVs. No. of trips for the fully developed site (2014): 24 hour 2-way trips - 19700 Night-time 2-way trips - 2676 Peak hours (07.00 - 09.00) 2-way trips - 1915.	None	Green Transport Plan Monitor the level of pedestrian and cyclist activity at Blaxton, to identify the need for crossing provisions in this area. Provision of new crossing facilities at Hurst Lane/Hayfield Lane junction. Promotion of Hayfield Lane as a cycle route. New crossing facilities and traffic calming in Hatfield Woodhouse.	P32

Source	Health impact	Person affected and/or susceptible groups	Predicted levels (Policy analysis)	Standards/Guidelines (evidence base)	Mitigation or enhancement measure	Form ID No.
Vortex damage	Physical injury		The majority of incidents occurred within 2.1km of the ends of the runways; Vortex damage is confined to slate and tile roofs; Vortex strikes occur mainly at wind speeds below 5 metres per second; Strikes are not affected by other atmospheric conditions, or by roof pitch or orientation.	None.	Number of options: Set up an insurance scheme to cover vortex damage within a defined area around the airport; Undertake work to increase resistance of roofs to vortex damage where roofs are considered to be at risk (very limited); Undertake work to increase resistance of roofs to vortex damage as damage occurs.	P33

APPENDIX 1. AGREED POLICY APPRAISAL DATA EXTRACTION FORM

Potential / Probable / Definite health impact (+ve / -ve):		**Stated**	**ID'ed**
Source (e.g. pollutant):			
Activity (factors bringing about impact):			
Scope (neighbourhood, local, regional, national):			
Who (persons affected; by age, sex, social status, health status):			
Duration / timing (how long and when?):			
Evidence (evidence base - stated / identified):			
Sensitivity analysis:			
Comments:			

Mitigation / enhancement measure:			**Stated**	**ID'ed**
	Potential / Probable / Definite	**Quantified / Estimated / Speculated**		
Source/action (of mitigation / enhancement):				
Scope (local, regional, national):				
Who (persons affected; by age, sex, social status, health status):				
Duration (how long and when?):				
Evidence (evidence base stated/identified):				
Sensitivity analysis:				
Comments:				

APPENDIX 2. SCORING SYSTEM FOR HEALTH IMPACTS

Suggested scoring system where numerical data are not available

++	Significant, direct health benefit
+	Marginal, direct health benefit
+/-	Neutral health impact
-	Marginal, direct health cost
--	Significant, direct health cost
(++)	Significant, but indirect health benefit
0	No identifiable health impact
?	Health impact unknown

Source: Trent Health Impact Assessment Development Group