APPENDIX A

Health Impact Assessment Summaries

Table 1: Birmingham International HIA Summary

Airport	Birmingham International		
Reference	University of Liverpool, 2008		
Location	West Midlands, England		
Project Description	■ Application to extend the main runway to enable the full operation of a range of direct long-haul services (e.g., to India, China and the western United States (US)) ■ Located 10 km east southeast of Birmingham city centre ■ Located within the Local Authority area of Solihull (population of 199,517 in 2001) and adjacent to the Local Authority Area of Birmingham (population of 977,087 in 2001) ■ Adjacent land uses are agricultural, residential, industrial/commercial and a golf course ■ 9.2 million airport passengers per year in 2007 ■ Jets are used ■ Serviced by train and bus		
Baseline Health Profile	*Biological factors:* ■ Population structure ■ Age and sex structure ■ Ethnic structure *Individual lifestyle factors:* ■ Transport and mobility ■ Car ownership ■ Physical activity *Social and community networks:* ■ Satisfaction in local area ■ Active community participation	*Living and working conditions:* ■ Occupational morbidity ■ Occupational injuries ■ Deprivation *Economic activity:* ■ Economically Active – Employees ■ Unemployment ■ Jobseekers Allowance Claimants ■ Education and skills *General socio-economic, cultural and environmental factors:* ■ Health service activity and access ■ Productivity	*Health outcomes:* ■ Health status ■ Limiting long-term illness ■ Acute sickness ■ Cardiovascular disease ■ Mental health ■ Suicide rates ■ Disease prevalence ■ Road traffic accidents casualties ■ Life expectancy ■ Mortality
Impact Analysis Framework	■ Health impact – the health determinants affected and the subsequent effect on health outcomes ■ Direction of change – health gain (+) or health loss (-) ■ Scale – the severity (mortality, well-being) and magnitude (size/proportion of the population affected) ■ Likelihood of impact – definite, probable, possible or speculative based on the strength of the evidence and the number of sources ■ Latency – when the impact will occur ■ Geographical level of impact (e.g., the wards most affect, particular groups that may be affected)		
Notes on Assessment	Considered differential impacts (e.g. disproportional effects between socioeconomic groups) for all determinants.		
Determinant:	**Social and Cultural**		

Indicators	**Measures**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Social capital (norms and social relations embedded in the social structures of societies that enable people to co-ordinate action to	■ Stakeholder engagement	■ Some community stakeholders do not feel engaged with the proposed runway extension and this is possibly contributing to their perception of risks.	Negative	Local authority areas of Solihull and Birmingham	■ Review formal and informal mechanisms to engage with local residents and communities ■ Establish a health forum which receives regular reports on health impact data related to the airport's activities ■ Collect data in targeted areas on social capital, mental health and perceived health risks and monitor
	■ Connectivity	■ It is probable that there will be an increase in accessibility to people and places in the US and far east with the proposed runway extension, because of the increase in long-haul flights.	Positive	Primarily those in the county of West Midlands but provides opportunities for	N/A

achieve desired goals)				surrounding areas of England who may use this airport	
	■ Social capital and employment	■ It is probable that employment associated with the runway extension will facilitate positive mental health linked to new positive social networks for those moving from unemployment into employment. This is based on projected employment increases and literature studies that connect employment with improvement in mental health and social networks.	Positive	West Midlands region	N/A
	■ Social capital and noise and traffic	■ It is probable that increase in noise and traffic with and without the runway extension development will reduce opportunities for social interactions and networking within affected communities, with a negative impact on health and well-being. This is based on site-specific estimates of the increase in noise and traffic, stakeholder concerns about the effect on social interactions and literature studies on the relationship between social interactions and health and well-being.	Negative	Solihull and Birmingham	■ Support local residents and communities in targeted areas ■ Promote the development of local community involvement and communications strategies
	■ Direct effects of development on community resources such as buildings (schools, hospitals, places of worship), open space (recreational and public rights of way) and private properties (homes and businesses)	■ The runway extension itself will definitely affect opportunities for social interactions for the residents of Bickenhill village with the removal of some facilities and amenities. This is based on the plans to remove some facilities and amenities in Bickenhall in order to accommodate the proposed runway extension.	Negative	Bickenhill village (population affected estimated at 586)	■ Incorporate the development of community enterprise as a criterion for the Community Trust Fund
Determinant:	**Economic**				
Indicators	**Measures**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Employment and the economy	■ Employment forecasts	■ It has been estimated that the proposed runway extension would provide additional full time jobs to a total of 13,430 in 2012, 17,630 in 2022 and 19,090 in 2030. ■ It is probable that some of these employment opportunities will provide health benefits, based on literature studies that connect employment with improvements in health.	Positive	West Midlands region	■ Include the requirement for “Local Labour Agreements” in the constructors’ tender specification
	■ Income forecasts	■ It has been estimated that the proposed runway extension would generate income increases in the West Midlands region to a total of £400 million in 2012, £568 million in 2022 and £824 million in 2030. ■ It is probable that the income increases will result in improved health outcomes for the region, based on literature studies that correlate increased income with improvements in health.	Positive	West Midlands region	N/A
Determinant:	**Environment**				
Indicators	**Measures**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Air quality	■ Changes in PM_{10} and NO_2 concentrations and comparisons to UK annual mean air quality guideline within the airport (15 sites) and outside the airport (28 sites) for existing and project cases	■ The dispersion modelling indicates that annual NO_2 concentrations are expected to increase by 0 – 8% beyond the airport boundary as a result of the proposed runway extension. These increases will still be within the Air Quality Guideline. ■ Annual NO_2 levels in excess of the guidelines were found at some sites within the airport. ■ Identified a risk that airport workers could be exposed to levels of NO_2 that could damage their health, particularly at roadside. locations and locations near to taxiing aircraft within the airport ■ No exceedances of air quality objectives were identified for PM_{10}, either within or outside the airport.	Negative	NO_2 effects limited to within the airport site	■ Management plan to control dust raising activities ■ Monitor $PM_{2.5}$ in addition to other chemicals that are part of routine air monitoring ■ Utilize low emission construction equipment and materials during construction

Noise	■ Developed noise contours for the existing situation and the years 2012, 2022 and 2030 with and without the runway extension ■ Average summer day (07:00 – 23:00) and night (23:00 – 07:00) Leq contours were produced for all forecast years ■ Estimated the population within each of the contours, and the difference in this population between the scenarios, to determine whether more people will be exposed to higher noise levels ■ Estimated the number of people likely to experience highly disturbed sleep under each scenario ■ Estimated the number of schools exposed to noise levels above 54 dB(A) under each scenario, based on the WHO guideline of 55 dB for outdoor playgrounds at schools	■ Increase in the number of people affected by noise based on the change in summer day and night contours between the existing case and the project case. ■ Increase in the number of people experiencing highly disturbed sleep based on the night Leq contours compared to the WHO threshold for sleep disturbance. ■ Increase in the number of schools exceeding the WHO threshold for school playgrounds, based on the daytime Leq contours.	Negative	Solihull (noise contours not provided within report, reference an EIA for the project)	■ Future developments including schools and health care facilities should not take place within the 50 dBA day time contour ■ Noise monitoring ■ Monitor and report on annoyance and sleep disturbance ■ New schools should not be planned close to the airport where the noise exceeds WHO thresholds for school playgrounds
Climate change	■ Change in carbon dioxide emissions	■ If unmitigated, the project will produce a 37% increase in carbon dioxide emissions in 2030. ■ This increase will contribute to climate change.	Negative	Global	■ Support the development of the airport's Climate Change Strategy
Transport	■ Air passenger forecasts ■ Air passenger and employee trips by vehicle forecasts for am and pm peaks ■ Risk of aircraft accident (based on probability, geographical distribution and consequences) ■ Risk of non-aircraft accidents (e.g. road traffic)	■ In 2022, there would be an estimated 18,393,000 passengers per year without the runway extension and 20,939,000 passengers per year with the runway extension. ■ Increase in the number of vehicles during peak traffic times. ■ The additional risk of aircraft accidents with the proposed runway extension is probably negligible, based on historical data of aircraft accident rates in Europe and the small increase in the number of flights per year. ■ Road traffic accident rates from the increase in road traffic are speculated to increase with the additional volume of traffic, but the contribution of the proposed runway extension is speculated to be negligible, based on road traffic accident rates in Europe and the small increase in traffic volume.	Negative	Solihull and Birmingham	■ Develop, monitor and publish a statement on road traffic impacts and mitigation measures to deal with road traffic issues during construction ■ Contact transport authorities to request dissemination to both developers and the public of the various transport infrastructure developments close to the airport

Table 2: Santa Monica Airport HIA Summary

Airport	Santa Monica Airport				
Reference	UCLA, 2010				
Location	California, United States				
Project Description	■ Assessment of existing operations in response to community concerns following growth in the number of jet operations. ■ Located at the southeast corner of the city of Santa Monica approximately 5 km from the city centre. ■ Adjacent land uses are residential (150,000 residents live within a 2-mile radius of the airport). Within a 1-mile radius around the airport, there are at least 9 preschools and daycares, 11 elementary schools, 4 middle schools, 5 colleges or universities and 6 parks. ■ 296 operations a day (for 12 months ending July 2011) ■ Jets are used ■ Serviced by bus				
Baseline Health Profile	Not carried out				
Impact Analysis Framework	Not provided				
Notes on Assessment	Assessment was carried out by pediatricians from the UCLA medical centre. Included only environmental determinants.				
Determinant:	**Environment**				
Indicator	**Measure**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Air quality	■ Input from nearby residents ■ Air quality data for Santa Monica ■ Literature studies on components of jet fuel exhaust ■ Literature studies on the relationship between air contaminants and health effects	■ Numerous nearby residents have complained about jet fuel exhaust and reported physical symptoms including burning of the eyes, nose and throat and headaches. ■ Lead levels were found to be elevated closer to the airport and spikes in ultrafine particle, black carbon and PAH concentrations were observed during jet departures. ■ Literature studies have identified the following components of exhaust from jet fuel: black carbon, particle-bound polycyclic aromatic hydrocarbons (PAHs), ultrafine particles, polychlorinated dibenzodioxins and dibenzofurans (PCDD/Fs) and carbon monoxide ■ Epidemiological evidence has linked the identified air contaminants with various health issues. Black carbon has been associated with reduced lung function and cardiovascular effects. Ultrafine particles are associated with respiratory and cardiovascular diseases. PAHs have been identified as carcinogenic and are linked to disruptions in the endocrine system and adverse birth outcomes.	Negative	< 3 kilometres	■ Eliminate or significantly decrease the number of jet takeoffs to reduce exposure to both the by-products of jet fuel exhaust and the loud “single event” noise of jet takeoff ■ Install HEPA (high efficiency particulate absorbing) filters in surrounding schools and residential homes to mitigate the indoor effects of pollution ■ Notify all potential property buyers, residents and affected community members in the vicinity of the airport of the noise and air pollution risks ■ Maintain a runway buffer zone of at least 660 metres to protect surrounding residents from the harmful health effects of jet fuel exhaust byproducts during idling and takeoff ■ Closure of the airport would eliminate all health risks associated with airport air and noise pollution
Noise	■ Input from nearby residents ■ Adequacy of currently adopted noise threshold of 65 dB DNL (day-night average sound level) ■ Literature studies on the relationship between noise and health effects ■ [Noise data for Santa Monica was not presented]	■ Many nearby residents have complained about noise and stated that they are unable to hear the television or have conversations in their home because of the loud noise from overhead planes. ■ Residents report that their sleep is interrupted multiple times, with planes flying overhead as early as 6 am and as late as midnight during all seven days of the week. ■ Noise threshold (65 dB DNL) does not account for loud “single-event” noise of aircraft takeoff ■ Literature studies have associated elevated noise levels with	Negative	< 3 kilometres	■ Implement additional noise abatement policies such as soundproofing of schools and significantly affected homes nearby ■ Notify all potential property buyers, residents and affected community members in the vicinity of the airport of the noise and air pollution risks ■ Closure of the airport would eliminate all health risks associated with airport air and noise pollution

		impaired reading comprehension and memory among children as well as annoyance and sleep disturbance			

Table 3: Stansted Airport HIA Summary

Airport	Stansted Airport				
Reference	ERM, 2008				
Location	Essex, England				
Project Description	■ Expansion of the airport to provide a wide-spaced second runway and associated facilities; diversion of local roads, provision of environmental offsetting and compensation measures, provision of off-site utilities infrastructure, changes to airspace patterns and routes to accommodate aircraft movements to and from the expanded airport. Also, new road junctions to serve the expanded airport and a second rail tunnel and fourth platform for greater rail access. ■ 48 km northeast of central London ■ Adjacent land uses are primarily agricultural ■ 24 million airport passengers per year (in 12 months to October 2007) ■ Jets are used ■ Serviced by train and bus				
Baseline Health Profile	*Population factors:* ■ Age structure ■ Marital status ■ Percentage in religious and ethnic minority groups *Education:* ■ Education deprivation ■ Education qualifications ■ Educational performance of schools (comparison of schools close to the airport and further away) *Employment and Income:* ■ Employment rate ■ Income level ■ Car ownership		*Housing:* ■ Indices of multiple deprivation (a measure of barriers to housing) ■ Type and cost of housing *Crime:* ■ Crime rate *Health:* ■ Self-rated health ■ Mortality from coronary heart disease ■ Life expectancy		
Impact Analysis Framework	Analysis approach for each determinant provided separately.				
Notes on Assessment	The zone for community consultation was defined based on the following: ■ Land take – defined by the proposed development boundary and denotes the geographical extend of direct physical effects of the proposed development ■ 54 dBA noise contour footprint – this contour marks the lowest threshold noise level at which community annoyance is defined ■ Approximate zone of visual influence – this represents the approximate area surrounding the airport from where the proposed developments would be theoretically visible ■ Secondary socio-economic effects – areas that are most likely to be affected by secondary effects such as the physical presence of the construction workforce and the services and facilities this group of workers will need				
Determinant:	**Social and Cultural**				
Indicator	**Measure**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Social capital (a network together with shared norms, values and understandings that facilitate co-operation within or among groups)	■ Reciprocity and trust (giving and receiving favours, trust of other people and institutions such as the government and police) ■ Views about the area (satisfaction with living in the area and problems in the area) ■ Social Participation (involvement in groups and voluntary activities) ■ Social Network and Support (contacts with friends and relatives) ■ Civic Participation (the propensity to vote, to	■ Reduction in ‘reciprocity and trust’ as a result of inward migration and the influx of temporary workers during the construction phase, based on stakeholder feelings of mistrust towards the temporary construction workforce. ■ Reduction in ‘views about the area’ as a result of visual effects, noise and changes to road infrastructure during the construction phase, based on the expected changes due to the project and the results of stakeholder consultation. ■ Reduction in ‘social participation’ as a result of the community facilities that will be lost as a result of the project land take.	Negative	Surrounding 14 rural parishes	■ Targeted grant scheme for community activities, such as recreation and sport ■ More effective engagement with local strategic partners

	take action on local or national issues)	■ Reduction in 'social network and support' as a result of the residential properties that will be lost as a result of the project land take. ■ The project is unlikely to affect interest in national issues in the area, although there may be some change in interest in local issues. The opposition to expansion of the airport has led to a high level of involvement in local issues, if the project is approved, then there may be a reduction in civic participation.			
Health care facilities	■ Effects on community access to health services during the construction and operation phases on the project. ■ Potential for change in the transmission of infectious diseases. As a proxy for the overall effect, the change in the number of Human Immunodeficiency Virus (HIV) and Sexually Transmitted Infections (STIs) was calculated.	■ It is unlikely that the construction phase of the development will impact on access to health facilities for the local community, even with the potential ways in which health care may be accessed. There is sufficient capacity within the existing health care infrastructure to deal with these occurrences. ■ The operational phase of the airport could have a small and theoretical adverse effect on access to health care facilities, but any such effect will be minimal and therefore unlikely to have any measurable effect on the health of the communities around the airport. ■ With the airport expansion, it is estimated that there would be an additional 14 cases of HIV per year and 224 cases of STIs, based on the prevalence of the disease, the number of travellers, the likely number of cases of unprotected sex and the likelihood of transmission per single event. The number of travellers is specific to the project while the other data are from the literature.	Negative	Passengers likely to use the airport, who come from Essex, London, South East England as well as the remainder of Britain	■ Explain the project and its effect to key stakeholders (e.g., the fire service) ■ Ensure adequate training and provision of facilities to cope with any emergency relating to a highly infectious disease transmitted by passengers
Determinant:	**Economic**				
Employment and Income	■ The number of additional direct and indirect employment opportunities ■ Increase in income as a result of new employment ■ Change in mortality per annum due to change in employment ■ Description of other health outcomes related to employment and income changes	■ 6,200 additional employment opportunities during operations (including direct, indirect and induced) by 2021. ■ £144 million in additional income as a result of new employment from the project by 2021 . ■ Predict that the increase in employment would decrease the mortality rate and result in approximately 3 -14 deaths avoided per 10,000 people by 2021, based on literature relationships between unemployment and mortality ■ It is likely that the project will, through the provision of employment opportunities, have a positive effect on mental health, self-rated health and the existence of long-term limiting illness, based on literature studies that connect employment to these health indicators.	Positive	Essex	■ Use of local structures for training and recruitment of new workers ■ Local procurement of services and support for the airport, where possible
Determinant:	**Environment**				
Transport	■ Road traffic changes as a result of the project ■ Changes in traffic volume (number of vehicle kms) were used to estimate the increased incidence of road traffic related serious injury and mortality ■ Changes in rail movements were used to estimate the increased incidence of rail related accident and injury ■ Estimate of the change in numbers of	■ Limited increase in traffic (overall traffic increases of1.5% in the morning peak, 0.7% in the afternoon peak and 1.5% in the inter-peak period). ■ The increase in road traffic was estimated to cause an additional 0.8 fatal accidents, 5.5 serious accidents and 73.4 slight accidents per year were estimated, based on literature relationships between accidents and road transport. ■ The increase in rail traffic is estimated to cause 0.1 additional fatalities and 3 additional injuries per year for passengers as a result of growth in passenger demand of 1% in passenger kms,	Negative	Essex	■ Use employee travel plans and other means to reduce private car use for both passengers and airport users

	persons exposed to aircraft-related fatality risk as a result of increased aircraft movements	based on literature relationships between accidents and rail transport. ■ The increase in aircraft accident risks is small, minimising any likely health effect on the local population, but were such an event to occur the effect on the local population in terms of health could be severe and result in loss of life and severe injury.			
Air quality	■ Change in annual average concentrations of PM_{10}, $PM_{2.5}$ and NO_2 for each assessment case (existing and 2 future cases) ■ Utilized concentration-response functions from epidemiological studies to determine health impact, incorporated population data and background rates of relevant health outcomes	■ Based on increases in PM_{10} concentrations and concentration-response functions from the literature, an additional 0.051 respiratory hospital admissions per year, 0.048 cardiovascular hospital admissions per year, 0.59 GP consultations for asthma (15 – 64 years of age), 0.32 cases of chronic bronchitis, 0.0074 cases of lower respiratory tract symptoms (children) and 0.02 cases lower respiratory tract symptoms (adults) were predicted. ■ Based on increases in $PM_{2.5}$ concentrations and concentration-response functions from the literature, an additional 57 restricted activity days per year and 18.87 years of life lost were predicted. ■ Based on increases in NO_2 concentrations and concentration-response functions from the literature, per 1,000 people per annum, an additional 0.82 cardiovascular hospital admissions, 0.13 respiratory hospital admissions and 0.12 deaths were predicted.	Negative	Essex	■ Measure local air quality and make information available to the community
Noise	■ Relationships from the literature were used to evaluate effects based on the noise data for each case ■ Effects for annoyance and sleep disturbance were estimated separately for ground noise (aircraft movement on taxiways) and air noise (aircraft movement on the flight path) ■ An exposure-effect curve was used to estimate the number of 'highly annoyed' people in each case ■ For air noise, the 90 dB SEL noise footprint was used to calculate the number of awakenings (i.e., sleep disturbance) within the exposed population for air noise ■ For ground noise, Lnight contours were used to generate the percentage of the population highly disturbed by noise at night ■ The LAeq values for schools for each case were used to estimate the consequence in reading age	■ Modelled LAeq 16 hour day contours and spot values for schools ■ 90 dB SEL footprint per night-time aircraft event ■ Lnight contours ■ Increase in the number of people highly annoyed by air noise by approximately 170 people in 2015 and by approximately 710 people in 2030. ■ Increase in the number of people highly annoyed by ground noise by approximately 15 people in 2015 and by approximately 47 people in 2030. ■ Noise levels at Hatfield Forest (high recreational value) will increase by less than 3 dB, which is judged as being too small to have an effect on leisure activities. ■ The estimated additional number of night-time awakenings attributable to air noise was approximately 50 in 2015 and 20 in 2030. ■ All properties within the 90 dB SEL night-time contours are offered noise insulation to prevent or reduce effects of sleep disturbance. ■ The estimated additional number of people highly disturbed by night noise attributable to ground noise was approximately 6 in 2015 and 6 in 2030. ■ By 2030, one school will experience changes in noise exposure that could lead to changes in reading age development by more than two months. Three further schools may experience a lesser effect of between one and two months of reading age delay.	Negative	Essex, contours are provided and specific schools identified	■ Complete noise measurements at key locations ■ Offer sound insulation where appropriate ■ Engage with most affected schools to investigate ways of offsetting noise effects
Visual and light pollution	■ Degree of changes in landscape and visual amenity ■ Input from stakeholder engagement	■ During construction, there would be notable changes to the landscape and visual amenity around the airport with some areas of intensive change, such as the loss of the Philipland Wood and Molehill Green Bund which have an important screening role. This will lead to many viewers in the area being affected and a high level of annoyance and increased concern about other health	Negative	Airport-adjacent parishes	None

		effects associated with development. ■ Evidence from stakeholder engagement suggests that there is very little concern about the visual effects of the construction of the airport. ■ During operation of the expanded airport, there would be visual intrusion as a result of overflying aircraft (especially on flight paths not currently used) and changes in the built environment and airport ground based operations. ■ With the increase in the number of buildings and lighting requirements for the airport, there will also be a general increase in night glow and night glare in the area ■ The change in visual landscape will be noticed by people from their own homes and by others using footpaths and recreational areas. The precise links between the landscape and the health of a population are uncertain, according to the evidence base. ■ It seems likely that a subset of the population experiencing the change to their environment will experience some reduction in their wellbeing, how long this might persist is unknown.			
Determinant:	**Other**				
Involuntary relocation	■ Input from stakeholder engagement ■ Health effects of involuntary relocation	■ Stakeholder engagement did not reveal involuntary relocation to be an issue for the local community. ■ The project will require the involuntary relocation of 73 residential properties and 14 non-residential properties. ■ Impacts on health of individuals through involuntary relocation are likely to involve negative emotions, including annoyance, anger and upset, as well as stress incurred during the relocation itself. ■ The characteristics of the populations affected by the relocation (e.g. age, employment, health) make them relatively adaptable to changes in the short term. The emotions experienced during and after involuntary relocation are likely to be of short term nature because of the provision / acquisition of suitable alternative housing and the adaptability of the population to new situations.	Negative	Airport-adjacent (73 residential properties)	■ Implementation of best practices for assistance given to those people obliged to move their home

Table 4: Manchester Airport HIA Summary

Airport	Manchester Airport				
Reference	Manchester Health Authority, 1994				
Location	Manchester, Greater Manchester, United Kingdom				
Project Description	■ The HIA was undertaken as part of an application for the development of a second main runway and associated facilities (including new highways) ■ Located approximately 16 km south of Manchester city centre, and lies within the urban metropolitan of Greater Manchester (estimated populations of 512,000 and >2,553,000 people, respectively) ■ 10.2 million passengers per year in 1990; estimated forecast of 30 million per year in 2005 ■ Aircraft include jets, including Commercial III ■ Modes of transport: 66% private car; 22% taxi; 12% public transport (bus or coach) in 1990				
Baseline Health Profile	■ Air Pollution Study from 1989 ■ Literature review of health status and prevalence of disease in residents of Greater Manchester (i.e., through hospital admission data, mortality data) ■ Literature review of health status and prevalence of disease in residents of neighbouring communities in England ■ Literature review of health status and prevalence of disease in people residing near airports				
Impact Analysis Framework	■ Health impact – the health determinants affected and the subsequent effect on health outcomes ■ Direction of change – health gain (+) or health loss (-) ■ Likelihood of impact – calculable, estimable, definite but not measurable, speculative ■ Geographical level of impact (i.e., potential 20 km radius)				
Notes on Assessment	■ Assessment was carried out by Public Health Manchester Health Authority				
Determinant:	**Social and Cultural**				
Indicator	**Measure**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Social Capital	■ Social separation due to the physical division of communities through the presence of roads, railways, etc. ■ Literature search of the social effects on communities exposed to aircraft noise	■ The effect of social separation on health is difficult to quantify; however, it can have a significant impact on the social and psychological well-being of communities. ■ Concluded that some people are highly vulnerable to noise, but that the majority of people are able to ignore it.	Negative	Community of Moss Nook, and other surrounding communities	None
Determinant:	**Economic**				
Employment	■ Literature review of the correlation between employment and health ■ Two methods of calculation of the health impact of job creation: the Scott-Samuel Model and the Brenner Method ■ Employment forecast	■ Estimated job creation of 20,000 between 1990 and 2005 ■ Positive relationship between employment and health (decreased poverty; positive psychological effects including social networks, work ethic, self-image and time structuring). ■ Associations shown between unemployment/deprivation and a number of diseases including cardiovascular disease, bronchitis, lung and stomach cancer, and admissions for psychiatric illness (particularly depression). ■ The Scott-Samuel Model predicts that for every 2000 men seeking work, 2 men and one of their wives will die each year as a result of unemployment. ■ The Brenner Method predicts that every 1% decrease in unemployment sustained for 5 years produces in the fifth year: 1.9% decrease in mortality; 4.3% and 2.3% decrease in male and female mental health hospital admissions, respectively; 4% decrease in prison admission; 4.1% decrease in suicide; 5.7% decrease in homicide.	Positive	Greater Manchester Area	Employment opportunities should include a minimum proportion to be filled by disabled people and local residents with an emphasis on those from socially deprived neighbourhoods and areas of high unemployment

Determinant:	Environment				
Transport	■ Air traffic movement (ATM) forecasts ■ Air passenger forecasts ■ Freight tonnage forecasts ■ Parking space forecasts ■ Hotel bed forecasts ■ Annual average daily traffic flow forecasts ■ Public transport mode share targets ■ Risk of road accident due to increased vehicular traffic	■ Increase in ATM from 123,114 to 300,316 ■ Estimated forecast of 30 million passengers per year in 2005, corresponding to an increase of 19.8 million passengers from 1990 to 2005 ■ Increase in road freight estimated at 18 times current level ■ Increase in parking spaces from 15,500 to 36,000 ■ Increase in hotel beds from 529 to 2,150 ■ Increase in road traffic (i.e., increase in annual average traffic flow from 46,000 to 108,000) ■ Increased risk of accident and death as a result of increased road traffic	Negative	Greater Manchester and surrounding communities	■ Maximize the percentage of passenger journeys made to and from the airport by public transport in order to minimize air pollution (i.e., target of 50% by the year 2000) through development and extension of rail links and encouraging development of luggage handling facilities at major rail and bus terminals ■ Limit the number of on-site car parking spaces ■ Monitor and control the number of off-site car parking spaces in neighbouring districts ■ Introduce measures rewarding staff who come to work by public transport ■ Develop an integrated transport policy ■ Promotion and implementation of traffic calming measures for roads
Air Quality	■ Correlation between air pollution produced by aircrafts/road vehicles and health ■ Annual tonnes of CO, NO_x and hydrocarbons produced by airport road traffic ■ Compared to Zurich airport for existing and projected cases ■ CO_2, NO_2 and SO_2 emissions from aircrafts	■ The air pollutants generated by aircraft/vehicular traffic (i.e., NO_2, NO_x, CO, O_3, particulates and hydrocarbons) exacerbate asthma, chronic bronchitis, allergic conditions, respiratory conditions; CO has deleterious effects on people with cardiovascular disease; benzene and particulates have been implicated in the development of cancers (especially leukemia) ■ Total emissions of air pollutants due to air traffic were calculated as follows: 1015 tonnes/year for CO; 646 tonnes/year for hydrocarbons; and 329 tonnes/year for NO_x ■ Total emissions of air pollutants due to road traffic were calculated as follows: 1120 tonnes/year for CO; 209 tonnes/year for hydrocarbons; 139 tonnes/year for NO_x ■ The airport monitoring system suggests that aircrafts are not a major source of NO_2, SO_2 or hydrocarbons; if aircrafts do contribute to air pollution at ground level, it will be while they are on the ground (i.e., taxiing, manoeuvering, and acceleration during take-off)	Negative	Greater Manchester (particularly residents within a 9 km radius)	■ Air quality monitoring ■ Monitoring of the health effects of air pollution by relevant Health Authorities ■ The introduction of newer planes and more efficient engines to minimize the effect of more aircraft movements
Noise	■ Conducted literature searches for noise and impacts on health (i.e., hearing loss, blood pressure, stress, mental health, behavioural disorders, performance, cognitive development, communication interference, sleep disturbance, annoyance, and social impact)	■ Increase in noise levels due to higher numbers of aircraft movements, shift in flight paths, and higher amounts of road traffic ■ Health effects due to speech interference, increase in blood pressure, chronic stress syndrome, impaired cognitive and academic development in children, sleep disturbance, annoyance, increased accident risk, and psychiatric, psychosomatic, and behavioural disorders ■ Literature suggests exposure to aircraft noise poses no hazard to hearing ■ Literature suggests a negative effect on performance at noise levels >100 dB (those closest to the flight path will experience ~140 dB) ■ Effects of noise on sleep include prolonging time taken to fall asleep, awakening, interference with a return to sleep, shift from deeper to shallower sleep ■ Annoyance increases with the level of noise exposure	Negative	Greater Manchester and surrounding communities (especially residents living along flight paths)	■ Enforce noise legislation ■ Introduce a landing fees policy that favours low noise aircraft ■ Introduce financial penalties on aircraft straying from approved flight paths ■ Reduce the amount of noise that occurs at night ■ Ameliorate the effects of noise by those responsible (i.e., sponsorship of local schools) ■ Noise monitoring ■ Protection of those exposed to significant levels of noise ■ Minimize added noise burdens during development ■ Sound insulation scheme ■ Adopt and implement a “quietest operations policy”, Ground Noise Control Policy, preferred noise route and aircraft track keeping policy, Nighttime Restrictions Policy,

					■ Set a point budget and movement limit between 11:30 pm and 6:00 am
Determinants:	**Other**				
Global Warming	■ Emissions of CO_2, NO_2 and SO_2 and H_2O in association with global warming	■ The most significant effect of aircraft on global warming is due to emissions of water in the upper atmosphere; the water freezes, creating a fine screen that reflects heat back to Earth	Negative	-	■ Improved engine efficiency and aerodynamics ■ Improved air traffic control to shorten journey times ■ Further urgent research
Infectious Disease	■ Change in the risk of contracting infectious disease, and foodborne/waterborne disease linked to air travel ■ Change in the risk of contracting scleroderma	■ Air travel increases the potential for international transmission of infectious diseases ■ Reference to specific food poisonings and malaria cases (from mosquitoes on the aircraft) linked to air travel in the past ■ One study noted clustering of scleroderma cases around 3 major UK airports; however, no biological explanation has been found	Negative	Greater Manchester	■ Surveillance of imported infectious disease ■ International immunization programs
Fuel Dumping	■ Incidence of fuel dumping	■ No evidence that “dumping” takes place on a regular basis ■ Aircraft are only required to dump fuel when undertaking emergency procedures	Negative	Greater Manchester	None

Table 5: Schiphol Airport HIA Summary

Airport	Schiphol Airport				
Reference	RIVM, 1999				
Location	Amsterdam, Netherlands				
Project Description	■ In 1993, an Environmental Impact Assessment (EIA) was published in which the impact of building a fifth runway was described in terms of environment and public health. The 1999 report was written to document the progress of the Evaluation and Monitoring Programme for Schiphol, established in 1993. The original EIA written in 1993 has not been translated to English, and thus was unavailable for review. ■ The airport is approximately 14 km southwest from Amsterdam city centre (estimated population of 1.5 million people) ■ The study area consisted of a 25 km radius around the airport (>1.5 million people) ■ Aircraft include jets and turbo-prop				
Baseline Health Profile	■ Baseline health endpoints studied include cardiovascular and respiratory diseases, sleep disturbance and annoyance, birth weight, performance, and medication use ■ Epidemiological field studies were conducted on sleep disturbance, annoyance, respiratory diseases, medicine use and performance; cardiovascular diseases and birth weight were studied through health data registries				
Impact Analysis Framework	■ Plausibility of possible effects ■ Evidence for an exposure-effect relationship based on literature review ■ The number of people potentially affected (given background noise and air pollution levels in relation to airport activities) ■ Concern in the population about the effect (i.e., respiratory diseases) performed from risk perception survey of a subpopulation of the study area				
Notes on Assessment	■ Assessment was carried out by RIVM in collaboration with other Dutch research institutes and universities				
Determinant:	**Social & Cultural**				
Indicator	**Measure**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Perception of risk and residential satisfaction	■ A questionnaire was used to described risk perception and residential satisfaction	■ There was substantial concern about the presence and expansion of Schiphol airport among the population. ■ Respondents living around the airport were more concerned about safety risks and possible health effects of air traffic compared to a sample of the general Dutch population. ■ Based on the risk perception and residential satisfaction questionnaire, people were found to be concerned about aircraft pollution and noise; nuisance caused by the airport was the most frequently named unfavourable aspect of their housing location. ■ More people were found to be concerned about air pollution (42%) than aircraft noise (18%). ■ Regression analysis showed a positive relationship between residential satisfaction and aircraft noise exposure (with higher aircraft noise levels, dissatisfaction with the neighbourhood or the housing increased).	Negative	Residents within a 25 km radius of the airport	None
Perceived Health	■ Perceived health was considered to be an “umbrella indicator” for various health aspects ■ Information on perceived health was collected as part of a questionnaire. ■ The relationship between self-rated health and exposure to aircraft noise and air pollution was examined by logistic and linear regression analyses	■ Positive relationship between aircraft noise exposure levels and poor health perception. ■ Distance to the airport and noise levels were significantly associated with poor self-rated health scores.	Negative	Residents within a 25 km radius of the airport	None
Annoyance	■ Annoyance was determined using modelled aircraft noise exposure levels in combination with a linear exposure-response relationship based on community surveys conducted in the 1960s and 1970s by Bitter ■ Modelled aircraft noise expressed in Kosten units	■ Generally the percentage of severely annoyed people equalled the number of calculated Ke minus 10. ■ It was estimated that over 100,000 people were severely annoyed by aircraft noise, based on modelled exposure levels in 1991 and the exposure-response relationship from Bitter.	Negative	Residents within a 25 km radius of the airport	None

	Note: the Kosten unit (Ke) is a yearly average defined by the maximum noise levels during flights, the total number of flights, and the time at which these flights take place ■ Annoyance was also determined by postal questionnaire survey in a study area with a radius of 25 km around the airport (mailed to 30,000 residents) ■ Results of the questionnaire were compared to 20 international annoyance surveys	■ Positive relationship between annoyance due to aircraft noise, odour, dust, soot/smoke, and vibrations in relation to distance to the airport. ■ According to the questionnaire, 18 to 31% of adults reported serious annoyance by aircraft noise; in the "noise zone" (i.e., the 35 Ke zone), 48 to 65% reported serious annoyance. ■ The percentage of people annoyed was higher than expected as compared with the results of the 20 international surveys. ■ It was estimated that 80,000 to 108,000 people (5 to 7%) were seriously annoyed by odour from aircraft.			
Determinant:	**Environment**				
Air Quality	■ Studies on the effect of air pollution and health included the following: ▪ Semi-ecological study of drug dispensing data (i.e., asthma medication) from selected pharmacies within a 30 km radius from Schiphol; the use of medication for asthma was analysed in relation to distance to the airport as a proxy for exposure to air traffic generated air pollution; ▪ Ecological study of general physicians' registrations of respiratory health complaints between 1993 and 1994; ▪ Measurements of PM_{10} and $PM_{2.5}$ were taken in the region due to concern in the population and potential reduced ventilation inside residences due to sound insulation (leading to higher indoor air pollution levels); ▪ Respiratory health was investigated as part of a questionnaire survey (on annoyance, sleep disturbance, health, perceived risk and residential satisfaction); relation with distance to the airport was analysed in a multiple logistic regression analysis; ▪ Comparison of indoor air quality levels in high noise exposed homes to those with low noise exposure; results published after 1999 (see Section "Results of Follow-up Studies" below); ▪ Disease rates and 95% confidence intervals for five groups of respiratory diseases were calculated using hospital admission data on a postal code level from 1991 to 1993; spatial patterns were studied using a Bayes model ■ Discussion of known and modelled air pollution levels cited in the 1993 EIS	■ Following the asthma medication study, prevalence of medication for asthma in the region was similar to the national reference value, except for within a radius of 10 km (asthma medication use was 14% higher in this area); overall, data limitations prelude the conclusion that air traffic generated air pollution is responsible for increase in medication for asthma seen within a 10 km radius from the airport, but cannot exclude it either. ■ Following the general physicians registrations of respiratory health, it was found that residential areas closer to the airport registered more respiratory systems in children than those in areas at greater distance. ■ Respiratory health effects from air traffic related air pollution was considered unlikely (though particulate pollution from $PM_{2.5}$ and PM_{10} was considered insufficient). ■ However, based on the questionnaire survey, 57% of adults reported one or more respiratory complaints, and a significant association with distance to airport was found for respiratory systems (i.e., chronic cough, phlegm, bronchitis). ■ Based on hospital admissions, there was no consistent spatial pattern that would suggest a relation of respiratory diseases with the airport. ■ Based on the 1993 EIS, it was concluded that known and modelled air pollution exposure levels in the Schiphol area were similar to levels encountered elsewhere in urban areas; levels were generally below current air quality standards and guidelines, although standards could be exceeded around heavy road traffic areas. The overall contribution of air traffic emissions to general background air pollution was estimated to be <10%.	Negative	Residents within a 30 km radius of the airport	None
Noise	■ Exposure to aircraft noise determined using model calculations from the National Aerospace Laboratory (NLR) ■ The model determines the annual exposure to night-time aircraft noise as B65 (expressed in Kosten units) and $L_{Aeq,23\text{-}06\ hours}$; in calculating the B65, the level of 65 dB is taken as a threshold ■ Other measures were also calculated including B45, L_{Aeq} for different time periods, and the number of flights during which the noise level exceeded a defined value (i.e., 70 dB). ■ Sleep disturbance as a result of aircraft noise levels was assessed in 1990 based on drug dispensing data from	■ Positive relationship between high blood pressure and aircraft noise exposure (i.e., 0.6 to 1.4% of cardiovascular diseases or elevated blood pressure could be attributed to an aircraft noise exposure of >20 Kosten units (50-55 dB); 1.7 to 2.3% for areas >35 Ke (60-65 dB)). ■ Higher rates of sleep disturbance (based on sedative use within a 30 km radius, and well as a self-administered questionnaire of people within a 25 km radius). ■ The prevalence of sedative use in the Schiphol area was 32.1 per 1000 people, comparable to the national reference value of 34.5 per 1000 people; in areas with high aircraft noise exposure, the use of sedatives was 14% higher.	Negative	Residents within a 25 km radius of the airport	None

	selected pharmacists in a 30 km radium around the airport. ■ Sleep disturbance was also studied through a self-administered questionnaire within 25 km of the airport. ■ Using hospital admission data, disease rates for four groups of cardiovascular diseases were calculated and mapped per postal code area from 1991 to 1993; spatial patterns were studied using an empirical Bayes model; analyses were adjusted for age and sex, and a follow-up analysis was done in 1995. ■ A questionnaire was used to determine medicine use for cardiovascular diseases or elevated blood pressure. ■ The prevalence of birth weight and prenatal growth and the relationship with aircraft noise exposure was studied from 1989 to 1993 using data from midwives and gynaecologists.	■ Based on aircraft noise levels in 1990, the number of people with sleep disturbance within the $L_{Aeq,23\text{-}06\ hr}$ contours of 20 and 27 dB was 100,000 and 13,000 respectively. ■ Based on the questionnaire, 33 to 39% of the population reported serious sleep disturbance caused by aircraft noise in the area with night-time noise levels >26 dB (6,000 to 7,000 people); people in this area also more frequently reported having 4 or more sleep problems than those living outside the high noise area. ■ A quantitative risk evaluation carried out showed that due to aircraft noise exposure there are about 1500 extra cases of hypertension in adults living in a 55 km X 55 km area around the airport (total population of 1.6 million), as well as increased risk of heart disease. ■ Regression analysis showed that the use of cardiovascular medicines is related to both aircraft noise exposure and distance to the airport; medicine use increased 1 to 16% per 10 unit increase in aircraft noise. ■ Based on the birth weight data, regression analysis showed no significant relationship between reduced birth weight or prenatal growth and aircraft noise exposure. ■ No suggested relation between cardiovascular diseases and the airport based on hospital admission data.			
Neurobehavioural effects in association with noise exposure	■ A pilot study was carried out to test reliability of selected neurobehavioural methods and questionnaires, as well as the feasibility of the study design in a school environment. ■ Measurements were carried out in an aircraft noise exposed group (86 children, avg. noise level of 59 dB, L_{Aeq},24 hours) and a low exposed group (n=73, 53 dB). ■ Potential differences in cognitive performance between groups of children exposed to different levels of aircraft noise was also explored (i.e., temporary closure of one runway provided an opportunity to explore the effect of a reduction in noise levels). ■ The HIA made reference to other studies completed in Los Angeles and Munich that showed negative effects on cognitive performance.	■ Negative effects on cognitive and psychomotor tests in children exposed to noise were found (hand eye coordination and switching attention); parents of noise-exposed children reported more attention and social problems, and more children reported annoyance with noise in the noise-exposed group. However, no definite conclusions could be drawn because of the small number tested and lack of individual exposure data. *Note: Based on the temporary closure of one runway, reduction in noise levels from 59 dB to 52 dB resulted in improvement in the hand eye coordination test, but decrease in the attention test; however, the runway was closed for only 3 weeks* ■ Based on a risk-evaluation, it was concluded that reduced performance (i.e., cognitive and motor functioning) might occur among children living in the vicinity of the airport. ■ The studies completed in Los Angeles and Munich showed exposure to aircraft noise might result in negative effects on cognitive performance.	Negative	Two villages around the airport: Zwanenburg (high aircraft noise exposure levels) and Uitgeest (control area)	None
Results of Follow-up Studies					
Summary Report, 2006	■ The health status of the population living around the airport did not change substantially after the opening of the fifth runway ■ Spatial shifts did occur in noise exposure and subsequent annoyance and sleep disturbance ■ There is growing evidence between exposure to air traffic noise and prevalence of high blood pressure around Schiphol airport ■ Air traffic and activities of the airport contribute no more than a few percentage points to local air pollution levels ■ Observed association between aircraft noise and both poor self-perceived health and the use of sedatives ■ No relation between aircraft noise and mental health ■ Unlikely that an increase in noise level due to the opening of the fifth runway has had an extra influence on possible health effects ■ No evidence that air traffic contributes to the occurrence of respiratory disorders; however, concern among residents has increased since 2002 ■ Since 1996, severe annoyance and severe sleep disturbance have decreased; however, less severe sleep disturbance has increased since 2002 ■ Annoyance, sleep disturbance, filing a complaint about air traffic noise, and environmental concern are strongly related to aircraft noise levels				
Interim Report, 2004	■ The report focused on a study that was executed in 2002, before the opening of the fifth runway ■ The study was a questionnaire survey on self-reported health status and quality of life				

	■ ~600 residents were followed until 2005 to monitor possible changes that take place after opening of the new runway ■ The study showed that the prevalence of self-reported annoyance and sleep disturbance due to aircraft noise decreased between 1996 and 2002 ■ Health effects (i.e., high blood pressure, respiratory symptoms, and depressive mood) are more prevalent in the region compared to national data; however, relationships between health effects and exposure to aircraft noise were not found ■ Concluded that perception of risks and quality of life are negatively affected by increasing levels of aircraft noise
Study, 2005	■ Study was carried out among primary schoolchildren to investigate the effect of aircraft and road traffic noise on children's cognition, annoyance and blood pressure ■ Effects of aircraft noise were observed on memory (a decrease in recognition memory), and was related to an increase in mistakes on a switching attention test ■ It was estimated that 50-3000 (0.1 – 2.5%) additional pupils in the last 4 classes of primary schools around Schiphol have a relatively low test result for reading comprehension due to aircraft noise exposure (normally 9% have a low score) ■ An estimated 3400 (2.9%) of pupils in the last 4 classes of primary schools in the Schiphol area were severely annoyed at school due to aircraft noise
Study, 2002	■ A sleep disturbance study was carried out among 418 adults living in 15 locations close to and further away from the airport ■ Objective was to assess the relationship between nighttime aircraft noise exposure and indicators of sleep disturbance ■ Subjects participated for 11 nights; noise was measured from 10 pm to 9 am indoors in the bedroom and outdoors ■ Information about sleep disturbance was collected by actimetry (motility, awakenings, sleep onset latency), diary (remembered awakenings, sleep quality, medication) and questionnaire (annoyance, health complaints) ■ The increase in motility due to aircraft noise events started at lower indoor levels than expected ■ Persons with long-term exposure to relatively low nighttime aircraft noise levels were more sensitive to aircraft noise events than people living in locations with high levels ■ Sleep latency time, use of sleep medication, average motility and number of awakenings increased with indoor aircraft noise exposure levels during sleep
Study, 2000	■ Study on sound insulation and changed ventilation behaviour in 92 homes in the vicinity of Schiphol was undertaken ■ Air concentrations of PM2.5, soot, PAHs and volatile organic hydrocarbons were measured in the living room ■ Collected house dust was measured for endotoxins, ESP (from moulds), beta-1,3-glucane (from moulds) and dust mite allergen Der p 1 ■ No statistically significant differences in measured levels were found between homes with and without sound insulation ■ It was concluded that sound insulation or changed ventilation behaviour due to noise annoyance did not result in different levels of contaminants in indoor air or house dust
Study, 1999	■ A study was conducted to assess the differences in lung function and prevalence of respiratory symptoms between school children living in different towns in the Schiphol area; the differences in air pollution levels caused by air and road traffic as measured inside and outside primary schools; and the association between exposure to air pollution caused by air and road traffic and respiratory health ■ Study was performed on 2500 primary school children (aged 7 to 12) living in the Schiphol area ■ The health survey consisted of a questionnaire on respiratory symptoms and allergy; a lung function test, blood test and skin-prick test ■ Air pollution models were used the assess the exposure levels and air pollution measurements ■ It was found that the average prevalence of respiratory symptoms, decreased lung function and quantity of antibodies was higher in the Schiphol area than in a control population (neither situated near Schiphol or near a busy highway) ■ Higher concentrations of air pollution were found in schools near busy highways ■ Levels of NO_2, soot and benzene decreased with increasing distance to the airport ■ No association was found between the different exposure measures and the prevalence of respiratory symptoms, decreased lung function or increased level of antibodies ■ Air pollution around Schiphol was concluded to not be associated with health effects observed in participating children

Table 6: Finningley Airport HIA Summary

Airport	Finningley Airport (now known as Robin Hood Airport Doncaster Sheffield)				
Reference	Doncaster Health Authority and Doncaster Metropolitan Borough Council., 2000				
Location	Doncaster, United Kingdom				
Project Description	■ Development of a former RAF airbase into a commercial airport. The HIA was carried out in the initial stage of the planning application, and was thus a prospective HIA. The HIA was conducted to provide planners with information on the potential health impacts of the proposed airport on local residents, and on Doncaster as a whole. ■ Located to the southeast of the city center of Doncaster (population of 291,800 in 1991) ■ Study was divided into the local impact area, main impact area (area within a 30 minute travel time to the airport), and wider impact area (area within a 60 minute travel time), corresponding to populations of 291,800, 660,000 and 4.2 million people, respectively ■ An estimated 2 million passengers per year by 2014 ■ Aircrafts include Jets, specifically the Airbus 300, Bae 146, Boeing 767 and RAF Dominie ■ The airport is serviced by train and bus				
Baseline Health Profile	*Population factors:* ■ Age structure ■ Sex structure ■ Population statistics *Employment and Income:* ■ Index of Local Deprivation, as defined by: ▪ Employment rate ▪ Children in low earning households ▪ Overcrowding ▪ Households lacking basic amenities ▪ Car ownership		*Health:* ■ Self-rated health ■ All cause mortality ■ Prescribing rates of drugs (i.e., anti-depressants, benzodiazepines, and zopidem/zopiclone) ■ Mortality from coronary heart disease ■ Respiratory disease mortality (including chronic obstructive pulmonary disease (COPD)) ■ Asthma hospital admission rates ■ Lung cancer mortality rate		
Impact Analysis Framework	For each determinant of health, the framework identified the: ■ Health impact and its likelihood (potential, probable or definite) ■ Source and scope of identified health impact ■ Individuals and groups who are likely to be affected by the impact ■ Duration of the impact and the stage of redevelopment at which it is likely to occur ■ Quantification of the impact (quantified/estimated/speculated) ■ Evidence-base supporting the identified health impact				
Notes on Assessment	■ The assessment was conducted by Doncaster Health Authority in partnership with Directorate of Environment, Health and Housing ■ Used the WHO guidelines for noise of 55LAeq, 16h general for outdoor noise in residential areas to prevent community annoyance ■ The maximum indoor noise level for no disturbance of sleep is 50 dB ■ Air quality predictions were compared with the UK air quality standards recommended by the Expert Panel on Air Quality Standards; the Air Quality Objectives for England, Scotland, Wales and Northern Ireland; and the WHO Air Quality Guidelines ■ An environmental statement (ES) was carried out by a sub-contractor consultant prior to the HIA				
Determinant:	**Economic**				
Indicator	**Measure**	**Findings**	**Direction**	**Geographical Extent**	**Recommended Mitigation**
Employment and Income	■ Direct estimate of number of jobs created and number of jobs displaced by the development ■ Literature search and description of health outcomes	■ Additional employment would bring beneficial health effects (i.e., reduced coronary heart disease and improved mental health).	Positive	Doncaster and surrounding communities	■ Use of local structures for training and recruitment of new workers ■ Clear policy of employment opportunity for

	related to employment	■ Potential that job opportunities could be taken away by recruitment policies not focused on local populations (therefore, no employment or health benefit).			local people, where possible ■ Local procurement of services and support for the airport, where possible
Socio-Economic	■ Literature search for unemployment/regeneration, transport and tourism projects and documented impact on health ■ Conducted a social impact assessment (literature review) ■ Discussion on public perceptions of regeneration (positive and negative effects) ■ Effect on migration patterns	■ Urbanization overtaking peaceful quality of village life ■ Economic growth (decreasing deprivation in the area) ■ Regeneration potential (prosperity strengthens community spirit) ■ Greater income equality is associated with better health because it improves social cohesion and reduces social divisions ■ Development of the airport could result in possible regeneration of the area and thus increased migration	Positive	Doncaster and surrounding communities	None
Determinant:	**Environment**				
Air Quality	■ Conducted an evidence based analysis of health impacts of key pollutants (i.e., CO, benzene, lead, O_3, PAHs, CO_2, PM_{10}, NO_2, SO_2, hydrocarbons) based on published literature and official documents ■ Sources of pollution were identified as aircraft movements (approach, taxi, take-off, landing, holding), road traffic (construction, car parks, airside vehicles), airport combustion plant, fuel handling, and railway operations ■ Air quality predictions were compared to various health-based air quality standards ■ Respiratory disease mortality, COPD mortality, asthma hospital admission rates and lung cancer mortality were used as baseline indicators for effected wards and compared to national averages as well as Doncaster as a whole	■ Elevated air pollution and associated health effects (i.e., allergic sensitization, exacerbation of asthma, respiratory illness and cardiovascular effects) from exposure to NO_2 and PM – overall, impact on public health was considered very small ■ Air quality predictions for 2014 were found to likely fall within acceptable limits	Negative	Doncaster and surrounding communities	■ Implement a Green Transport Plan (i.e., address reductions in air pollution, noise, road traffic; minimize congestion; maximize local worker access, pedestrian/cyclist access and public transport access) ■ Air quality monitoring programme ■ Consider wards with higher incidence of respiratory ailments during proposals of future infrastructure developments
Noise	■ Predictions for noise before construction, during construction and the fully operational scenario were completed; the HIA focused on comparing predicted noise levels with guideline values (i.e., PPG24 (DoE, 1994)) to assess likelihood of increase in health effects ■ Evidence based analysis for the non-auditory effects of noise was based on the Institute for Environment and Health Report ■ A literature search was conducted for the auditory impacts of noise ■ The HIA looked at average noise levels as measured by $L_{Aeq,\ 8\ h}$, as well as single event level (SEL) measurements (i.e., the noise at the time of departure and arrival) ■ 48 dB $L_{Aeq,\ 8h}$ was used to determine risk of sleep disturbance, 55 dB $L_{Aeq,\ 8h}$ was used for risk of some sleep disturbance, and 65 dB $L_{Aeq,\ 8\ h}$ was used for discernible increased disturbance ■ High annoyance was considered to be >69$L_{Aeq,\ 16h}$; moderate annoyance was 63-69$L_{Aeq,\ 16h}$; and low	■ The population within the 2014 contour incorporating 57 to 69 dB was calculated at 693; no dwellings affected by high levels of annoyance ■ 3421 people were calculated to be at risk from some sleep disturbance within the 2014 contour; no dwellings affected by discernible increases in disturbance ■ Sleep disturbance due to SEL calculations was provided for different aircrafts (i.e., Airbus, Boeing 767) and flight paths ■ Elevated exposure to noise and associated health effects (i.e., increased annoyance, anxiety, sleep disturbance and effects on child health which could lead to secondary health impacts including cardiovascular disease, immune system defects, cognitive dysfunction and respiratory illness) – overall, risk is not considered significant for majority of local population ■ Slight risk for aural effects (i.e., aural pain and hearing loss) in sensitive individuals ■ Cognitive function of children due to noise exposure (schools not situated close enough to be effected)	Negative	Doncaster and surrounding communities	■ Sound proofing ■ New residential dwellings to be assessed for noise exposures as part of the planning application ■ Implement a Quiet Operations Policy (i.e., runway optimization that encourages use of a preferred runway, time restrictions on training flights, ensure landscape bunding is maintained) ■ Noise monitoring (including aircraft, railway and traffic noise) ■ Night Flying Regulation (i.e., noise restrictions and bans on the noisiest aircraft, restrict non-commercial aviation movements at night) ■ Restrictions on ground running of engines, and construction activities

	annoyance 57-63$L_{Aeq,\ 16h}$ ■ Risk of sleep disturbance is considered to be insignificant if noise level is <90 dB SEL; >90 dB represents some sleep disturbance (i.e., for noise levels between 90 and 100 dB SEL, there is a 1 in 75 change of awakening) ■ Populations affected by air noise were calculated using isochrones diagrams for various noise levels and flight paths ■ Population profiling was carried out for the largest contours and footprints (i.e., projected population in 2014 and loudest jet engine) ■ Air traffic and road traffic noise data was taken from the Transport Impact Assessment ■ Traffic noise assessment was completed using contours and showed the percentage increases in traffic due to future airport development; populations within 20 to 100 m of effected roads were profiled ■ The impact of rail noise was also assessed by using contours and calculating the size of the populations living within 20 to 100 m of the rail line ■ Level of stress due to noise was looked at as an indicator through prescribing rates of drugs	■ Amounts of stress-related medicines in the areas around the airport are not consistently higher than the rest of Doncaster			
Water/Land Quality	■ Potential pollutants were identified (i.e., aircraft de-icing fluid, engine oils/fuels, chlorinated solvents, asbestos, zinc, arsenic) ■ Literature searches were conducted to identify potential health impacts of pollutants	■ Health effects were considered extremely unlikely due to environmental exposure levels and scenarios and levels of contamination reported previously in an environmental statement	Negative	Finningley airport and immediately adjacent properties	■ Adopt measures to segregate, classify, handle and dispose of contaminated material ■ Operate a Construction Management Plan to test for and manage undetected contamination and ensure compliance with H&S legislation ■ Monitor groundwater quality beneath the site before, during and after construction
Transport	■ Community concerns about road transport from the stakeholder engagement process were summarized ■ Number of trips were projected for 2014 (24 hour, night-time and peak hours) ■ Changes in road traffic movements were used to estimate the increased incidence of road traffic related accident and injury ■ Estimate of the change in numbers of persons exposed to aircraft-related fatality risk as a result of increased aircraft movements	■ Increased risk of injury from road traffic accidents due to increased traffic in the area ■ Positive health impacts resulting from public transport (i.e., improved access and greater physical activity) ■ Increased traffic congestion could contribute to an increase in anxiety ■ Heavy traffic would impede recreation and sport	Neutral	Doncaster and surrounding communities	■ Build a new motorway link road to the airport to reduce traffic, improve road safety and social integration, and reduce community severance ■ Monitor traffic congestion through line-up lengths at junctions and adherence to signed access routes ■ Maximize pedestrian/cyclist access for local communities ■ Maximize public transport access via coach and train
Visual and light pollution	■ Assessed as part of ‘anxiety’; looked at individuals susceptible to anxiety/stress caused by communication masts and lighting	■ No standards or guidelines available; recommended mitigation measures for sensitive individuals	Negative	Finningley airport and immediately adjacent properties	■ Landscaping measures to prevent or reduce effects ■ Avoid visual impacts to the surrounding area through landscaping, mounding, fencing, planting
Fuel Dumping	■ Estimated frequency ■ Assessed as part of ‘annoyance’	■ Frequency was estimated to be 0.082 per year (1 in 12 chance per year), based on five years of Civil Aviation	Negative	Doncaster and surrounding communities	■ Protocol for fuel dumping such that: ▪ Preferred dumping is at sea

		Authority safety data ■ The risk of significant amounts of fuel being discharged onto residential areas are very low			▪ Dumping will be away from built-up areas and over 5000 ft altitude ■ Incident management plan
Vibration	■ Previous airport HIAs were used to identify likely impacts ■ Assessed as part of 'annoyance'; looked at isolated properties <20 m from major highways ■ Dwellings near high traffic levels of >70 dB $L_{A10, 18h}$ were considered at high risk of vibration annoyance ■ Used BSi Standards (1990) for measuring vibration and its effect on buildings and evaluating human exposure	■ Isolated properties closer than 20 m to major highways were at risk of annoyance caused by traffic vibration	Negative	Doncaster and surrounding communities	■ Green Transport Plan to minimize traffic ■ Environmental Management Strategy, which includes periodic traffic surveys
Odour	■ Previous airport HIAs were used to identify likely impacts ■ Assessed as part of 'anxiety and stress' ■ Sources include fuel, products of combustion, sewage	■ Individuals already suffering from stress may be more vulnerable ■ Predicted 2014 annual mean hydrocarbon concentration due to aircraft fuel emissions ranged from 0.16 to 3.43 ug/m^3 ■ Levels are expected to decrease with the use of more modern aircraft	Negative	Finningley airport and immediately adjacent properties	■ Air quality monitoring programme ■ Use of biological filters for sewage ■ Carefully position new houses to minimize odour nuisance
Determinants:	**Other**				
Imported Diseases	■ Literature searches were conducted	■ Potential health impacts are from influenza, staphylococcal gastro-enteritis, salmonellosis, cholera, malaria, shigellosis, typhoid fever ■ No predicted levels were made; mitigation measures were recommended	Negative	Doncaster and surrounding communities	■ Manage diseases through WHO International Health Regulations, spraying aircrafts with insecticide, immunization of passengers and crews members, and traveller education
Accident/Fire Risk	■ Risk figures for aircraft accidents and fire/explosion hazards were obtained from planning documents ■ Evidence based analysis was focused on mental health aspects associated with risk perception ■ Risk of physical injury from aircraft crashes was assessed using 10^{-4} to 10^{-5} individual annual risk contour (significant risks not expected >12 km from the runway end) ■ Radius effected due to a catastrophic explosion of a fuel tank ■ Vortex damage within 2.1 km of the ends of the runways	■ Increased anxiety due to risk perceptions about the airport development ■ Health impacts of physical injury from fire and explosion hazards, vortex damage and aircraft crashes were considered exceedingly small	Negative	Finningley airport and immediately adjacent properties	■ Engage with all public service bodies to review the potential impact of the airport on their service delivery (including emergency response plans) ■ Public safety zones within 12 km from where the runway ends to decrease risk of injury due to crashes ■ Implement fire protection design measures, hazard studies and incident management/emergency plans